ANNALS

OF THE

ROYAL BOTANIC GARDEN, CALCUTTA

Volume XIV, Part II

AN ACCOUNT

OF THE

GENUS DIOSCOREA

IN THE EAST

Part II

THE SPECIES WHICH TWINE TO THE RIGHT: WITH ADDENDA TO PART I, AND A SUMMARY

by

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The Species which Twine to the Right

ENANTIDPHYLLUM |Uline as a section in 1897). *Tubers* one or a few descending into the soil, usually deeply, arising as a swelling Dr as swellings upon the base of the current year's stem apparently as a repetition of what happens in the seedling when the hypocotyl or epicotyl laterally swells to form the first tuber ; in most species this base of the stem becomes indurated and lasts in the soil beyond the end of its year, but towards the end of the time possibly only as dead tissue ; the soft, annually replaced tubers are protected by the depth of the soil over them, and are free or almost free from poisonous substances. *Annual stems* renewed from the hard woody knot or, if the tuber has become detached, from some part of it, probably the oldest : although more than one tuber may be present, not uncommonly one stem alone is produced, which drains the stored food from all the tubers : the stem vigorous, which is necessary because the species live among trees and at each renewed growing season the effort to reach the light may be considerable ; these stems twine invariably tD the right. *Leaves* never compound, always entire, typically cordate, but often ovate, with a very well developed glandular tip (forerunner tip) which persists as the acumen of the leaf-blade and receives besides the midrib the ends of the first pair of lateral nerves. *Male flowers* in spikes, one flower at each bract, except in *D. spicata* where sometimes there is a second, or very rarely more ; in, say, seventy-five per cent, of the species these spikes are 2 to 4 cm. long : the buds are globose or only a little elongated ; they open very little in flowering and have no disc. */Stamens* usually B, equal, standing upright under the pore-like opening of the flower : but sometimes in two slightly unequal series, and very rarely three are sterile. *Gynoecium* in the male flowers present in all except *D. Sarasinii,* but always very small. *Female flowers* in simple spikes which are curved earthwards. *Capsules* facing forwards, allowing the winged seeds to glide out when they are ripe ; in which process, the species being rather high-climbing, they obtain dispersal in their falling. */Seeds* very flat, more or less evenly winged all round, always greyish brown, through a small variety of shades.

Species 12D or more, distributed through the wetter parts of tropical Asia and Africa ; but none common to both continents, extending to Australia (even tD Western Australia, which is not reached by any other section), and to the furthest tropical islands of the Pacific.

TIIB fallowing key to the Asiatic species is arranged somewhat artificially, no natural arrangement being possible ; nevertheless, the affinities are fairly well respected. All thB Asiatic hairy species come towards the Bnd of the key ; all the species with negative geotropism in their male flower-spikes arB at the beginning. SomB of the species which possess this negative geotropism have their spikes gathered into special lBafless inflorescences and somB have their spikes among the leaves. It seems possible that the production of axillary spikes among the leaves was a condition which came in evolution before these spikes were collected into special leafless inflorescences : but to obtain a clear-cut key, it has been necessary to commence it with species combining this geotropism with special inflorescences, then to run through the species which seem more primitive, on the way to others with special inflorescences but no strong geotropic peculiarities.

Combined with what may be regarded as a progressive tendency tD separate flowers from foliage, is a prDgressive tendency to limit the spike in length. These dimensions illustrate the suggestion : e.g. in *D. spicata* which seems tu be one of the most primitive, spikes have been observed SD long as to attain 27 cm.: jn *D. Warburgiana,* which has axillary spike?, they may measure 2D cm. : but in the groups of *D. japimica,* of *D. aliti* and of *D. glabra* they are seldom conspicuously shorter or conspicuously longer than 2—4 cm., while the number of flowers carried averageE 25—3D. Weregarithemore specializedshort spikes of these as indicative of advance beyond the others. The species with negatively geotropicmale spikes are numbered 72 to 78 ; but it is to be added that in *D. japoniza* |no. 91) there is a slight tendency towards this character. ThB species with spikes in the haf-axils arB numbered 77 to 97. The species with special leafless inflorescences arB numbered 72 to 76 and 98 tD 14B. The species with hairs about the male flowers are numbered 138 to 145.

D. luzonensis deserves remark on account of its large flowers ; *D. cirrhosa* on account of the tannin in ita tubers ; *D. alata,* because of the plasticity which man has found in it ; *D. decipims* Dn account of its three sterile anthers ; *D. Sarasinii* on account of its fused filaments ; and *D.japonica* as being the most temperate.

The capsule is on the whole a very constant structure, varying a little in thB proportions of the wings, and in the relatively temperate group of *D. japonica* being smaller than in the species of the tropics. Seed formation is rather restricted : not as many as one-half of thB female flowers Dn a spike maturing fruit, the number being limited in some way according to the capacity of the bearing axis, for the remoter flowers produce nothing.

No Asiatic section of the genus is more distinct than *Enantiophyllum.* The twining of the stem to the right cuts it off from all the others : the forward direction of the capsules cuts it off from all but *Stenocorea :* the elongation of the deep-going tubers separates it from most Df the others : and, lastly, no section is SD prone tD produce opposite leaves. It is more vigorous than they are and two of its characteristics may be regarded as a consequence of this vigour ; namely, the depth to which its tubers are pushed with a consequent protection by the covering soil, making poisons unnecessary in the tissues, and the mechanism of freeing the seeds by gliding, which is adequate in consequence of the considerable distance which they have for spreading in their fall. In the still air of the shelter of relatively tall trees, gliding would seem to afford better chances than whirling off in a gust such as disturbs the capsules with the censer-mechanism.

Except for Uline's untenable attempt to separate from *Enantiophyllum* a section *Stznophyllidium* |see p. 12) no one has taken the section to be unnatural.

Key to the Asiatic species of the section Enantiophyllum.

Male flower-spikes upright in response to gravity [SBB also 91. *D. japuniza) :*

B. Leaves coriaceous : male flowers small and globose Igroup Df *D. laurifolia,* SBB also 77. *D. Warburgiana):*

Leaf-blade ovate tD very broadly elliptic, rounded below and under the acumen .. 72. *Havilandii.*

Leaf-blade ovate, rounded below but narrowed towards the acumen .. . . 7 3 . *bancana.*

Leaf-blade broadly lanceolate to lanceolate-ovate :

Blade up to 16 cm. in length .. 74. *laurifolia.*

Blade up to 4 cm. in length .. 75. *Vanvuurmii.*

BB. Leaves not coriaceous:

Leaf-blade obtuse or rounded or just cordate at the base :

Male flower-spikes on specialleafless branches : leaf obtuse at the base .. 7B. *Prainiana.*

Male flower-spikes axillary, dispersed among leaves :

Plant robust, with long male spikes and with leaves more firm than herbaceous .. 77. *Warburgiana.*

Plant slender, with shorter male spikes (these unknown in 79. *D. madiunensis),* and herbaceous leaves (group of *D. filiformis) :*

Leaf-blade broadly lanceolate to narrowly ovate and by no means infrequently very slightly cordate at the basB . . . . 78. *filiformis.*

Leaf-blade somewhat broader ; perhaps only the female plant of the last .. 79. *madiunznsis.*

Leaf-blade deeply cordate at the base : the male flower-spikes axillary as in the species immediately above IgrDiip of *D. luzonensis) :*

Male flowers relatively small, the sepals and the petals about 1 mm. long : auricles of the leaves rounde d, but in one variety angular .. BD. *peperoides.*

Male flowers relatively larger, the sepals and the petals about 2 mm. long ; the auricles of the leaves always angular .. .. .. 81. *luzomnsis.*

AA[3]. Male flower-spikes taking their direction from the direction of the axis which bears them, i.e., diverging from it at a more-or-less constant angle and maintaining the direction thereby determined uninfluenced by gravity (91. *D. japonica*is a partial exception) :

0. Male flowers-spikes produced among the leaves and not Dn special leafless branches |in a few species such variability exists in this character that it is necessary to give their names in two places in this key), or near the stem-ends in the axils of gradually diminishing leaves and finally of bracts :

Leaf-blades at least as broad as long, and sometimes conspicuously broader :

Male flowers with a broad base pressed against the axis ; buds conical :

Leaves when so broad as to be as broad as long, more Dr less quadrate 123. *oryzetorum.*

Leaves broadly cordate .. 82. *bicolor.*

Male flowers with a narrow base ; buds ellipsoid .. 83. *aspersa.*

Leaf-blades narrower than their length :

D. Leaves never SD narrow as to be linear, but in 95. *D. limari-cordata* linear -lanceolate :

E. Stamens six in number with free filaments, inserted round a cone which id the gynDecium :

F. Stipule-like organs not represented : the wings Df the capsules evenly rounded in all the species whereof they are known :

3. Width of the wings of the capsule from 18 mm. upwards, but though, however, they are unknown in several species, that they should be smaller is altogether unlikely, unless *D. Moultonii* be exceptional :

H[3]. Leaf-blade cordate at the base :

Blades with the margin between the auricles and the acumen only a little less in length than thB greatest width of the blade .. 84. *Wightii.*

Blades ovate-cordate . . 85. *Trimznii.*

HH[3]. Leaf-blade not cordate at the base but rounded :

Blade thin, ovate or elliptic, with a characteristic hyaline margin .. 138. *oppositifolia* var. *dukhunensis.*

Blade harsh with a prominent reticulation :

Male flower-spikes to ID cm. in length, with the buds facing forwards .. 95. *Moultonii.*

Male flower-spikes 3 cm. long : the secondary nerves much more conspicuous that the somewhat indistinct reticulation ; the primary nerves near the margin .. 137. *intermedia.*

*HHH**. Leaf-blade as in *HH*[3], not cordate at the base, but differing in being there obtuse instead of rounded : the first pair of primary nerves thrust towards the margin to two-thirds Df the distance from the midrib .. 36. *spicata.*

QQ. Capsules relatively small, the width of their wings not exceeding 15 mm. :

J. Leaves with a basal sinus, but in 94. *D. degans* only a very slight one,—being to the exclusion *of* that species the group of *D. japonica :*

K. Base of the blade with conspicuous obliijue auricles,

Stem wiry: the leaves small : the sinus between the auricles making a broad evenly rounded bay .. 87. *doryphora.*

Stem thin, but scarcely wiry : leaves larger and less firm : the auricles standing in a peculiar way at a right angle to the midrib, and the basal sinus shallow .. 88. *Potanini.*

Stem soft : leaves larger, softer, the auricles more lateral than in 87. *D. doryphora* but less so than in 88. *D. Patanini,* but so lateral that the broadest part of the blade is abovB the insertion of the petiole; tb.B basal sinus divided into two bays by th.B blade extending down to meet the petiole .. 89. *oppoaita.*

Stem scarcely wiry: the leaf-blade firm with small auricles subsagittately placed at the base, and the broadest part of the blade just across them : the sinus deep and rounded at the petiole .. 9D. *lineari-cordata.*

KK. Base of the blade cordate, the auricles not being oblique :

Greatest width of the blade rarely less than one-half of the total length as measured along the midrib :

Auricles rounded or only very slightly angular .. 91. *japonica.*

Auricles angular and the blade sagittately hastate .. 92. *Owenii.*

Greatest width Df the blade considerably less than one-half of the total length as measured, along the midrib :

Axis of the male flower-spikes thin: the flowers not globose when open: (this species is repeated to enable specimens without their lower leaves to be identified) .. 93. *lineari-cordata.*

Axis of the male flowers-spikes thick : flowers subglobose |a species described on inadequate material) .. 94. *degans.*

JJ. Leaves without a basal sinus : |94. *D. elegans* is repeated because a. basal sinus has been seen in its largest leaves but in them only very slightly developed) :

Blade not harsh :

Male flowers exactly like those of 91. *D. japonica,* i.e., relatively large .. 93. *Benthamii.*

Male flowers exactly like those of 120. *D. glabra,i.B.,* relatively small .. 124. *gracilipee.*

Blade harsh :

Male flowers not further apart than their own diameters : buds globose .. 94. *elzgans.*

Male flowers further apart than their own diameters, on long spikes: buds elongated .. 95. *Moultonii.*

Male flowers about as far apart as their own diameters, with very broad bases, on spikes which are axillary, but more probably in vigorous plants on spikes which are in short leafless inflorescences .. 1J1. *intempes-tiva.*

FF. Stipule-like organs as curious gland-like organs : wings of the capsule sometimes not evenly rounded .. 117. *stemimoideB.*

EE. Stamens of two sizes, three large and three small, their filaments united SD that there is no outward sign of the gynoecium : spikes very numerous : capsule unknown .. 9B. *Sarasinii.*

DD. Leaves linear, or linear above a hastate base, in association with deltoid-hastate leaves (with *D. transversa* makes the Australian group) .. 97. *hastifolia.*

0 0. M&IB flower-spikes produced Dn special flowering and leafless branches :

L. Special flowering branches with a short axis, sometimes much shorter than the spikes themselves :

Spikes with well spaced large male flowers :

Base of the flowers not flat : axis of the spike thin, somewhat zigzag : the leafless inflorescence not sharply differentiated from the bracteated branch-ends : leaves thin .. 98. *transvsrsa.*

Base of the flower flat : axis of the spike straight, not as variable in length aa in 9B. *D. tra?isversa :* leaves firmer :

Dapsule-wings to 27 mm. in width : leaves to 10 cm. by 5 cm., ovatB-CDrdate .. 99. *Wattii.*

Dapsule-wings to 22 mm. in width : leaves to 21) cm.by IB cm., cordate in the lower part of the stem, becoming narrowly ovate above .. 100. *cirrhosa.*

Capsule-wings to 2D mm. in width : leaves ovate or narrowly ovate .. 101. *intempestiva.*

Spikes with smaller rather closely set male flowers :

Leaves lanceolate, pruinDSB .. 102. *Bonii.*

Leaves cordate (group Df *D. Wailichii)* :

Capsule nat or just a little glaucous, the wings wider than long .. 103. *Wailichii.*

Capsule distinctly glaucous, wings longer than wide .. 104. *pulvsr&a.*

LL. Special flowering branches with long well-developed axes, longer than the leaves which subtend them and much longer than the spikes which they bear :

M. Male spikes with zigzag axes Igroup of *D. alata) :*

N. Leaves, except those at the very base of a new shoot produced in the sun, widest on a higher, generally much higher, level thai? the insertion of the petiole :

Blade of the leaf dull when dried, particularly upon the upper surface :

Expanded male flower wider than its small flattened base:

Petioles very short : leaf-blade narrow, up to 12 cm. long by 2-5 cm. in width or sometimes up to 4 cm. in width: the auricles very small: the stem usually rough .. 1D5. *brevipetiolata.*

Petioles longer, equalling one-third or one-half the length of the blade : stems never rough :

Blade narrowed into the petiole, to 10 cm. in length by 3-5 cm. in width .. IDS. *hainanensie.*

Blade with a cordate base :

Petioles at least half as long as the leaf-blade which may attain 24 cm. in length by 7 cm. in width .. 1D7. *kratica.*

Petioles equalling in length one-third *to* one-half of the blade which may attain 8 cm. in length by 4 cm. in width .. 109. *Fordii.*

Expanded male flower not wider than its flattened base which bears a curious small wart directed towards the apex of the spike ..].09. *gibbiflora.*

Blade Df the leaf, though when dry dull on the upper surface, on the lower liver-coloured and bright: the leaves associated with the flower-spikes shaped like those of 109. *D. gibbiflora,* but those on sterile parts of the stem apparently more delicate .. HO. *myriarUha.*

NN. Leaves with their widest parts about Dr on a lower level than the insertion Df the petiole, their colour when dry with some red in it and bright; the male flowers sometimes in 114. *D. alata* with a wart such as the flowers Df 109. *D. gibbiflora* exhibit:

Stems thin and firm, often brightly tinted with *a,* copper red CDIDUT :

Plant slender, with its largest leaves only 7 cm. long and their margins incurved above the auricles .. HI. *depauperata.*

Plant not slender, with the largest leaves up to ID cm. in length, and with the margins bowed outwards :

Network of nerves rather distinct on the underside of the blade: capsule in size as that of 114.*D. alata* 112. *psrsimilia.*

Network of nerves less distinct on the underside of the blade : capsule larger than that of *D. alata* 113. *Hamiltonii.*

Stems soft, usually with four conspicuous wings, though sometimes with more at the very base : the tubers polymorphic as a result of man's selections, sometimes going deep into the soil, but usually not going deep .. 114. *alata.*

MM. Male spikes nat zigzag :

0. Male flowers not associated with hairs :

Disparity in size between the sepals and the petals great: the leaves with a thickened margin .. 115. *opaca.*

Disparity in size between the sepals and the petals small:

Margins Df the coriaceous leaf thickened: secondary nerves and the network conspicuous DH the upper surface of the blade :

Stems entirely unarmed: leaves less than 10 cm. long -. 137. *intermedia.*

Stems armed : leaves much larger, up to IB cm. in length .. 116. *lamprocaula.*

Margins not at all thickened (group of *D. glabra) :*

Blades of leaves produced on thB stem below tha inflorescence with their greatest width at least one-third the length of the blade measured along the mid-rib :

Internodes of the male inflorescence longer than the spikes .. 119. *hpaharum.*

Internodes of the male inflorescence shorter than the spikes :

Basal lobes of the stem-leaves with the inner margin straight thus making thB leaf-blade somewhat sagittate or hastate :

Network Df nerves conspicuous on both sides, raised below ; the lesser leaves such as are produced among the flower-spikes retaining the outline of the largBr leaves of the stem lower down .. 118. *bdophylla.*

Network of nerves inconspicuous above, raised beluw: thB lesser leaves produced among the flower-spikes not retaining the outline of thB lower leaves, but losing their lobes :

Lower leaves hastate; leaves among the flowers ovate .. 131. *Lofieri.*

Lower leaves sagittate ; leaves among the flowers sagittate to ovate :

Texture of blade rather firm .. 132. *iivaricaia.*

TBxture of blade tender .. 133. *Foxworthyi.*

Basal lobes of the stem-leaves with the inner margin curved so as to make thB leaf-blade markedly cordate :

Hairs sometimes on thB innovations, but never elsewhere :

First primary nerves diverge at the petiole with a curvB outwards .. 135. *Kingii.*

First primary nervBa diverge at the petiole fun wise :
Blade and capsules do not turn uniformly red-brown when dried:
Stem unarmed ; tubers diffuse .. 122. *aryzetarum.*

Stem armed at the base ; tubers spread little : ..
Leavea thinly herbaceous :
First lateral nerves wide-curving .. 121. *v&xana.*

First lateral nerves not wide-curving :
Capsules with wings 20 mm. wide .. 120. *glabra.*

Capsules with wings to 25 mm. wide 123. *gsdenais.*

Leaves rather firm ; capsules unknown . . 127. *Nieuwenhuiaii.*

Leaves film to coriaceous 134. *Merrillii.*

Blade and capsules turn uniformly red-brown in drying : ..
Leaf-blade firm |firmer than in 120. *D. glabra)* .. 125. *nummularia.*

Leaf-blade thin, dries a very deep colour .. 12B. *Sitamiana.*

Hairs on the backs of the leaves, at least in part, and to some extent also elsewhere .. 13 B. *pyrifolia.*

Bladea of leavea produced on the stem below the inflorescence with their greatest width less than one-third the length measured along the midrib, probably much less :
Base of the blade more or less cordate :
Texture of leaf firm :
First primary nerves diverge at the petiole with a curve outwards |only immature plants have these narrow leaves) .. 135. *Kingii.*

First primary nerves diverge fanwisB .. 124. *calcizola.*

Texture of leaf very thin .. 122. *oryzetorum,* var. *angustifolia.*

Base of blade rounded or Dnly just cordate :
Blade firm :
Male spikes few, on inflorescences but little developed .. 130. *grata.*

Mais spikes rather plentiful, on inflorescences more like those of 120. *D^glabra* 129. *salidfolia.*

Blade thin :

Leaves drying green .. 122. *oryzetorum,* var. *anguatifolia.*

Leaves drying a glaucous grey ; female spikes on wiry axes . . 123. *graailipea.*

00. Male flowers associated with hairs :

R. Male flowers touching each other pr almost so : the spikes bearing them diverging from the axis of the inflorescence at angles up tD 9D°:

3. Hairs not enwrapping the male buds:

Leaves firm, the hairs red-brown . . 13B. *pyrifolia*

Leaves thin :

Leaf-blade drying green and distinctly more Dvate than in the following species : the first pair of primary nerves rather remote from the margin which is hyaliriB .. 138. *appositifolia.*

Leaf-blade drying reddish, large and elongated : the first pair of primary nerves rather near tD the margin . . 139. *trinervia.*

Leaf-blade drying green, in shape between Dbovate and obcuneate .. 140. *obcuneata.*

SS. Hairs enwrapping the male buds :

Capsule wings 22 mm. by 14 mm. |unknown in 143. *D. Listen) :*

Fertile stamens three .. 141. *decipiena.*

Fertile stamens six :

Pubescence general : bulbils usually of moderate size . . 142. *pubera.*

Pubescence partial : bulbils very large . . 143. *Liatzri.*

Capsule wings 3B mm. by 3D mm. : male flowers crowded together : pubescence general .. 144. *poly eludes.*

RR. Male flowers well-spacBd, 1—2 mm. apart, and Dn spikes which stand at angles of 35—4D° to the axis which bears them :

Leaves exactly Dvate below the mucronate apex .. 145. *platycarpa.*

Leaves elliptic or ovate-Elliptic . . 145. *orbiculata.*

A A A.[3] Male flower-spikes directed earthwards, axillary among ths leaves, the axis minutely rough ., 147. *t&nuifolia.*

Group of D. liurifnlia |species 72—75). Species of Sunda-land, with the male flower-spikes very decidedly negatively geotropic. ThB spikes are produced on specialized leafless inflorescences : their flowers are globose : the capsules are rather largB with a long stipe, and have wings relatively broad : the leaves are coriaceous.

72. DIOSCOREA HAVILANDII, Prain and Burkill in Journ. AS. SOD. Bengal, N. S. ID, 1914, p. 4D, excluding the Bangka specimen : Merrill in Journ. Roy. As. SDC. Straits Branch, special No. 1919, p. 118 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 281.

Underground parts unknown. *Stems* glabrous, unarmed at least in the upper parts and probably throughout, wiry, rather conspicuously bluntly ridged, green or reddish green. *Bulbils,* none observed. *Leaves* alternate, decidedly coriaceous, so very broadly elliptic as to be almost circular, abruptly acuminate, just cordate at the base, up to 11 cm. long by 9 cm. in breadth, the acumination 1 cm. long, 5-nerved : the nerves of the first pair enclose a broadly Dvate area : the nerves of the second pair are relatively weak and run submarginally or finally marginally to CIDSB under the acumen : the secondary nerves cross the interspaces with slight elbows, and are scarcely distinct from the network : upper surface glabrous, rather shining, with the whole of the nervation just prominent when dried : the lower surface duller, glabrous, with the primary nerves standing out as sharp thin ridges, and the others slightly prominent : margin rimmed : petiole up to 5 cm. in length.

Male flowers in spikes which are produced upon special leafless branches : these branches unless supported hang by their own weight, while the spikes which they bear become rigidly erect by a strong negative response to gravity: the leafless flowering branches may be as much as 70 cm. in length : axis of the spikes up to 6 cm. long, conspicuously angled, glabrous, each with 3D—4D flowers : the rounded flower-buds set upon them at right angles : bracts from a broad base where they are pressed against the axis by the bud, ovate, acuminate : bracteoles similar but much smaller. *Sepals* broadly ovate, from a moderately thick base rounded, concave, deep red-brown, 1 mm. long. *Petals* very thick and strongly keeled, a little shorter than the sepals, narrowly obovate, obtuse. *Stamens* B, inserted at the base of the perianth-members ; filaments D-3 mm. long; the anthers a trifle longer, introrse. *Gynoecium* a three-pointed cone.

Female flowers (not known in var. *vera,* but described from var. *ovatifolia)* in long decurved spikes which attain 35 cm. in length and carry about 15 flowers. *Capsules,* described from var. *ovatifolia,* their stipe included up to 25 mm. long, retuse above ; the stipe up to 5 mm. long, widening upwards until 3 mm. in diameter, the wings curving from it through 9D°, much broader than semi-circular, 18 to 2D mm. long along the placenta by 22 mm. in width, retuse at the apex. *Seeds* with a membranous brown wing all round.

BORNEO andBILLITDN.

This species seems in Borneo and Billiton to represent the Malayan *D. laurifolia* ; for though no one haa, as yet, reported in what situations it occurs, its very coriaceous foliage suggests a habitat in places well-drained and similar to those which supply *D. laurifolia* with the conditions necessary for growth. Haviland collected his specimens in flowerin October and the fruit has been obtained in February. The two varieties, both Bornean, the first occurring also in Billiton, are :—

Leaves almost exactly circular under the acumen	•• var. *vera*
Leavei exactly Dvate ..	•• var. *trvatijoha*

" Akar kowat " is a name recorded as used for it by the Malays of Sarawak.

MALAYSIA. **11 g. Northern Borneo.** Sarawak state. Near Kuching |var. *vera), Haviland* 1815 ! 2313 ! *Hewitt* ! *Merrill's collector* 31D ! 38B ! 842 ! (also var. *ovatifolia), Merrill's collector* 453 ! Billiton island. Without locality, |var. *vera) Riedel* !

PLATE 85. Dioscorea Havilandii, *Prain and Burkill.* |1) A branch with male flowera from Haviland's no. 1816, nat. size : |2) part of a spike of the same, X ID : |3) a flower dissected : |4) leaf of var. *ovatifolia* from Hewitt's Kuching specimen, nat. size : |5) a branch of var. *ovatifolia* with capsules, nat. size : |5) a seed.

73. DIOSCOREA BANCANA, Prain and Burkill in Kew Bull., 1925, p. 62.

Dioscorea Havilandii, Prain and Burkill in Journ. As. Soc. Bengal, N. S. 10, 1914, p. 4D, as regards the Bangka specimen only.

Underground parts unknown. *Stems* unarmed, at least in their upper parts and probably throughout, wiry, with three Dr four slight angles, each of which increases upwards until it becomes the ridge of the back of a petiole, green. *Bulbils,* none seen. *Leaves* alternate, decidedly coriaceous, ovate or ovate-elliptic, acuminate, rounded at the base, up to 15 cm. long by 5 cm. in width, 5-nerved : the nerves of the first pair, diverging from the midrib at about 35°, enclose an almost exactly broadly elliptic area, becoming submarginal at about the mid-length of the blade : the nerves of the second pair diverge at about 8D°, to run within the margin and vanish at about the mid-length of the blade : secondary nerves nearly straight, but not conspicuous in the network, rather far apart and from that circumstance creating an appearancs which is not noticed in *D. Havilandii :* upper surface glabrous, with the nerves indistinct : lower surface glabrous, a little darker than the upper in the dry specimen, with the primary nerves prominent and the others just prominent : margin rimmed : petiole up tD 3 cm. long.

Male flowers in spikes that are grouped as in *D. Havilandii,* upon leafless pendent inflorescences, the axis strongly negatively geotropic SD that the spikes themselves are directed upwards : axis about 1D cm. long, slightly angled or ridged, glabrous : buds globose, facing a little forward : bracts lanceolate-ovate, acuminate from a broad base which is repressed by the flower against the axis : bracteole similar, half as long as the bract. *Sepals* broadly ovate, from a moderately broad base, rounded above, thick, concave, deep red-brown, rather under 1 mm. long. *Petals* exactly boat-shaped with a very prominent keel, a little shorter than the sepals. *Stamens* 5 : filaments D-25 mm. long, equalled in length by the introrse anthers. *Gynoecium* a small wart.

Female flowers upwards of 25, in decurved spikes which arise 1 to 3 together and are upwards of 15 cm. in length : axis strongly angled, glabrous : bracts triangular-ovate. *Sepals* ovate, rounded above, thick, deep red-brown. *Petals* boat-shaped, a little shorter than the sepals. *Capsules* unknown.

BANGKA ISLAND.

D. banzana, seems intermediate between *D. Havilandii* and *D. laurifolia.* In venation it suggests the latter, but the leaf-blade is much larger in size.

MALAYSIA **11 f. Sumatran sub-Subregion.** Bangka. Without precise ID cality, *Horsfield* ! Pangkal Pinang, *Teijsmann* !

PLATE 87. Dioscorea bancana, *Prain and Burkill.* |1) A branch with male flowers, and |2) a branch with female flowers from Horsfield's specimens, nat. size : |3) a branch with leaves, nat. size: |4) buds and bracts, X8: |5) and |5) flowers forced open, X 12: |7) three stamens: |8) stamens, X 15 : |9) a female flower: |1D) its stigmas.

74. DIOSCOREA LAURIFOLIA, Wallich, Cat. lith., 1830, no. 5111 : Hooker fil., Flora Brit. Ind. 6, 1892, p. 293 : Ridley and Curtis in Journ. Roy. As. Soc. Straits Branch, 33, 19D2, p. BB : Ridley, Mat. Flora Mai. Penins., Monocot., 2, 1907, p. 83, and in Journ. Fed. Mai. States Mus., 4, 1909, p. 81 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 39 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 289 : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 821.

Dioscorea oppositifolia, Curtis, Flowering plants and ferna Penang, in Journ. Roy. As. SDC. Straits Branch, 25,1894, p. 149; not Df Linnaeus.

Tubers few, descending intD the soil, but not deeply, slightly thickened downwards, stringy in the upper parts, pink to red, with a brown skin upon which are a few small rootlets. *Stems* unarmed, wiry, glabrous with faint ridges, green or yellowish green, freely rooting from any one of the lower nodes which happen to rest upon the soil, at full growth perhaps ID metres long. *Bulbils,* none seen. *Leaves* alternate, coriaceous in fully grown plants, always in drying with the nerves conspicuous, in outline broadly lanceolate or lanceolate-ovate, obtuse at the base or truncatcly rounded, acuminate at the apex, up to 15 cm. long by 5 cm. in width, 5-nerved : the nerves of the first pair almost throughout their course parallel to the margin : the nerves of the second pair submarginal, weak and evanescent not far above the base of the blade ; the secondary nerves cross the interspaces with some elbows and run in a network which is nearly as conspicuous as they are: the margin rimmed: the upper surface rather dull, with all the nerves just prominent : the lower surface of a brighter green, shining, with the primary nerves very prominent and the others prominent : petiole rather stout, up to 2 cm. in length.

Male flowers in spikes some of which arise in the axils of foliage-leaves, but most of which are grouped upon special leafless branches which hang unsupported at or near the branch-ends : these leafless branches attain as much as 45 cm. in length : the axis of the spike is negatively geotropic and sn the spike itself is directed upwards : itmay be 7 cm. long, is angled, glabrous, with 4D— BD flowers : buds oblong, set Dn at right angles : bracts ovate, acuminate, strongly repressed against the axis by the flower, D-75 mm. long, red-brown : bracteoles similar, shorter. *Sepals* ovate from a broad base, obtuse, concave, with red-brown dots. *Petals* a little shorter, narrowly obovate, thin, concave, obtuse, with red-brown dots. *Stamens* B; the filaments slender, 0-25 mm. long; the anthers slightly exceeding them in length. *Gynoecium* Df three small points on a low cone.

Female flowers on axillary decurved spikes : axis above 1D cm. long, bluntly angled, quite glabrous : the flowers 15—20 in number : bracts lanceolate-acute, small. *Sepals* ovate, obtuse, rather thick, 1 mm. long. *Petals* elliptic-ovate, a little shorter than the sepals. *Staminodes* about f the length of the petals. *Capsules* rather large, brightly polished, slightly retuse, with a stipe 8—ID mm. long expanding to a diameter of 4 mm. at the point where the wings spring from it very abruptly with a curve which passes through more than 90°, these wings broader than semicircular, and rarely somewhat oblique, up to 27 mm. long by 24 mm. in width. *Seeds* winged all round : wing deep brown.

MALAY PENINSULA, Dn steep well-drained places, such as are chiefly found in the mountains : it ascends to 4,500 ft. (1,372 metres).

This DiDscorea is generally distributed throughout the Malay Peninsula, where it flourishes best on hill-crests and steep slopes from which thi' rain is [juickly drained away. It ia much more abundantly seen flowcrless than flowering ; but when, owing to the fall of some tree, sunlight reaches its site, it flowers profusely ; and its male flowers are SD strongly and pleasantly scented of benzoin that the Malays term it " akar kemenyan " or benzoin creeper. This name is widely used, but may be at times applied to allied and similar species af the

genus. Alvins obtained in Malacca another mime for the species; this he wrote. " akar surinting." A knowledge of Alvins' method Df transliteration shows that this name would be better spelled " serinting ": but what it means is not known. In the *Journal of the Royal Asiatic Society, Straits Branch,* 3D, 1897, p. 259, by a misprint it appeared as " surunting." Led astray by the misprint Wilkinson in his *Malay-English Dictionary* |19D3, p. 381) took the namr tD represent " akar serunding ", serunding being a Javanese dish made up of coconut and various ingredients. DneDfus (Burkill in *Gard. Bull. S.S.,* 3, 1924, p. 179) printed it as " akar surunting " the meaning being the same : and Watson |in Mai. Forest Rec. 5, 1928, p. 132) printed it as " serunting ". But until we understand the name or getit confirmed, itis valueless. Alvins' original label has been consulted, but he adds no note of explanation tD the name which he recorded.

The northern limits of *D. laurifolia* are not yet established : Kerr collected what may be it in the Circle of Surat, Lower Siam, almost at 1D^{D} N. : but the most northern locality otherwise known is Dnly in 5^{D} 3D' N. To the south and east it is displaced by the closely allied *D. Havilandii, D. bancana* and *D. Vanvuurenii.* These three species indeed, seem tD form along with *D. lavrifolia,* a group Df common origin, now, in response to geographic isolation, in process of diverging. *D. laurifolia* in the Malay Peninsula is itself sometimes difficult to distinguish. It may be that it forms hybrids with associated species of the section *Enantiophyllwn,* and that the plants which present difficulties tD the systematist are hybrids of this kind : but at present this is no more than a speculation. One specimen from Fraser hill bears unusual capsules, deeply retuse at the apex.

An observation relative to the amount of tannin in the tubers of *D. laurifolia* has caused us gome perplexity. While still under the impression that the Malay name given by Alvins implied edibility, Dne of us was surprised to be told by a Malay that the underground parts might be used for colouring cloth; and, having heard this, deemed it desirable that the amount of tannin in the tubers be determined. Two tubers were dug up on the top of Maxwell's hill above Taiping, and through the kindness of Mr. J. A. LeDoux a third was supplied from his estate at Kota Tinggi in JuliDrc. The Government Analyst, Singapore, was so good as to analyse these tubers ; the fDund only 1-48 and 1-74 per cent. Df tannin in the Taiping examples, but 5-15 in the Kota Tinggi one. The tubers were dug in March and were not resting tubers. We record these figures, but cannot explain them.

The flDWsring of *D. laurifolia* occurs in various months, but is observed chiefly between January and April. Flowerin" is recorded however in the months of June, July and October. It may well be that the accidental removal Df overhead shade, as by the fall Df a tree, brings about at almost any season the tcmperature-CDndi-tions usual at the normal time of flowering, and that this accounts for what may be termed flowering out of season.

We have failed to find in Penang any indication that *D. laurifolia* produces its flowers below 15DD ft., yet in Singapore it flowers at sea-level. This may perhaps be a consequence of the extensive clearing of the low ground of Penang with, as a result, an increase in the temperature at the soil through ths first quarter of the year, which is the time when flowering may be expected, as flowering occurs then Dn the moister, cooler, wooded slopes at higher levels.

MALAYSIA. **12 d. Peninsular Siam.** Surat Circle. Langsuan, *K err* 119D9 ! but doubtful. **12 B. Malaya.** Penang island. Without locality, *Maingay* 17D1 ! *Porter* 51 Dl b ! 51H ! At a few feet abDVB tide limit. west of Telok Bahang, *Burkill* 3382 ! Pantei Acheh, *Burkill* ! Western Hill, *Burkill* 1528 ! Tiger Hill, *Burkill* 1525 ! Government Hill, *Curtis* 2292 ! *Ridhy* ! Government hill road from 4DU ft. upwards to the top of Government Hill, *Burkill* 578 ! 58U ! 588 ! 154D ! 1542 ! 2391 ! Perak state. Near Taiping between 8DD and 1,DDD ft., *Kunsthr* 5449 ! On the Taiping hills at all heights up to 4,DUD ft. on Gunong Hijau, *Mohamtd Huniff and Mohamed Nur,* 2303 ! 23D9 !B2311 ! 2315 ! 2318 ! 2329 ! 2343 ! 2388 ! 2393 ! 2394 ! *Burkill* ! *Burkill and Mohamtd Haniff* 128B2 ! Hermitage Hill, *Ridhy* 2951 ! Gunong Keledang, *Ridhy* 9589 ! Kuala Sampan, *Ridhy* 10219 ! Dindings. Lumut, *Curtis I Ridhy* 1D298 ! Selangor state. SemangkD pass, *Ridhy* 12D27 ! Kanching forest reserve, on the top of a cliff at 1,DOD ft., *Foxworthy and Burkill* ! Gombak forest, *Foxworthy* ! Bukit Raja forest near Klang, on a hill, *Burkill* 7633 ! Tclok forest reserve at sea-level, *Burkill* SB1D ! Pahang state. " Telom " i.e. Cameron's plateau in the Main range, on the edge of open places, *Ridhy* 138D5 ! Fraser Hill (Sempang), *Ridhy* 15616 ! *Hose* 153 ! *Burkill and Holttum* 8401 ! *Holttum* 215D1 ! *Kalong* 22478 ! West of Raub, *Forest Guard* 22515 !

Negri Sembilan. Seiaru forest reserve, *Holttum* 9716 ! Gunong Angsi, at 2,7D0 ft., *Mohamed Nur* 11644 ! Tampin, *Burkill* 2518 ! Bukit Arang Kayu, near Tampin (suggesting somewhat *D. orbiculata), Mohamed Nur* 1S25 ! Gunong Tampin at 1,5DD ft., 1,SD[) ft., and 2,5DD ft., *Burkill* 2537 ! 2857 ! and 3186 ! Malacca territory. Without locality, *Griffith* 5556 ! Merlimau, *Alvins* ! Bemban, at the 12th mile from Malacca town towards Jasin, *Burkill* 1354 ! 2187 ! 2286 ! Johore state. Mount Dphir, on the summit, *Hulhtt* 832 ! Gunong Msring, at 2,DDD ft., *Ridhy* ! Gunong Ledang, *Ridley* ! Gunong Lambaknear Kluang, at 1,575 ft., *Holttum* 9378 ! and at 7D0 ft., *Holttum* 9454 ! Gunong Belumut, at 3,DDD ft., in mossy forest, *Holttum* 10578 ! Bukit Pengarang, *Ridhy* ! Batu Pahat, *Ridley* ! Johore Bahru, *Ridley* 9175 ! Hota Tinggi, *Lz Doux* ! Singapore island. Bukit Timah, *Ridley* ! Sungai Morai, *Ridhy* ! Seletar, *Goodmough*! Mandai forest, *Burkill* 28D ! Holland road, *Burkill* ! Jungle of the Botanic Gardens, *Ridhy* 48D9 ! *Hullett* ! Hills over Pasir Panjang, *Burkill* 7518 !

PLATE 88: Dioscorea laurifolia, *Prain and Burkill.* |1) A branch with male flowers from Kunstler's no. 5449, nat. size : |2) a flower dissected : |3) stamens, X 2D : |4) a female flower from Ridley's HD. 1D298, nat. size : (5) a branch with capsules from Curtis' no. 2292, nat. size : |6) a capsule cut across, nat. size : (7) the wing of a capsule with immature seeds, nat. size.

75. DIOSDDREA VANVUURENII, Prain and Burkill in Kew Bull., 1925, p. 63.

Underground parts unknown. *Stems* at least in the upper parts unarmed, scarcely ridged, glabrous. *Bulbils,* none observed. *Leaves* opposite, ovate, shortly acuminate, those seen attaining 4 cm. in length by 2 cm. in width, 5-nerved : the nerves of the first pair diverge from the midrib at about 2D° and enclose an elliptic area : the nerves of the second pair diverge from the midrib at 35° and, running submarginally, end a little above the mid-length of the blade : the secondary nerves are for the most part lost in the network: the upper surface glabrous, with the primary nerves distinct and the others indistinct : the lower surface glabrous, with the primary nerves prominent and the rest distinct : the margin is slightly strengthened : petiole 2—3 cm. long.

Mah flowers in spikes which arise 1—4 together in leaf-axils or in the axils of bracts towards the branch-ends ; axis in response to gravity directed upwards, up to 5 cm. long with over BD flowers, glabrous, angled : bracts ovate, acuminate, repressed against the axis in the flowering part : buds globose, directed obliquely forward. *Sepals* quadrately ovate, obtuse and not at all rounded at the apex. *Petals* subclavate, shorter than the sepals. *Stamens* 6.

Female plant unknown.

CELEBES.

We regard this species as much more nearly related to *D. laurifolia,* than to *D. Warburgiana* which occurs in Celebes : but then the last named plant is not yet well-known.

KoDrders' *no.* 15729 from Ratahan in northern Celebes has a considerable resemblance to it, but bears thinner leaves. We hesitate to give a name tD it, because nD fully developed foliage was obtained.

MALAYSIA. **11 I. Celebes.** Lahondape, *Rachmat* (collector on the Van Vuuren expedition) 632 !

PLATE 91 (right-hand lower quarter). Dioscorea Vanvuurenii, *Prain and Burkill*. A collotype figure of the type specimen, reduced to ⅓ nat. size.

Group of D. Prainiana (species 76). A species of Malaya, agreeing with the preceding specie in carrying its male flowers in special leafless inflorescences and in the negative geotropism of the male flower-spikes • but differing in the shape of the flowers and apparently in the underground tuber, as well as in having herbaceous foliage.

76. DIDSCOREA PRAINIANA, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 286, in so far as the name replaces *D. deflzxa,* Hooker fil., that is'to the exclusion of the three Indian specimens, which he cites : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 824.

Dioscorea deflexa, Hooker fil., Flora Brit. Ind. 6, 1892, p. 293 : Ridley, Mat. Flora Mai. Penins., Monocot. 2, 19D7, p. 83 ; not of Grisebach.

Dioscorea glabra, Ridley, Mat. Flora Mai. Penins., Monocot. 2, 19D7, p. §3, only as regards his no. 8D59.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, only in synonymy.

Dioscorea t repanda, Blume, Enum. Plant. Jav. 1, 1827, p. 22 : Kunth, Enum. plant., 5, 1850, p. 40D.

Tubers bulky, about 45 cm. in circumference, and formed about 3D cm. below the surface of the soil, yellow-fleshed, edible but bitter without long cooking, said to weigh sometimes as much as 18 kilos (4D lb). *Stems* wide-climbing and attaining a length of 16 m., unarmed dark straw-coloured when dried, 5 mm. thick at the base. *Bvlbils,* none seen. *Leave's* opposite or sometimes alternate, elliptic DI- ovate-elliptic, acuminate, rounded at the base up to 15 cm. long by 7 cm. in width and exceptionally to 13 cm. in length by 8 cm. in width' 5-nerved : the nerves of the first pair enclose a rather narrowly obovate area ; the nerv-s' Df the second pair run at a very gradually narrowing distance from the margin, and finally end Just within it close under the acumination : the secondary nerves cross the interspaces obliquely and rather indistinctly at some distance apart : the upper surface glabrous, dull green, with the primary nerves prominent and the others just visible : the lower surface dull green, when dry in colour like the upper surface, but in life often with a reddish flush along the midrib, the primary nerves prominent, the others manifest to distinct : margin with a tawny edge : petiole up to 6 cm. long.

Male flowers in fascicled spikes, both in the axils of foliage leaves and arranged upon special pendent leafless branches ; the spikes by strong negative geotropism directed upwards and SD reflexed (not deflexed as Sir Joseph Hooker's name implied) upon the pendent branches : the special leafless flowering branches attain as much as BD cm. in length • axis of the spike angled, glabrous, about 8 cm. bng with 40-BD ovoid buds sst on at right angles : bracts ovate, acuminate, at the base repressed by the bui against the axis, D75 mm. long, red-brown : bracteoles similar but smaller. *Sepals* triangular-ovate above rather broad base, obtuse above, thin, with red-brown dots, navicular, 1-25 mm Ion *Petals* narrowly elliptic-ovate, a little shorter than the sepals, equally thin and similarly dotted with red-brown, keeled. *Stamens* 6, the anthers twice as long as their filaments. *Gynoecium* as three small points.

Female flowers wide-spaced on very long simple axillary spikes, which when the capsules are ripe may be as much as 5D cm. long, carrying 40 flowers : axis markedly angled : bracts ovate-acuminate, red-brown, about 1 mm. long : bracteoles similar, shorter and broader. *Sepals* broad, thick, truncately obtuse under the apex which is a minute mucrD, red-brown, D-75 mm. long. *Petals* thick, shorter than the sepals, lanceolate-clavate, red-brown. *Staminudes* 5, small. *Capsules* large, upon a stipe B mm. long and in all, if the stipe be excluded, 3D mm. in length, with the wings broader than semicircular 25 mm. long by 3D mm. in width. *Seeds* with a smoky-brown wing all round.

The MALAY PENINSULA and SUMATRA.

Dioscorza daflexa was founded by Sir Joseph Hooker upon specimens collected by Maingay partly in Singapore and partly in Malacca : Maingay's 3D87, as the handwriting upon the label indicates, was gathered in Singapore ; his 3391 bears the printed label usually attached to his Malayan specimens with Malacca upon it : for these two numbers 17D5 and 17D6 were substituted at Kew when the collections were arranged for distribution.

In 1883 Kunstler collected in Larut in the months of February, March and September specimens with male flowers numbered by him 3858, 3972 and b'5B7, which were determined by one of us in the Royal Botanic Garden, Calcutta, in 1893, as *D. deflexa :* and in 1907 Ridley accepted them as such, though possibly without critical examination, for at the same time he named as *Dioscurea glabra,* other specimens af this species which in 1896 he had himself collected in Singapore under his number 8D59.

In December, 191 B, Lorzing collected at Sibolangit in Sumatra intertwined male and female plants, the former flowering, the latter in fruit, which agree in characters exactly with the Larut specimens ; but the fruit is not absolutely indentical with Maingay's 3391. After carefully examining these specimens, we have decided, in spite of the difference in fruit, to accept them as belonging to this species.

Dr. R. Knuth has called attention to the existence of the name *D. deflexa,* given in 1875 by Grisebach *to* an American species, and has substituted the name *D. Prainiana,* which will hold good for the Malayan plant, but cannot be accepted for certain Indian specimens which Knuth has treated as conspecific. We add provisionally to the species, specimens collected in a sterile state in Perak, Pahang and Singapore.

What has been said above regarding the tuber is dsrived from these sterile specimens : and it is necessary, therefore, to caution the reader that tubers and flowers have never as yet been examined in a state of organic union.

The large tubers which we assign to *D. Prainiana* are termed "kelunoh" by the Malay-speaking Sakai of tbB forests of western Pahang and are eaten by them. But unfortunately the name used by these Sakai is not invariably restricted to this species, in consequence of which it is unsafe to assume that European writers who have used the word mean this particular *Dioscorza.* With this caution, W3 propose to quote what they have recorded. The older writers are Logan, whose knowledge of Malayan affairs was profound, and J. T. Thomson, whose duties as Government Surveyor in Singapore took him up and dawn the island and round its coasts. Both observers wrote in Logan's *Journal of the Eastern Archipelago,* and their records relate to "kelunoh" as found near Singapore and in southern Johore.

When Raffles established the Settlement of Singapore in 1B19, several clans of primitive folk were clinging to the estuaries nearby, leading a precarious existence : they practised no agriculture, but fed DII what they could gather from the land and the sea. Dne of these clans was the Orang Sabimba |men of Sabimba) who said they were descendants of natives of Celebes, shipwrecked on the island of Battam in the Riouw ArchipelagD, and reduced to extreme poverty by depredations of pirates. They were removed from Battam tD southern Johore by the Temenggong Df Johore, who claimed them as subjects ; and it was in their newer location that Logan studied them. He says (Journal, 1, 1847, p. 295) that they ate many roots, and he names first in his list "akar kaluna", i.e., the kelunoh climber. About the same time Logan studied also the Orang Kalang or men of tha Kalang river, who, like the Drang Sabimba, had been removed to southern Johore, where they were given part Dfthe estuary Df the Pulai river. Of them he says |p. 35D) that the first thing put into the mouth of a new born babe was a little juice of "buah kaluna", literally fruit of the kelunoh climber, but the word "buah" could beuuedforthe bulbils. Such a custom puts kdunoh into a very prominent place in the lives of these people.

Thomson |p. 343*) found Sea Gypsies, certainly closely akin to the Drang Kalang, living DH the northern coast of Singapore island in the estuary of the Seletar river (to which the Thomson road now leads), but holding themselves in spite Df their residence feudatories to the TemenggDng of Johore, whose State they could reach in less than an hour : and of these—the Drang Seletar—Thomson wrote "of esculent roots they have.... kalana. . . .bulbous. . . .not unlike coarse yams."

We are confident that before Singapore island and southern Johore were overrun by Gambier planters and the forests destroyed, *D. Prainiana* was plentiful : and we find no difficulty in believing that it was used as food ; our chief difficulty is that we have seen no bulbils, and are constrained thereby to think that the "buah kaluna" Df Logan's account of the Drang Kalang may relate to *D. bulbifzra.*

Dn p. 255 Logan refers to "kluna" as one of the roots eaten by the Berembun tribes of Seremban, Negri Sembilan, but not eaten by the Benua-Jakun of Johore.

There exists a much later reference to kelunoh in Derruti's *My friends the Savages* |19DB, p. 199). He lived among the Central Sakai in southern Perak, two hundred miles to the north of Singapore, and of those with whom he was SD intimate he says that they drop the juice of kelunoh into the mouths of new-born babes in a mouth-opening ceremony. Derruti was not above borrowing unacknowledged colour for his book from earlier writings, but he ought to be accurate in this.

Readers who find access to the works, just quutsd, to be difficult, may obtain the information also in Skeat and Blagden's *Pagan Races of the Malay Peninsula* |2, 19DB, p. 2B).

MALAYSIA. **11B. Malaya.** State of Perak. Larut, near water among rocks, between 30D and 5D0 ft. *Kunsthr* 3858 ! 3972 ! and between 8D0 and 1,DDD ft., *Kunstler* B5B8 ! Sungai Siput, Dn limestone (a little doubtful), *Burhill* 63D8 ! State of Trengganu. Bundi, *Rostados* ! State of Pahang |all sterile and somewhat uncertain). Dong, near Raub, *Burkill and Haniff* 159D8 ! 13949a ! Batu Talam, *Burhill and Haniff* 17D2B ! Pelangai, *Burkill* and *Haniff* 16789 ! States of Negri Sembilan. Gemas, *Burkill* 3545 ! Settlement of Malacca. Without precise locality, *Maingay* 3391 = K. D. 17D5 ! Island of Singapore. Without locality, *Maingay* 3D87 = K. D. 17D3 ! *Ridley* 8D59 !

11 f. Sumatra. Residency of the East Coast. Sibolangit, at 5DD m., *Lijrzing* 4544 ! Bandar Bharu on Gunong Sebayok, *Mohamed Nur* 7399 ! Bukit Parang near Sibolangit, *Mohamed Nur* 723D ! Bukit Semaik, *Mohamed Nur* 737B !

PLATE 89. Dioscorea Prainiana *R. Knuth.* |1) A branch with male flowers from Kunstler's no. 3972, nat. size : |2) part of one of its spikes, XlD : |3) a flower forced open, XlD : |4) two large leaves from a specimen collected by Kunstler : |5) capsules from Lörzing's no. 4544 : |B) a capsule from Maingay's no. 3391. Nos. 4—B, nat. size.

Group of D. Warburgiana |species 77). A species of Celebes, not adequately known. The group of *D. laurifolia* is suggested, but the male flowering spikes arise in leaf-axils, and the flowers are less squat upon the axis, and spaced.

77. DIDSDDREA WARBURGIANA, Uline ex Koorders in Mededeel. 'sLanda Plantentuin, 19, 1898, p. 313, name only : Prain and Burkill in Journ. As. Soc. Bengal, N. S. 4, 19D8, p. 45B, and ID, 1914, p. 4D : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 291.

Underground parts unknown. *Stems* glabrous, at least in the upper parts, unarmed, smooth. *Bulbils,* none seen. *Leaves* alternate or subopposite, glabrous, almost coriaceous, elliptic-ovate, shortly acuminate, rounded or truncate at the base, rounded also under the acumen, up to 17 cm. in length by ID cm. in width, 7-nerved : the nerves Df the first

pair enclose a broadly elliptic-oblanceolate area : the nerves of the second pair diverge from the midrib at about 55° to become submarginal in the distal half Df the blade : the nerves of the third pair are weak and run submarginally near the base of the blade : the secondary nerves dD not cross the interspaces, but break up in the network : the upper surface glabrous, with the nervation rather obscure : the lower surface also glabrous, with the nerves prominent : the margin of the blade with a hyaline rim : petiole up tD 5 cm. in length, glabrous.

Male flowers, as far as seen, on spikes which arise in fascicles in the leaf-axils, 2—4 together : axis up to 2D cm. long with upwards of 8D flowers, conspicuously angled, glabrous : buds oblong-ovoid : bracts oblong-lanceolate, acuminate : bracteoles only half as long as the bracts, acuminate. *Sepals* ovate-oblong, rounded above, thick, about 1-25 mm. long. *Petals* smaller, rather more ovate and narrower at the base than the sepals. *Stamens* B, the anthers twice as long as their filaments. *Gynoecium* minute.

Female flowers not seen. *Capsules* light tawny in colour when quite dry, but probably darker when fresh, the wings much broader than semicircular, 22 mm. long by 22 mm. in width, slightly oblique so that the capsule is just retuse at the apex.

CELEBES, in the northern limb of the island.

Three collectors have obtained this species, and their localities are all within 2DD miles Df the north-eastern end of the island.

MALAYSIA, **11 I. Celebes.** Northern Celebes, in the Minahassa district, in the forests of Pinamorcngan, *Koorders* 1B72D b ! Menado, without precise locality, *Warburg* 15754 ! Tondano, *Warburg* 15755 teste R. Knuth. Gorontalo, *Riedel* !

PLATE 93. Dioscorea Warburgiana, *Uline.* |1) A branch with male flowers from KoDrders' specimen, nat. size : |2) and |3) male flowers, X B : |4) the same dissected, X12 : |5) a bract and a bracteole, X 12 : |B) a capsule from Warburg's no. 15754, nat. size.

Group DI D. filiformis |species 78-79). Slender species of Java, with negatively geotrppic male flower-spikes, distributed among the foliage leaves.

78. DIDSDOREA FILIFDRMI5, Blume, Enum. plant. Jav., 1, 1827, p. 22: Kunth, Enum. plant., 5, 1850, p. 4DD : Koorders, Excursionsflora Java, 1, 1911, p. 3D9 : and atlas 4, 1923, fig. 5DD: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 290.

Dioscorea vilis, Zollinger, Systematisch. Verzeichn. d. im indischen Archipel geaammelt. Pflanzen, 1854, p. B8 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 41 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 29D, excluding the Moluccan and Indian specimens.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in very small part; not of anyone else.

Underground parts not known with certainty, but, if the specimen collected by the late Dr. Koorders at Tjibodas be rightly assigned, descending straight into the soil to a depth of at least 25 cm., white-fleshed, edible, with scattered rootlets upon the surface.

Stems according to Koorders, ascending to a height of 15 m., 3—4 mm. thick at the base, and there with a few small prickles : the upper parts always unarmed, glabrous, terete Dr faintly ridged. *Bulbils* not seen. *Leaves* alternate at the base of the stem, often opposite above, very thin in texture, bright green, from broadly lanceolate to narrowly rounded-ovate, slightly cordate at the base, very acute towards the apex or somewhat acuminate, ijuits glabrous, up to ID cm. long by 4 cm. in width, 7-nerved : the nerves of the first pair enclose a linear Dr linear-lanceolate area : the nerves of the second pair diverge from the midrib at 75°—8D° tD end near the margin a little below the apex : the nerves of the third pair end about the mid-length of the blade : secondary nerves cross the interspaces indistinctly, being almost lost in the network: upper surface glabrous, smooth, with the larger nerves prominent: lower surface glabrous, with the larger nerves prominent, but the others scarcely so : margin just strengthened : petiole glabrous, up to 4 cm. long.

Male flowers in axillary spikes, which stand 1—3 together: axes up to 7 cm. long, slender, strongly ridged, minutely scabrid, assuming a vertical position in response to gravity, each with 3D—*5D* flowers : bracts ovate, long-acuminate, repressed by the flowers against the axis, 1 mm. long: bracteoles similar, smaller : buds subglobose. *Sepals* broadly ovate and *so* very obtuse as to be almost truncate, about D-5 mm. long. *Petals* a little shorter, broadly ovate, obtusely rounded above. *Stamens* 6, the anthers about twice as long as the filments. *Gynoecium of* three small points.

Female plant unknown.

JAVA, a montane species.

It seems strange that this species remains so little known. Blume obtained its male flowers upon a rather weakly stem, and we have figured his specimen Dn plate 90. Zollinger obtained male flowers upon a rather more vigorous stem |his IID. 2528). Koorders obtained further specimens |plate 9D as *D. vilis)* which differ a little. These again are male. The female plant remains unknown, unless it be *D. ma.diune.nsis* ; and that can only be decided by study in the field.

MALAYSIA. **11 j. Java.** Residency of B a t a v i a. Parang, *Blume*! Residency of P r e a n g e r. Tjibodas, in high forest at 1,5DD m., *Koorders* 4D937 b ! In scrub by the Botanic Garden (sterile and doubtful), *Burhill* 8275 ! Residency of P a s o e r o e a n. Goenoeng ArjoenD, among Dasuarinas at 2,1 DD—2,4DD m., *Koorders* 38152 b ! Mount Tengyer, near Gebok Klakka at 4,DDD ft., *Zollinger* 2528 ! Residency Df K e d o e. Ngasinan, in high forest between B5D and 1,5DD m., *Koorders* 27728 b !

PLATE 9D, at the top on the right. Dioscorea filiformis, *Blume.* A collotype illustration of a specimen collected by Blume and preserved in the herbarium of the Botanic Garden, Buitenzorg : below, collotype figures of two specimens collected by Koorders and preserved in the same herbarium.

PLATE 94. |1) A branch with male flowers collected by Blume, nat. size : |2) a flower from the same, X12: |3) its bract and its bracteole, X 12 : |4) its stamens, X12: |5) a stamen seen from either side, X2D : |B) a branch from Zollinger's specimen no. 2528, nat. size : |7) its flower with the bract and the bracteole, X7 : |8) the parts of a flower : 19) a stamen seen from either side, XlD : |1D) a floral diagram.

79. DIDSDDREA MADIUNENSIS, Prain and Burkill in Kew Bull. 1925, p. B3.

Underground parts unknown. *Stems* in the upper parts unarmed, glabrous, inconspicuously ridged. *Bulbils,* none observed. *Leaves* alternate as far as seen, lanceolate-

ovate, rounded at the base, very shortly acuminate, up to ID cm. long by 3-5 cm. in width, 7-nerved : the nerves of the first pair enclose an area which narrows equally to both ends, and is at its broadest rather broader than one-half of the entire blade : the nerves of the second pair run for almost the whole length of the blade a little within the margin : the nerves of the third pair are weak and end at a very short distance from the base of the blade : the secondary nerves are rather few and inconspicuous in the network : the upper surface of the leaf glabrous, with the nervation distinct : the lower surface glabrous, with the primary nerves prominent and the rest just prominent Dr distinct: the margin not thickened : petiole up to 3 cm. long.

Mah plant unknown.

Female flowers in spikes which at fruiting may be 15 cm. long. *Capsules* about 8 on the infractescence, the stipe 11 mm. or even 15 mm. long, expanding in diameter to 4 mm. where the wings spring from it in a curve which passes through more than 90° ; the wings much broader than semicircular, and not oblique so that the fertile part of the capsule is nearly equally retuse towards base and apex ; these wings are up to 27 mm. long by 3D mm. in width. *Seeds* with a dark chestnut wing all round but not perfectly equally, more or less conform to the IDCUIUS.

JAVA.

From the meagre material which has been collected, it is difficult tD feel any satisfaction regarding its place in our classification : but the capsule has a resemblance to that of *D. laurifolia* sufficient to cause us tD think that We do not place it incorrectly when we give it a position neaT to it : and the leaves are sufficiently likB those of *D. filiformis* to make it possible that we have in it the female plant Df that species.

The vernacular name'' wi-ajah " is recorded for *D. madiunensis,* but the implication of " ajah " is uncertain.

MALAYSIA. **11 j. Java.** M a d i o e n residency. Dn Goenoeng Sigogor in the district of Ponorogo, *Koorders* 29205 b !

PLATE 92. Dioscorea madiunensis, *Prain and Burkill.* On the right hand is a collotype figure of the type specimen, reduced to \.

Group ol D. luzonensis |species 80—81). Species of the Philippine islands, without special leafless inflorescences : the male flower-spikes strongly negatively geotropic : the leaf-blades very broadly Cordate or subsagittate.

8D. DIDSDDREA PEPEROIDES, Prain and Burkill in Elmer's Leaflets of Philippine Botany, 5, 1913, p. 1597, and in Journ As. Soc. Bengal, N.S. 10, 1914, p. 28 : Merrill, Enum. Philipp. Flowering plants, 1, 1922, p. 219: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 259: Prain and Burkill in Lecomte, Flore gen. de 1' Indoch., 6, 1934, p. 73B.

Dioscorea luzonensis, Merrill and Merritt in Philipp. Journ. Sci., D-5, 191D, p. 339 ; not of Schauer.

Underground parts unknown. *Stems,* at least in the upper parts, unarmed, glabrous, smooth or faintly and bluntly ridged longitudinally, becoming somewhat hollow in age. *Bulbils,* none seen. *Leaves* subopposite or alternate, generally rather broadly cordate, auricles not angular at all, the apex abruptly acuminate, in length up to 12 cm. by ID cm.

in width, 7—9-nerved : the nerves of the first pair diverge from the midrib at about 2D° to enclose a broadly oblanceDlate-acuminate area : the nerves of the second pair diverge from the midrib at about 45° to become submarginal in the distal third Df the blade : the nerves of the third pair curve into the auricles : between these nerves secondary nerves run across the interspaces forking on the way SD that often they are not conspicuous in the network : the upper surface dark green, glabrous, with the primary nerves just prominent and the network only just distinguishable : lower surface with the primary nerves prominent, and the secondary just prominent, and the network just distinct: petiole up to 3 cm. long.

Male flowers in spikes which stand more or less erect, 2—4 together in a leaf-axil: axis up to 5 cm. long with upwards of BD flowers rather closely placed along it from just above the base, scarcely angled, glabrous : buds between cone-shaped and subglobose : bracts reflexed'by the slightly broadened base of the bud round which they curve, small, lanceolate-ovate, acuminate, not 1 mm. long : bracteoles minute. *Sepals* triangular-ovate, almost acute, with a thin somewhat hyaline margin, and rather thick copiously red-dotted centre, 1-5 mm. long. *Petals* ovate, acute, with a hyaline margin and like the sepals red-dotted in the thicker centre, *Stamens* 6, the anthers rather longer than the filaments, in two series, the outer three being somewhat larger than the inner. *Gynoecium* a very small cone.

Female flowers up to the number of 15 Dn each downwardly directed spike : axia slightly angled and marked with reddish short lines : bracts ovate-acuminate, 1 mm. long, very thin. *Sepals* ovate, obtuse, with a broad hyaline margin and a central part with red **aots, ⅃ mm.** lone. *Petals* a little shorter than the sepals and much thicker. *Staminodes* minute. *Stigmas* as three pairs of curved organs. *Capsules* facing outwards and downwards ; the stipe 3 mm. long, expanding into the wings which are evenly rounded or sometimes with.a small measure of abruptness contracted to the truncated apex, each **wing w**ith a length of 17 mm. by about ID mm. in width. *Seeds* with a reddish chestnut wing all round.

PHILIPPINE ISLANDS, chiefly within the area occupied by *D. luzonensis,* and a variety in TDNKIN.

This species is rather variable and we have recognized four varieties :—

Leaves exactly cordate :	
Leaves rather large, up tD 13 cm. in length	var. vera.
Leaves smaller, only to 8 cm. in length	var. *minor.*
Leaves hastate-cordate, also small, being up tD 7 cm. in length	var. *sagittifolia.*
Leaves cardate-sagittate, similar in size to the last	var. *angulata.*

The first three are found in the Philippine Islands ; the last in Tankin, and unfortunately it is only known from fruiting specimens, SD that perhaps it may prove when better known to deserve a different place. The Philippine specimens suggest that, perhaps by hybridization, *D. pzparoides* approaches *D. luzonensis.* It is as if after *D. luzonensis* had evolved into a rather characteristic species, its isolation in the island of Luzon had been broken into by something able tD cross with it, *D. pep&roidzs* resulting. But *D. pepzroides* also occurs where *D. luzonmsis* has not as yet been found.

EASTERN INDOCHINA. **9 c. Tonkin.** Province of K w a n g - y e n |var. *angulata).* Tankeuin, in hedges, *Balansa* 297 !

MALAYSIA. **11** g. **North Borneo.** P a l a w a n island : Pabellones islands in Taytay bay, in the crevices of limestone cliffs, in thickets, *Merrill* 9441 ! **11 k. Philippine island5.** (Luzon.) N u e v a V i s c a y a province |var. *sagittifolia).* Without precise

locality, *Ramos* 8178 ! Benguet province |var. *vera).* Twin peaks, *Elmer* 6399 ! 64DD ! Mt. Pulog, in the lower pine region at about 1,3DD m., *Merrill* B512 ! Riza1 province. Dueva de Montalban, *Loher* 1882 ! 1891 ! 1892 ! 7DD7 ! 7010 ! Zoehle peak near Montalban, *Loher* 1895 ! |also var. *sagittifolia)* in the Morong district, *Vidal* 1980 ! Bosoboso, *Vidal* 3932 ! (MindDro.) GDID island |var. *minor), Merrill* 11552 ! 11555 !

PLATE 95. Dioscorea peperDides, *Prain and Burkill.* |1) A branch with male flowers from Loher's no. 7010, and |2) a branch with capsules from Loher's no. 7DB7 : |3) a capsule in section : |4) seeds in a capsule : |5) a seed, |5) a leaf and male spike of var. *sagittifolia* from Ramos' no. 8178 : |7) male flowers and leaves of var *minor,* from Merrill's no. 11552 : |8) capsules Df the same variety from Merrill's no. 11555 : |9) a leaf of var. *angulata* from Balansa's specimen. All nat. size.

81. DIDSCDREA LUZONENSIS, Schauer in Nova Acta Nat. Cur., 19, suppl. 1, 1843, p. 444 : Kunth, Enum. plant., 5, 185D, p. 381 : Miquel, Flora Ind. Bat. 3, 1859, p. 571 : Naves, Flor. Filip. Novia. Append., 1BBD, p. 258 : Vidal, Phan. Duming. Philipp., 1885, p. 153, and Rev. Plant. Vase. Filip., 188S. p. 175 : Deron, Cat. plant, herb. Comis. Flor. Forest., 1892, p. 171 : Prain and Burkill in Elmer, Leaft. Philipp. Bot. 5, 1913, p. 1597 and in Journ. As. Soc. Bengal, N. S., 10, 1914, p. 28: Wester in Philipp. Agric. Rev. 9, 1916, p. 175: W. H. Brown, Merrill and Yatea in Philipp. Journ. Sci., D—12, 1917, p. 232 : W. H. Brown in Bull. *22,* Philipp. Bur. Forest., 2. 1921, p. 258 : Merrill, Enum. Philipp. Flowering plants, 1, 1922, p. 218: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 27D.

Dioscorea ? glabra, Naves in Blanco, Flor. Filip. Novis. Append., 188D, p. 258 : Ceron in Dp. cit. p. 171.

" Ganduy," Kamel in herb, propr.

Tubers descending deeply into the earth, up to 1 metre long with a diameter up to 15 mm. |Merrill), esculent, white-fleshed, or sometimes with a pink flush in the superficial tissues, the surface relatively free from rootlets. *Stems* unarmed, glabrous, smooth, hollow when Did and then slightly rough, ridged faintly in the upper parts, green or tinged with dark purple. *Bulbils,* none seen. *Leaves* subopposite or alternate, cordate-hastate or subsagittate, those situated low down on the stems with their greatest breadth across the auricles and twice as long as they are broad, but the leaves associated with the flowers are shorter proportionately : the auricles always somewhat angular, and as they are smaller on the upper than on the lower leaves, the basal sinus becomes less deep and wider until it is quite shallow : the margins between the auricles and the acuminate apex are often notably straight: the blade is up to 15 cm. long by about 12 cm. in width, 5—7-nerved : the nerves of the first pair diverge from the midrib at about 20—4D° and enclose a narrowly obDvate acuminate area : the nerves of the second pair diverge at about 55° or even up tD 90° to become submarginal a little under the acumen : the nerves of the third pair (which are present in the largest leaves) diverge from the midrib at an angle greater than 90°, and forking send one branch tD end submarginally in the lower half of the blade, and the other continues into the auricle where it again branches towards the extreme part of the auricle : in smaller leaves, the nerves of the second pair send a branch into the auricles : the upper surface very dark green, glabrous, with the larger nerves

distinct and the network obscure : the lower surface also glabrous, with the larger nerves prominent, and the network obscure : petiole up to 12 cm. in length, sometimes with two narrow purplish wings towards the base.

Male flowers in spikes which stand erect, 2—4 together in the leaf-axils : the flowers themselves comparatively large, 40-5D in each spike: the axis, with only a very small basal part sterile, in all up to 7 cm. in length, angled, glabrous : bracts lanceolate-ovate, acuminate, about 1-5 mm. long, glabrous, the base of the flower broad enough to press them back against the axis, their apices curving round the flower : bracteoles similar in texture, in shape deltoid-ovate-acuminate : buds somewhat elongated, equally obtuse at both ends. *Sepals* very broadly ovate, concave, thick in the middle, obtuse, 2 mm. long, separating but little when the flower opens, copiously dotted with red-brown. *Petals* narrowly obovate, very thin at the margins, dotted with red-brown in the middle, nearly equalling the sepals. *Stamens* B, with filaments in length equalling their anthers. *Gynoecium* a very small cone.

Female flowers in long solitary decurved spikes : axis up to 22 cm. in length when the fruit is ripe and carrying at flowering as many as 35 flowers, glabrous, angled. *Sepals* thick, triangular-ovate, 1-5 mm. long. *Petals* similar, but smaller. *Staminodes* half as long as the sepals Dr petals. *Stigmas* short, as three pairs of hooks. *Capsules* directed forwards and slightly outwards, truncate above and mucronulate ; the stipe is 5 mm. long and the wings measured along the placenta 2D mm., these are just broader than the Scircular, the width being 12—14 mm., their colour when dry is ashy green. *Seeds* with wings of a smoky chestnut colour all round.

PHILIPPINE ISLANDS, in the islands of Luzon and Palawan.

This species is common in the island. Luzon, where Meyen collected it in 1831, and the type is one of his specimens : both Meyen and Cuming collected in the Philippine Islands from 1835 to 1839, and his contemporary, the missionary Gallery, who was in the district of Tayabas, Luzon, wrote in such terms that Dr. Merrill thinks *D. divaricata* was before him. Seeing how abundant it is in Luzon, it is interesting that it is almost confined to the island.

It flowers in September, or possibly earlier, and fruits in October.

Loher and Tamesis independently state that the Tagalog tribes eat the tubers : Merritt and Darling state that it is eaten in the province of Ilocos Norte, which is inhabited by the Ilocanos. The usual Tagalog name is "pakit" or "pakwit." An Ilocano name is "kamángeg." A second Ilocano name is "aribubu." Two other Tagalog names are "mayatbang," and "ubag."

MALAYSIA. **11 g- North Borneo.** Palawan island. Puerto Princesa, *Elmer* 13038! **11k. Philippine islands.** (Luzon.) Ilocos Norte province. Pasughun, on a limestone hillside at 1DD m., *Merritt and Darling* 5525 ! Nueva Vizcaya province, without precise locality, *Me Gregor* 14397 ! Bulucan province. Angat, *Ramos,* 21752 ! Bataan province. Dorregidor island, *Curran* 13218. Riza1 province, without precise locality *Ramos* 1D7D ! Tabacuhan Malaqui, *Loher* 189B ! Montalban, *Loher* 1891 ! 1892 ! Cerra Bigaa near Montalban, *Loher* 1B90 ! Antipolo, *Merrill* ! Zoehle peak, *Loher* 1895 ! Tl iala *Meven* ! Laguna province. Los Banes, *Hoilier* ! *Copeland* 2DB8 ! *Baker* 'll\\ *Raimundo* 348 ! 349 ! Mt. Maquiling, *Elmer* 18290 ! 1845B ! *Uopeland* 2D71 ! PinagtDlusan near LDS BanDS, at 5D m., *Tamesis* 1333B ! Perapiraro on the Taal island, *W H. Brown, Merrill and Yates.* Dalawang, *Calleŕy* 24 ! *Me Gregor* 12449 ! common, Batangas province, without precise locality, *Lyon* ! Santo Tomas, *Ramos* 13734! Tabayas province. Tayabas, *Vuming* 779! and without locality, *Cuming* 189 teste Kunth.

PLATE 95. Dioscorea luzonensis, *Schauer*. |1) A branch with male flowers from an unlocalized specimen collected by Ahern's collector, nat. size : |2) a male flower showing how little it expands, X 8 : |3) the flower and the axis of the spike, in section : |4) a sepal; |5) a petal; |B) a stamen, all X 8 : figs. 2—5 from a living plant grown in the Botanic Gardens, Singapore.

PLATE 97. |1) A branch with capsules from Hallier's LDS BanDS specimen : |2) a capsule in section : |3) seeds : |4) a leaf from near the base of the stem of a plant in cultivation in the Botanic Gardens. Singapore, all these, nat. size: |5) a tuber reduced to one-sixth, from the plant which supplied the figure no. 4.

Group of D. tricolor |species 82). A species of south-western China,, not yet adequately known, with male flowers, in appearance very like those of *D. caysnensis,* Lam., arranged on rather long axillary spikes.

82. DIDSCDREA BIDDLDR, Prain and Burkill in Journ. As. SDC. Bengal, N. S. 4, 19D8, p. 449 and 13, 1914, p. 29 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 275.

Underground parts unknown. *Stem* rather slender, glabrous, unarmed, with four very narrow wings, green and later tinted with red. *Bulbils,* none seen. *Leaves,* at least in the upper parts of the stems, opposite, subcordate, shortly acuminate, minutely mucronulate at the apex, with a widely open sinus at the base, mostly 5 cm. long by 5 cm. in width, but some up to 6 cm. long by 7 cm. in width, 9-nerved : the nerves of the first pair enclose a broadly oblanceolate area : the nerves of the second pair diverge from the midrib at an angle of 8D° to curve to the margin close under the acumination : the nerves of the third pair diverge at 9D° and more, to curve into the margin and end about the mid-length of the blade : the nerves Df the fourth pair do not pass out of the lobes where they are submarginal : secondary nerves almost straight : the upper surface entirely glabrous, with faint short brown hues, and with the primary and secondary nerves distinct: the lower surface lighter in colour than the upper, with the primary nerves prominent : the margin is not hyaline : petiole glabrous, up to 5 cm. long.

Male flowers in simple spikes which arise 2—3 together in the axils of the leaves, 5D or more on each spike : axis not rigid, sterile at the very base, approximately triangular in section at any point, glabrous : bracts slightly reflexed, lanceolate, acute, 1—1-5 mm. long : bracteoles very small, Dvate. *Sepals* gibbous at the base and there pale in colour, orbicular-ovate, obtuse, with brown dots, almost 2 mm. long. *Petals* subclavate, scarcely 1 mm. long. *Stamens* B, equal, 0-5 mm. long, the filaments about as long as the anthers.

Female flowers in solitary decurved axillary spikes, ID—12 in each : bracts ovate-lanceolate. *Sepals* Dvate, obtuse. Petofa smaller, similar in shape, thick. *Staminodes* small. *Stigmas* as three pairs of slightly curved hooks. *Capsules* perhaps rather more turgid than is usual in the genus, rather acute at either end ; wings exactly semi-elliptic, rather glaucous, 22—25 mm. in length, 8—9 mm. in width.

SOUTH-WESTERN CHINA, in the province of Yun-nan.

The two colours Df green in the inflorescences, which caused us tD give it the name *bicolor,* are due to a contrast betwesn the bracts and thB perianth. The same contrast is seen in the African *D. cayenensis,* Lam., but there the light colour is not BD much on the bracts as on the lower parts of the sepals.

Flowering occurs in July. Fruit has been collected but once. The narrowness of the capsules makes it conspicuous among the species of the section *Enwntiophyllum.*

All the specimens which we have seen are conserved in the Museum National i'Histoire Naturelle, Paris.

SOUTH-WEST CHINA. **8 b. Province of Yun-nan.** Above Ta-pin-tze near Mao-kou-tchong, at B,5DD ft., in thickets, *Delavay* 2397 ! Dhe-tong near Ta-pin-tze, *Delavay* 1829 ! Djou-kou-la, near Pin-tchDuan, *Dudoux* 182 ! Hay-y near My-le, *P. Ngueou* in herb. Ducloux4023 !

PLATE 98. Dioscorea bicolor, *Prain and Burkill.* (1) A branch with male flowers from Delavay's no. 1829, nat. size : (2) male flowers, XlD : (3) the same with two sepala removed, XlD: |4) a sepal, X12 : |5) stamens and two petals, X 12 : |3) stamens, X 12 : |7) a branch with capsules from Delavay's no. 2397, nat. size : |8) female flowers, X6: and |9) the same dissected, Xl2.

Group of D. aspersa (species 83). An imperfectly known species of south-western China, with male flowering spikes from the leaf-axils.

83. DIDSDOREA ASPERSA, Prain and Burkill in Journ. As. Soc. Bengal, N. S. 4, 19DB, p. 447, and ID, 1914, p. 29: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 275.

Underground parts unknown. *Stems* glabrous, obscurely triangular in section, unarmed at least in the upper parts, of a purplish fuscous colour when dry. *Bulbils,* none seen. *Leaves* alternate, membranous, broadly cordate, acuminate and at the very apex mucrDnulate, the sinus very broad and open, in length up to 10 cm., in width up to 11 cm., 9-nerved : the nerves of the first pair enclose a narrowly elliptic-Dvate area : the nerves of the second pair diverge from the midrib at an angle of about 60° to approach the margin just above the mid-length of the blade : the nerves of the third pair diverge from the midrib at an angle greater than a right angle and curve to the margin : the nerves of the fourth pair are submarginal in the lobes : the secondary nerves indistinctly cross the interspaces : the upper surface glabrous, smooth, splashed with small black markings, the primary nerves prominent, the rest obscure : the lower surface similar, with the primary nerves prominent: the margin not brown-edged : petiole glabrous, up to 7 cm. long.

Male flowers in spikes which arise 2—3 together in the axils of leaves : axis of the spike about 5 cm. long, somewhat angled, carrying 20—3D flowers about 1 — 2 mm. apart : buds ellipsoid, facing a little forward : bracts short, embracing the base of the bud, ovate, acuminate, scarcely 1 mm. long : bracteoles broader and shorter. *Sepals* ovate, obtuse, thick. *Petals* a little smaller, and but little thickened. *Stamens* 5, equal, much shorter than the perianth, the anthers and their filaments equally long. *Gynoecium* reduced to three minute points.

Female plant unknown.

SDUTH-WESTERN CHINA, in the province of Yun-nan and perhaps also in the province of Kwei-chow.

TD the Kwei-chow specimen the name "huang t'sao pu" is attached.

The foliage of *D. aspersa* so much suggests that Df *D. Hemshyi* that as the two grow in the same country, sterile plants of the Dne might be mistaken for the other ; but when in flower the difference becomes obvious. The female plant is unknown.

SOUTH-WEST CHINA. **B b. Province** of **Y u n n a n .** On the Great Black Mountain, over Meng-tze at 7,000—8,000 ft., *Hancock* 278 ! **B C. Province Of H w e i - ch D W ,** without exact locality and a little doubtful, *Cavahrie* !

PLATE 99. Dioscorea aspsrsa, *Prain and Burkill.* |1) A branch with male flowers, nat. size : |2) a portion of a leaf showing the black mottlings : (3) fully grown buds, X 12 : |4) a flower, forced open : (5) the stamens and the gynoecium of a male flower. All from Hancock's specimen.

Group of D. spicata |species 84—8hl). Speuies of southern India, with long male flower-spikes which arise in the axils of the leaves, or more rarely in the axils of bracts near the branch-ends, and are not collected into special leafless inflorescences. In *D. spicata* the breadth of the wings of the capsule is great and the leaves are harsh : in other allied species the breadth of the wings is relatively less and the leaves not so harsh, which in our view, may possibly be due to hybridization ; for we suspect that Ceylon and some parts of southern India contain a hybrid-swarm between *D. spicata* and *D. oppositifolia,* and this accounts for the difficulty botanists have experienced in arranging their material *see* remarks under *D. intermedia). D. spicata* is unique in the section *Enantiophyllum* in the production, upon vigorous spikes, of more flowers than one at a point.

84. DIDSDDREA WIGHTII, Hooker fil., Flora Brit. Ind. 5, 1892, p. 291: Prain and Burkill in Journ. As. Soc. Bengal, N. S. 10, 1914, p. 29 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 28 D : Fischer in Gamble, Flora Madras Presidency, 1928, p. 1512.

Underground parts unknown. *Stems* glabrous, straw-coloured, very faintly or not at all ridged, unarmed at least in the upper parts and probably throughout. *Bulbils,* none seen. *Leaves* opposite or some alternate, ovate-cordate, acuminate, with the basal lobes sometimes very slightly hastate, the sinus wide, up to 10 cm. long by 5 cm. in width, 7-nerved : the nerves of the first pair diverge from the midrib at an angle of 35° to enclose a narrowly elliptic-acuminate area : the nerves of the second pair diverge from the midrib at an angle of about 70° to approach the margin gradually and to become submarginal near the acumen : the nerves of the third pair diverge from the midrib at an angle greater than a right angle and for the chief part of their course are submarginal, giving off a branch near the base into the auricle : the secondary nerves are rather few and just a little more conspicuous than the network in that they can be seen to cross the interspaces with some elbows : margin slightly strengthened : the upper surface glabrous, with the primary nerves just prominent and the others visible : the lower surface glabrous, with the primary nerves prominent and the others distinct: petiole up to 5 cm. long.

Male flowers in long slender spikes which arise among the leaves, 1 — 3 together : axis up to 7 cm. long, with only 12—20 flowers, very slender, slightly ridged : bracts ovate and very acuminate, thin and rather transparent, 1 -5 mm. long : bracteoles similar, smaller. *Sepals* ovate, obtuse, reddish brown, 2 mm. long. *Petals* ovate, acute, reddish brown, equalling the sepals. *Stamens* 6, with anthers rather more than twice as long as broad, on equally long filaments. *Gynoecium* a small point.

Female plant unknown.

SOUTHERN INDIA.

This species is imperfectly known. It has been collected once only and then with male flowers. Wight who collected it, left no notes regarding it, and did not preserve the lower parts of the plant. Its rather long spikes, which are axillary, suggest an affinity to *D. spicata ;* but the cordate outline of the leaves sharply distinguishes it. After long deliberation we have decided that the best position for it in a serial classification is close tD *D. spicata.*

INDIA. **4 b. CDromandelia.** T i n n e v e l l y district. Courtallam near the borders of Travancore state, *Wight* 2827 !

PLATE IDD. DiDSCorea Wightii, *Hooker fil.* |1) A branch with male flowers, nat. size: (2) a flower, X8: |3) the same dissected, XlD: |4) stamens, X15: |5) the gynoecium of the male flower, X15: |B) a bract and a bracteole, X 8.

85. DIOSDDREA TBJMENII, Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 29: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 287: Alston in Trim en, Handb. Flora Ceylon 5, 1931, p. 287.

Dioscorea spicata, var. *b.,* Thwaites, Enum. plant. Zeylan., 18B4, p. 325 : Hooker fil. in Trimen, Handb. Flora Ceylon, 4, 1898, p. 278 as regards the two specimens quoted below.

Underground parts unknown. *Stem* wiry, glabrous. *Bulbils,* none seen. *Leaves* alternate or sometimes opposite, long cordate or hastate-cordate and long acuminate, drying brown in colour, auricles rounded, sinus wide, the whole blade up to 15 cm. in length by 4-5 cm. in width, 5—7-nerved : the nerves of the first pair diverge from the midrib at an angle of about 30° to enclose an oblanceolate area : the nerves Df the second pair diverge from the midrib at an angle of about *8D*[3] to curve towards the margin and end submarginally in the upper half Df the length Df the blade : the nerves Df the third pair run near the margins of the lobes : the upper surface glabrous, with the larger nerves just prominent : the lower surface paler, glabrous also, the larger nerves prominent and the others distinct : petiole upwards of 6 cm. long.

Male flowers well-spaced, in solitary axillary spikes which are sometimes very much elongated, even to 15 cm. in length : axis angled, with about 2D flowers : bracts very small, ovate, acute, D-5 mm. long: bracteoles a little smaller and more triangular: buds globose. *Sepals* ovate, very obtuse, 1-25 mm. long. *Petals* very like the sepals, but smaller. *Stamens* six, about 1 mm. long, the filaments twice as long as the anthers. *Gynoecium* a small wart.

Female flowers in decurved spikes, apparently exactly like those of *D. spicata. Capsules* with a stipe 3 mm. long, expanding upwards to a diameter of 3 mm. at the point where the wings curve from it to an angle of about 95° tD curve again in the opposite direction quite evenly until they reach the slightly retuse apex of the capsule, their greatest width about 18 mm. and their length along the placenta about 18 mm. : their colour tawny brown. *Seeds* with a dull chestnut wing all round, more or less conform to the loculus.

DEYLDN.

Trimen left in the Herbarium of the Royal Botanic Gardens, Ceylon, a note expressing an opinion that certain specimens which Thwaites had collected and assigned to *D. spicata* should not be retained in it. With

this •pinion, which Sir Joseph Hooker had already quoted, we agreed and therefore described them in 1914 as *D. Trimenii* in Qur Synopsis of the genus. Subsequently a specimen—var. *tener.* with leaves of a thin texture—came into our hands, and one further example. The scantiness of this material does not bear Dut Dr. R. Knuth'a remark that *D. Trimenii* is a very common plant of the Central Province of Ceylon ; and the probablity is that he was thinking of the next species when he made it.

Thwaites obtained *D. Trimenii* in flower in the Central Province of Ceylon in July and October. Trimen did so in the Southern Province in September.

INDIA. **4 a. Malabaria.** Southern Deylon, without precise locality, *Thwaites* 2872 part! (Central province.) Medamahanuwara, *Thwaites* ! Hanguranketa, *Thwaites* ! Ambagamowa, *Thwaites* 3119 ! |Southern province.) Rasagala near Balangoda, *Trimen*! |Uva province or edge of Eastern province.) Kuruminiya, Handura or Uma Dya |var. *tener), Silva,* 270 !

PLATE 1D1. DioscoTea Trimenii, *Prain and Burkill.* |1) A branch with capsules from one of Thwaites' specimens, nat. size : |2) two seeds not quite mature, in position, nat. size, from the same : |3) a branch with male flowers from part of Thwaites' no. 2872, nat. size : |4) the largest leaf from it, nat. size : |5) part of a male spike with buds from Thwaites' Rasagala specimen, XlD: |B) an open flower of the same, XlD.

BB. DIDSCDREA SPICATA, Roth, Nov. Spec. Plant., 1821, p. 371 : Hunth Enum. plant., 5, 1850, p. 399 : Thwaites, Enum. plant. Zeylan, 1854 p. 325: Hooker fil., Flora Brit. Ind. 5, 1892, p. 291, and in Trimen' Handb. Flora Deylon, 4, 1898, p. 277 : Prain and Burkill in Journ' As. Soc. Bengal, N. S. 10, 1914, p. 29: Ramaswami in R Bcords Bot. Survey Ind., 5, 1914, p. 153: R. Knuth in Engl. Pflanzenreich, iv-43 1924, p. 279 : Fischer in Gamble, Flora Presidency Madras 1928 p 1512 : Alston in Ann. Roy. Bot. Gard. Peradeniya 11, 1929, p. 2D9, and in Trimen, Handb. Flora Ceylon, B, 1931, p. 287, in part.

Dioscorea intermedia, Hooker fil. in Trimen, Handb. Flora Ceylon, 4, 1898 p. 277 as regards the specimens from Kukul Korale and Medamahanuwara' and also quotations from Trimen's notes.

Dioszorea t Prainiana, R. Knuth in Engl. Pflanzanreich, 1924 p. 286 as regards Wight's no. 2825 only.

Underground parts unknown, but apparently edible. *Stem* wiry, glabrous somewhat prickly, dull green with purplish mottlings. *Bulbils* not observed. *Leaves* alternate glabrous, coriaceous, elliptic-ovate to elliptic-obovate, up to 12 cm. long by 5 cm in width in the variety *anamallayana,* but only 7 cm. long by 3-5 cm. in width in the variety *parvifolia,* 5-7-nerved : the nerves of the first pair diverge from the midrib at an angle of about 20° and enclose a broadly oblanceolate area : the nerves of the secon- pair re conspicuously more slender, they diverge from the midrib at an angle of about 4I) & d gradually approach the margin through the length of the blade : the nerves of the third Tir when present are very slender and submarginal through their whole cnnrap . ti. murse . tne secondary nerves cross the interspaces obliquely and are only a little more conspicuous than the net- work : the margin of the blade is strengthened : the upper surface dark green with The nervation slightly promiment: the lower surface glabrous, with the nerves prominent and the network just prominent : petiole up to 3 cm. long.

Male flowers solitary or sometimes two together, rarely more |four have been seen), in spikes which are axillary among the leaves and from the axils of bracts about the stem-endings, DT rarely on short axillary branches which are at the most only just longer than the leaves subtending them, in one case 27 cm. long with four branches towards the base, fertile below them and the flowers 2^ together— a curious state unique in the section *Enantiophyllum :* axis of the spike usually about 5 cm. long, with about 25 flowers, angled, glabrous • bracts ovate, acuminate, thin, with a few red-brown dots, scarcely 1 mm. long -'bracteole' similar in texture, but rather broader than long : buds subglobose. *Sepals* broadly ovate rounded, obtuse or subacute above, 1 mm. long. *Petals* similar except that they are narrower and rounded above. *Stamens* 6, with roundish anthers. *Gynoecium* a small wart.

Female flowers in iecurved spikes to the number of about 15 : axis with much raised angles : bracts ovate-deltoid, 1 mm. long. *Sepals* subovate from a broad base, subacute 1 mm. long. *Petals* shorter and more obtuse, or almost rounded. *Staminodes* minute' *Capsules* much larger than in the closely allied species, until ripe of a deep polished eree when mature with a stipe 5 mm. long broadening to 4 mm. at the point where the winds' spring from it rather abruptly at an angle of 90° to curve round nearly evenly to a slightly retuse apex, their maximum width 40 mm. and their length alone the HIRPPT,^ 9K n J ..I_ T_ J i • 11 i , s placenta ^omm. *Seeds* with a broad smoky wing all round, more or less conform to the loculus'

CEYLDN and southern INDIA, in the hills.

D. spicata is the most outstanding species of a small group of allies found in the n jVhh v. Tropical Rain-forests of Ceylon and southern India. It is montane, though some of ThwTtes' 1 V^ are at low elevations. It seems to be particularly common in the Central Province of Ceylon ^ " "ca_ties

Benjamin Hayne collected the type and Roth described it, but did not give the exact locality *Th ;* having collected it, fresly distributed it under hia herbarium number 2871 and al,n in * J Waltes 2872. Wight had collected it also ; and from the Royal Botanic Gardens KBW *hi* par. under his " " ^ ed under the number 2825. Trimen collected it in Lylon, but ^ ^ ^ l ^ T t " " ^ *intermedia* quence some confusion in the notes left by him and used by Sir Joseph Hooker in the *Ceylon.*

We distinguish two varieties, following Thwaites :—

Leaves relatively small, about 5 cm. long or longer, to 1D cm . . . . . " • • TaT- *ptmrifolia.*

.Leaves relatively krgB, in length from 10 cm. up to *2* D cm• • • Tar. *anamallayana.*

The first was takBn by Thwaites to be the type but it *i* T,™* M +U * -*i* based the species. ^ " ProbablB *hat lt Was UP™ *» »«md that Roth

D.spKata flowurs in southern India in September and fniit<i in T> *U* it flowers in September likewise, but not *J L* ^ ^ ^ ™ * " - ^^ ^^ Evince of Ceybn the South-East of the island. ^ ' ^W *hmn CoUs^d* ako * March, towards

INDIA. 4 a. Malabaria. Cochin distrint P=T U I \m ~ MntD. *op^itifolia), Meetoli* 12374! ' i r ^ ^ " ^ at 3-°»» *» <WD ft. *Uyana).* Sonthanpara at 5,00D ft., *MetbM* 132^ I. M 1° ° *I'* state |T*r- *"oMi- Ckbu.^. at 4,D»0 ft., *Ballon* 1397 ! South e r n cTvT' 7^ W ' unless »thBr^e stated). Without boality, |var. *an_amaUayanu)!w2kl llZ'^f,^ parvifdia), Walker* 1812 ! |CBntral Province) It.j,, J,. 233 • Tar- iva, *anamallayana), TL^S 2vr:L^:r^;^* ! Hanguranketa *Thwartes* 2872 (part)' (Sabaragamuwa or Saffragam pr0; JB| \ ^ 371 ! W 1 ^ ' (var. *anamallayana), Thwaites* 2871! Bulutot, A|Z 4 2 3^ ^ 7 ^ ^ "^ Galle, *Thwaites* ! Matara, *Thwaites* 2871 ! (Uva provnCB) M (S.oUt\ern Prince.)

Tinnevelly district. Kannikatti, *Barber* 387! 475! Between Naterikal and Sengalteri at 3,5DD ft. |var. *parvifolia), Hooper and Bamaswami* 38544! Madura, district. Palni hills, *Beddome* 774D ! Doimbatore district. Anamallai forests, *Herb. Wight* 2825 !

PLATE 1D2. Dioscorea spicata, *Both.* |1) A branch of var. *parvifolia* with maleflowers from Thwaites' no. 2871, nat. size : |2) a male flower, X ID : |3) the same dissected, X ID: |4) stamens, X 25: |5) the gynoecium Df the male: |B) a bract and bracteole, X 10: |7) part of a male spike showing a younger second flower arisen at the base of another, X ID: (8) A branch with capsules of var. *anamallayana* from Meebold's no. 13256, nat. size.

Group of D. japonica |speciBS 87—92). Species of temperate and sub-tropical Asia, with tht) male flowor-spikes in the leaf-axils, herbaceous leaf-blades and rather small capsules. ThB leaf-blades tend to be markedly auriculate, but in some speciBS are more or less long-cordate. The tuber is usually solitary. Just outside this group is *D. Benthamii.*

B7. DIDSDDREA DORYPHDRA, Hance in Ann. Sci. Nat., ser. 5, 5, 18BB, p. 244 : Henry in Trans. As. Soc. Japan, 24, 1895, suppl. p. 95 : D. H. Wright in Journ. Linn. Soc. Land., Bot. 35, 19D3, p. 91, misprinted *doryophora :* Hayata in Journ. Doll. Sci. Univ. Tokyo, 22, 19DB, p. 433, misprinted likewise : Kawakami, List plants Formosa, 191D, p. 122 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 28, misprinted again : Hayata, Ic. plant. Formos., ID, 1921, p. 35 with a figure on p. 37 : R. Knuthin Engl. Pflanzenreich, iv-43, 1924, p. 251 : Syun'iti Sasaki, List plants Formosa, 1928, p. 114.

Dioscorea Swinhoei, Rolfe in Journ. Bot. 2D, 1882, p. 359 : Hayata in Journ. Doll. Sci. Imp. Univ. Tokyo, *22,* 19D6, p. 433.

Dioscorea Bosthornii, Diels in Engl. Bot. Jahrb. 29, 19DD, p. 261 : Pampanini in NUDV. Griorn. Bot. Ital. N. S. 17, 191D, p. 243 and Piante vase. race, dal Rev. P. D. Silvestri nell Hupeh, 1911, p. 25.

Underground parts unknown. *Stems* thin, conspicuously angled, almost sufficiently to be called winged. *Bulbils* produced, those seen like small grey-brown peas with a, slightly uneven surface. *Leaves* alternate, rather firm in texture, broadly lanceolate above their large oblique auricles, at the apex narrowed abruptly to a mucro, up to 4 cm. long by 3-5 cm. in width across the auricles, but only 1-5 cm. wide beyond the auricles, 7-nerved : the nerves of the first pair enclose an Dblanceolate area : the nerves of the second pair diverge from the midrib at an angle of about 75° and bend round abruptly to the lateral sinus formed by the narrowing of the blade above the auricles : the nerves Df the third pair diverge from the midrib at 9D^{D} and curve in the auricles to disappear where the second pair come to the margin : secondary nerves not distinct in the network : the upper surface of the blade smooth, with the primary nerves just prominent : the lower surface with the primary nerves and also the larger of the secondary nerves prominent : petiole up to 2 cm. long.

Maleflowers in rather rigid spikes which arise 1 — 3 together in leaf-axils, about 25 in each spike : axis up to 5 cm. long, approximately triangular in section at any point, the angles raised into low wings, twisted somewhat, dotted with brown : buds subconical : bracts strongly reflexed against the axis by the pressure of the base of the flower,

deltoid-acuminate, about D -75 mm. long : bracteoles similar but smaller. *Sepals* between circular and ovate, concave, about 1 mm. long, rather thick. *Petals* broadly lanceolate or ovate, thick, a little shorter than the sepals. *Stamens* 6, in two series, the anthers about twice as long as the filaments which measure in length only 0 -25 mm., *Gynoecium* a small cone with three minute apices.

Female flowers in rather stiff decurved spikes, about 8 in each : axis about 2 cm. long, angled : bracts ovate, acuminate : bracteoles deltoid, sub-acuminate. *Sepals* thick, 0 -75 mm., long. *Petals* a little thinner and narrower than the sepals. *Staminodes* minute. *Stigmas* as three pairs of small hooks. *Capsules* with a short stipe 2—3 mm. long, from which the wings arise almost at a right angle, they are rather broader than semicirDular, at the most 14 mm. long along the placenta by 12 mm. in width, and usually smaller. *Seeds* winged all round.

CHINA, in the warmer parts, towards the south-east.

A very fair idea of the appearancB of this species is given by saying that it looks like an undernourished state of *D. upposita* : but though its affinity with *D. opposite/,* is apparent, it scarcely seems ancestral.

Kawakami, whosB specimen may be wrongly named, gives it the Japanese name "takasago tokorD[17] : thB significance of thLs association of the personal name Takasago with this particular yam is not apparent.

Silvestri's localities arB here quoted from Pampanini. Re-examination Df thb specimens is recommended, for his record of the occurrence Df this rather markedly southern species in a northern province Df China at the' altitude of 2,D5D metres gives rise to doubt.

CATHAY. **7d. Mid China.** H u - p e h province. Kao-kien-scian at SOD m., *Silvestri* 244. On Tan scian at 2,D50 m., *Silvestri* 245. K i a n g - s i province. Kiu-kiang (somewhat doubtful), *Herb. Oxon.* !

SDUTH-WEST CHINA. **8 a. Province of S z e- c h u a n** . Nan-chuan, *Rosthorn* 237B, 2377. **B C. Province Of K W e i - c h D W** . Near Kwei-yang on the Hou-lou-chan, along the banks of streams, *Bodinier* 1646 !

EASTERN INDD-CHINA. **9 a. Formosa.** Without precise locality, *Swinhoe* 33 ! Nanto, Takaw and Subonsha, teste Hayata. Ke-lung, at Sharyoto, *Nakasawa.* Ta-kaw, *Hznry* 1922 ! Tai-wan, *Playfair* ! Ban-kin-sing, *Henry* 878 ! 1672 ! Ko-shun (somewhat doubtful), *Yanagawa* 8 J **9 b. the MwangS.** K w a n g - t u n g province. Loh-fau mountains, at 12DDm., *Merrill* 11 DBS !

PLATE 1D3, left side. Dioscorea doryphora, *Hance.* (1) A branch with male flowers from Henry's no. 1922, f nat. size : |2) a male flower opening, X B : (3) the samB flattened : |4) a petal, X 12 : (5) the flower laid open : (6) a branch with female flowers from Playfair's specimen, f nat. size: (7) a female flower, XB: |8) the same with one side removed, XlO : |9) a branch with capsules from Henry's no. 1672 : and |1D) a seed, \ nat. size.

88. DIOSCDREA PDTANINI, Prain and Burkill in Kew Bull., 1933, p. 243.

Undzrground parts unknown. *Stems* slender, the lower parts, which have not been seen, probably never attaining the thickness found in the stems of *D. opposita,* the upper with several longitudinal rounded ridges. *Bulbils,* none seen. *Leaves* very thin, pāiřed

or rarely three at a node, linear-lanceolate above the very conspicuous lateral auricles which project at a right angle from the lowest part of the blade, in total length up to 7 Dm. with a width above the auricles Df 1 cm., but a width across the auricles of 4 cm., 7-nerved : the nerves of the first pair enclose a narrowly linear-lanceolate area, running at 2—1 mm. within the margin above the auricles : the nerves of the second pair diverge from the midrib at about 80° to curve to the upper margin of the auricles where they end: the nerves of the third pair diverge from the midrib at about 95° to branch pedately along the lower side of the auricles : the secondary nerves are scarcely distinguishable from the network : the sinus at the base of the blade is evenly rounded but very wide open : petiole about half as long as the blade, slender : upper surface glabrous, with the primary nerves distinct : the lower surface glabrous, with the primary nerves just prominent, the rest inconspicuous : petiole about half as long as the blade, slender.

Male flowers in axillary spikes which are 2—4 together at a node : axis up to 3 cm. long with about 20 flowers, very slender and slightly flexed in a zigzag manner at each flowsr, glabrous, very narrowly winged under each bract : bracts ovate-lanceolate from a broad base, scariDUS, not repressed against the axis by the base of the flower : bracteole triangularly Dvate, similarly scarious. *Sepals* shortly ovate from a broad base, 1 mm. long or a little longer. *Petals* shorter. *Stamens* Ei, shorter than the petals.

Female flowers in decurved axillary spikes : bracts ovate, acuminate, 1 mm. long. *Sepals* ovate, obtuse, less than 1 mm. long. *Petals* smaller. *Capsules* light buff-coloured, with a stipe 2 mm. long expanding to 1-5 mm. at the point where the wings arise : the wings spring out at rather less than 9D^{D} to curve evenly to a slightly retuse apex, being at their maximum width IB mm. wide and measuring along the placenta 15—15 mm. *Seeds* with a light red-brown wing all round, more or less conform to the IDCUIUS.

CHINA, towards the south-west.

Thia apeciea may be regarded as a development of thB group Df *D. opposita,* Extreme in BccBntricity of leaf-outline : in fact thB bladB is almost 3-partitB, and, as in lobed leaves of thB section *Stenophora* the second pair uf nervBS innervate thB lateral lobBS, so hBi'B the auricles. ThB blade of thB baf is very thin, whersas thB bladB uf thB *iB^iofD. doryphora,* is firm. The auricles are mora lateral. In neither of these two is thBre tha lushnesa of *D. opposita.* Because it has little or no dBVBlopniBnt of the auricles, *D. japonica* is Dn thB other side of *D. opposita.* With these indications it is Basy to rBCDgnizB typical specimens of thB species under discussion among its closest allies.

Potanin first obtained it in 1893, and SBnt it into cultivation in thB Imperial Botanic GardBn in Petrograd. Since thBnothsrs have collected it. It is to be regretted that no record was kept of the appsarance Df the tubers when that was so easily possible.

Before enumerating the specimens, we wish to state that twD others |Sze-chuan, Ping-shan hsein, between Ting-chan-wun and Tau-ya-ho, at lDDO m., *F. T. Wang* 235B1 ! and Western Hu-peh, without morB precise locality, *Wilson* 2922 in part!) connect this species with *D. apposita.*

CATHAY. **7 d. Mid-China.** Province of H o - n a n. In the hsien of Teng-feng, at B7Dm., *Schindler* 143 ! Province of H u - p e h . Nan-t[D and the mountains to the northward, *Henry* 2D23 !

SOUTH-WEST CHINA. **B a. Province of S z e - c h u a n .** Near Mien-chou, *Potanin* ! and Chao-hua-hien, *Potanin* ! D-mei shan, *Potanin* ! and cultivated from tubers collected by *Potanin* which he sent to the Imperial Botanic Garden, Petrograd ! Kuan-wu - shan in the Kaing-you hsien at 13[)D m., *F. T. Wang* 22242 ! **8 b. Province DfYun-nan.** MD-SD-yn, *Delavay I*

PLATE 1D3, right side. DioscDrea Potanini, *Prain and Burkill.* |1) A branch with male flowers from a specimen collected by Potanin, preserved at Petrograd, f nat. size : |2) a portion of the spike of the same showing the flexed axis, X 6 : |3) a flower forced Dpen, X ti : (4) a portion of a female plant with flowers, collected by Potanin and preserved in the same collection, f nat. size: |5) a female flower, X B : |5) a branch with capsules from a plant collected by Potanin, f nat. size : |7) a seed, -| nat. size : and |8) the same, enlarged two diameters.

89. DIDSDDREA DPPDSITA, Thunberg, Flora Japonica, 1784, p. 151 : von Siebold in Verhandl. Bat. GenoDtsch. 12, 1830, p. 14 : J. Hoffmann in ie Vriese, Tuinbouw-flora, 1, 1855, p. 295 : Prain and Burkill in Kew Bull., 1919, p. 349 : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 822.

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Dioscorza Batatas, Decaisne in More des Serres, ser. 1, 10, 1854, p. 7 with plates 971, 972 bis and 976 bis : and (reprinted almost entirely) in Rev. Hortic, ser. 4, 3, 1854, pp. 243 and 443 : Duchartre in Bull. Soc. Bot. France, 1, 1854, p. 199 : Pépin in Mém. Soc. Imp. et Centr. d'Agric, 1854, reprint p. 1, footnote : L. de Vilmorin in Gard. Dhron., 1854, p. 820, and Almanach du bon Jardinier, 1854, p. 22 : Floricultural Cabinet, 1855, p. 69 with a plate : Neuberts Deutsch. Gart. Mag., 8, 1855, p. 177 : Otto and Dietrich in Allgem. Gartenzeit., 22, Illustr. Beih., 2, 1855: Rep. Commiss. Patents, Dep. Agric. U. S. A. for 1854, 1855, p. 169 : Decaisne in RBT. Hortic, ser. 4, 4, 1855, p. 69 with a figure ; and in Domptes-rendus de 1' Acad. Sci. Paris, 1855, p. 77 : Naudin in Rev. Hortic, ser. 4, 5, 1855, p. 442: de Montigny in Bull. Soc. d'Acclimatation, 2, 1855, p. 271 : Fremy in Comptes-rendus de 1'Acad. Sci. Paris, 1855, p. 128: Fortune in Gard. Chron., 1855, p. 318 : Delessert in Bull. Soc. Bot. France, 2, 1855, p. 741 : Decaisne in Bull. Soc. Bot. France, 2, 1855, p. 765 : J. Hoffmann in de Vriese, Tuinbouw-flora, 1, 1855, p. 289 : Germain de Saint-Pierre in Bull. SDC. Bot. France, 3, 185B, p. 103 : Schwab in Bull. Soc. Bot. France, 3, 1856, p. 404 : Fortune in Journ. Agric.-Hort. Soc. Ind. 9, 185B, p. clix : Naudin in Flore des Serres, ser. 2, 2, 1857, p. *22 :* Duchartre in Journ. SDC. d'Hort. Paris, 4, 1858, p. 465 with a plate : Hardy in Bull. SDC. d'Acclimatation, 1853, p. 54B : Bentham, Flora Hongkong., 1861, p. 367 : Tournier in Bull. Congr. Internat. Hort. Bruxelles, 18B4, p. 213 : Reveil, Regne veget., 12, 1870, plate 5, and 14, 1870, plate 42 : Bretschneider, Dn the study and value of Chinese botanical works, 1870, pp. 12 and 44, with a plate: Vavin in Bull. Soc. d'Acclimatation, ser, 2, 9, 1872, p. 595 : Royer in Journ. Soc. centr. d'Hort. France, ser. 2, 7, 1873, p. 735 : Tougard in Comptes-rendus Assoc. franc, pour l'Avancem. Sciences, 187B, p. 2D1 : Lecler in Bull. SDD. d'Acclimatation, ser. 3, 5, 1878, p. 188 : W. G. in The Garden, 21, 1882, p. 97 : Vilmorin-Andrieux et Die, Les plantes potageres, 1883, p. 283 : Nicholson, Diet. Gardening, 1, 18B4, p. 478 : Chappellier in Bull. Soc. d'Acclimatation, ser. 4, 5, 1888, p. 371 : Popoff in Neuberts Deutsch. Gart. Mag., 41, 1888, p. 12 : Makino in Tokyo Bot. Mag. 1888, p. 25 and 1889, p. 112 : Baillon, Diet, bot., 3, 1889, p. 113: Watt, Diet. Econ. Prod. Ind., 3, 189D, p. 131 : Bretschneider, Bot. Sinic, 2, 1892, p. 193: Roberts in Gard. DhrDn., IB, 1894, p. 623: Sauvaigo, Cult, littor. Medit., 1894, p. 194:

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245 : Diels in Engl. Bot. Jahrb., 29, 19D0, p. 261, either in part or completely : Heckel in Ann. Instit. DDI. Marseille, 8, 1901, part 2, p. 29, and in Rev. Cult. Col., 10, 19D2, p. 259 : also in Rev. Cult. Dol. 14, 19D4, p. 39 and again in Bull. SOD. d'AcclimatatiDn, 51, 19D4, p. 23S : Hosie, Report Dn Ssuchuan, 1904, p. 12: Gosbel in Flora, 95, 1905, p. 177 : Jumelle, Plantes à tubercules aliment., 191D, p. 207.

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Dioscorea t Rosthornii, Diels in Engl. Bot. Jahrb., 29, 1901, p. 251, as regards Rosthorn's no. 858.

Dioscorea sativa, Bunge, Enum. plant. China, 1831, p. 54 : Miquel, Prolusio Flor. Jap. 1867, p. 323, as regards the plant collected by Buerger ; not of Linnaeus.

Dioscorea villosa, var. *coreana,* Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 15, only as regards the citation from Uchiyama.

iDioscore-a sp. |axillis bulbilliferis), Nakai in Journ. Coll. Sci. Tokyo, 31,1905, p. 235.

Tamus cretica, Pichler, in sched. 187D.

Pre-linman reference:

1712. Tsukne imo, Kaempfer, Amoen. Exot., p. 828.

Tuber solitary Dr in relatively rare cases twinned, thickening downwards from a narrow neck, its length varying with the variety ; the condition which seems to be most primitive being a long narrowly fusiform tuber perhaps 1 -5 m. long ; the condition of the most modified race being a shortly and irregularly club-shaped tuber of less than 20 cm. in length ; the flesh is white and the skin brownish-yellow, with few rootlets Dn it. The race with the most abbreviated tuber is *D. Decaismana,* called by the Japanese "tsukne imo." *Stems* up to 5 m. in length, 4—5 mm. in thickness towards the base, with eight to twelve slightly raised longitudinal lines, three ending in the petiole of each leaf, to be replaced gradually above by others, green with reddish spots along the raised lines or purplish. *Bulbils* freely produced, roundish or somewhat Dvoid, 1—2 cm. long. *Leaves* paired Dr rarely three together at a node, or more rarely still solitary over a few consecutive nodes, cordate-ovate, the auricles projecting laterally and downwards, the margin abruptly

narrowed above them so that there is a very marked shallow sinus, in length up to ID or 12 cm. by 8—ID cm. in width across the auricles, but measured across just above the auricles at least 2 cm. narrower, more commonly smaller than this, i.e., about 3—6 cm. in length, 7-nerved : the nerves of the first pair enclose a broadly oblanceolate-elliptic area : the nerves of the second pair diverge from the midrib at 6D—8D° and become submarginal at the lateral sinus : the nerves of the third pair enter the auricles where they give off a rather strong submarginal nerve, and then themselves curve to the margin : the network is rather scanty : the upper surface glabrous, bright but not shiny when dry, with the primary nerves just prominent : the lower surface paler, slightly glaucous, with the primary nerves prominent: the margin sometimes reddish : petiole often with a narrow reddish ridge on each side, with undulate wings on the upper pulvinus, about 3 cm. long.

Mah flowers dull yellow or livid, produced on spikes arising in the leaf-axils, or very rarely upon short leafless branches which have their origin in the leaf-axils : axis never quite straight and sometimes distinctly zigzag, much twisted, the angles raised to wings as they merge into the bracts, its length up to 3 cm., and the number of flowers about 2D : buds globular : bracts broadly ovate, acuminate, strongly reflexed upon the axis by thB base of the flowers, scarcely 1 mm. long, brown-dotted : bracteoles similar but shorter. *Sepals* broadly ovate, blunt, so concave as to be humped, 1-75 mm. long, brown-dotted, with hyaline margins. *Petals* smaller and less concave, but in shape similar. *Stamens* B, in two series, the filaments about equal in length to the anthers. *Gynoecium* of three small low warts.

Female flmuers to the number of about 15 in a decurved spike ; the spikes arising in groups of 2—3 in leaf-axils : axis up to 12 cm. long, rather rigid and narrowly winged : bracts ovate, acuminate, scarious, with some brown dots. *Sepals* rather thick, very concave, ovate, with the margina towards the obtuse apex thin, about D-75 mm. long. *Petals* smaller, acute, as concave as the sepals. *Staminodes* small. *Stigmas* three pairs of parallel lips. *Ovary* at flowering about 2 mm. long. *Capsules* tawny, directed obliquely forwards and outwards, glabrous, the wings almost semicircular but a little drawn out towards the atalk and tending towards a truncate shape above, up to 20 mm. long or a little longer, by 11 —12 mm. in width. *Seeds* tawny, brown-winged.

EASTERN ASIA in the warm-temperate parts, both wild and cultivated. It is certainly a native of China, but possibly not a native of Japan, though there it may occur wild. SincB 184B it had been taken experimentally to various parts of the world, as the Chinese yam.

In the yBar 1B55 a vary interesting account of this aperies from oriental sources was published by J. Huff maun in de VriBse's *Tuinbouw-fivra* |1, p. 289). WB haVB taken our refetBncBS to the old Chinsse and Japanese literature very largely from it.

Hoffmann begins by stating that thB plant is the shu-yu [tch'u-yu] of China, and as other names hB adds t'u-shu, shan-shu, shan-yu and tu-yu. HB does not give all its names ; so that it is possible to add shan-yoh, yieh-shu, and ta-shu, which may be found in Matsumura's *Shokubutau Mtii-i,* 1, p. 119. These names comiBct the plant with mountains [shan), with medicine [yao),with Cyperus |yDh), with CDlocasia |yu), with tuber |shu), and with thB earth |tu). Ta is great. FurthermorB fu-tsiang shu, or palm of Buddha's-hand tuber, is a namei for a racs, tsuknB imo, which will bo indicated later.

Bretschneider (On thB study and valuB of Chinese Botanical Works, 187D, p. 12) says that Dioscoieas are mentioned in the most ancient of ChineSB writings as those on Materia Medica of the Emperor ShBn-nung, and the Shan-hai-king. In legend thB Emperor Shen-nung lived in 27DO B.C. The Shan-hai-king is attributed to the Emperor Yii J22D5—2198 B.C.). Any *Dioscorea* so mentioned could scarcely be DthBr than this species or *D. japonica.*

Geil *[The, sacred five of China,* 1926, p. 3D) makes the statement that the yam was originally called "shu-yi." Then thBrB Dame to thB throne an Emperor Tai Tsung, one of tliB Tang Dynasty, whosB personal name was that of the yam : to avoid the disrespect of using the royal naniB for a common abject, the common obJBct was by consent referred to as "shu-yao," and "shu-yu." Moreover a second Emperor, Ying Tsung of the Sung Dynasty, had thB same personal name, which doubled ths disrBspect, had "shu-yi" remained a name for ths tuber of *Dioscorea opposita.* This quaint happening explains how thB Chinese word for *Colocasia* entered into one of ita common names. "Shu-yu" is mantionei by T'ao Hung-king, |who died in 535 A.D.), in his Ming-i PiB-u, as a plant found in the Sung shan of Ho-nan, where the tubers werB dug and dried for medicine, and in the Tung shan and in Nan-kiang in eastern Sze-chuan whers thBy WBIB dug for food. It is addBd that a very largB and excellent kind was to bB had in Nan-kang in the southern part Df the province of Kiang-si which, like thB last, was used as food. Perhaps this was *D. alata.*

Wu-pu, a learned man who lived immediately after T'ao Hung-king, wrote of it as in the ProvincB of Shan-tung, in the mountains of Chung shan, near Lin-chii which is to ths south Df Tsing-cliDw, i.s., in the Ta-sien shan.

Su-Kung, whoss *T'ang Pen-ts'ao* was written between 555 and BSD A.D., names two kinds of yam, the one with a white tuber which was dried in the sun and used medicinally, and which like all thB above, may bB regarded as *D. opposita* with *D.japonica* confused, and the other Df a dark greBn, and with an unpleasant taste found in the western parts of Sze-chuan, which would bB an entirely different species.

Su-yung |1D23—1DB3 A.D.) in his *Tu-king Pen-ts'ao* wrote of *D. opposita* (with perhaps *D.japonica*SDmswhat confused) as widespread, the best kind produced in the mountains of SzB-nung, west of Ning-pD. HB dBScribed thB threB lobBS of thB lBaf which characterize *D. opposita.* He msntionBd its cultivation in thB province of Shen-siiDr food, and IIB addsd that a wild condition found in the southern part of thB kingdom, though yislding a tuber no thicker than the finger, when rasped and made into cakes was Df most excellent taste, surpassing that produced in gardens. Then this author, like the last, mentioned another plant which cannot possibly be *D. opposita.*

In point of timB thB *Liu-hoang Pen-ts'ao* comes next. This titb means the Herbal for diminishing famüiB ; and the book was written during the Early years of thB Ming Dynasty. In it *D. opposita,* with probably *D. japonica* CDnfussd,-finds mention as a faminB food.

Li Shi-chBn, the author of the celebrated *Pen-ts'ao Kung-mu,* at the close of the sixteenth century, records our plant as found wild as WBII as in cultivation. And hB refers to the bulbils, as if seeds, used for food.

Ths first JapaneSB accounts of the plant are based upon these last two Chinese works. In them the plant is recognized as "naga imo," but "yama imo" is confused : and lastly there is in the Japanese recension of the "Herbal for thB diminishing of famine," a rsference tD the cultivated race "tsukne imo," of which race more later.

Earlier European botanists and the Chinese yam.-D. oppo3ita became known to European botanists first as a cultivated plant, the race which attracted their attention being the most highly selected. This happened when Kaampfer spent two years in Japan as *mtdizus legati* or embassy surgeon in the service of the Dutch East India Company. At that time the company was allowed to occupy a factory on the islet of De-shima close to Nagasaki town, where the trades lived as prisoners. To De-shima Kaempfer went in 169D and therB h resided for two years accompanying the Ambassador each spring on his official journey to the court at Tokyo. This journey had formerly been accomplished by sea, but sanction had been given that it should be accomplished overland, and it afforded the only opportunity which was vouchsafed to the Dutch of seeing the country Ka^pfer's industry was great; and using interpreters he acquired much knowledge regarding Japan which he « « r t d « i h . *History of Japan* |1727) and his *Amoenitates Exotic* (1712). He had barned and he recorded that the Japanese cultivated a yam called "tsukne imo "; and mistakenly he stated that it differed in producing bulbils from another -a wild or "yama imo". These statements constitute the first printed records of *D. oppose* and *D. japonica* respectively. The name "tsukne imo" means abbreviated yam : and the namB "yama imo", mountain yam.

James Cunningham, surgeon in the service of the East India Company at Amoy from 1698 to 1703 sent a specimen of *D. opposita* to Petiver, which can be seen in the British Museum, but bears no label.

In 1775 Linnaeus' pupil and subsequently successor in the professorship of Botany at Uppsala, Per Thunberg, repeated Haempfer's experience. He went in the autumn of that year to De-shima as embassy surgeon and in tliB following spring travelled overland with the Ambassador to Tokyo. Unlike Kaempfer he stayed but one year in Japan, and so made but DnB journey. At other times during his confiEB-ment on De-shima, he used every endeavour to obtain permission to botanize around Nagasaki but in vain until, towards tliB end of his stay, he was allowed a few excursions (Travels, English edition of 1736, p. 118) : hia energy found a way of expending itself in an examination of the greBn fodder which thricB a day was brought into thB factory for fseding the animals therB, and he states that tubers of *D. japonica* often came with it |p. 123). He described this species fully, but somehow ha scarcely made a morB detailed reference tD *D. opposita* than had Kaempfer. HB collected a specimen which is preserved at Uppaala, and in his *Flora Japonica* diagnosed it in the briefest way in the words which Linnaeus had used for *D. oppositifolia* quoting Linnaeus' name as a synonym. A curator of thB collections at Uppsala at some subsequent date wrote this name upon thB sheet, but not Thunberg. Assuredly hB borrowed the diagnosis, and apparently believing that he had obtained again Linnaeus' Ceylon plant and thinking to better the name, as his way was, when putting the manuscript of his Flora together. As to the name "opposita" used by him, we hold it valid, for the diagnosis, equally applicable to both species, is, when combined with the knowledge of the country of origin, enough to havB enabled his successors to recognize what plant was meant.

That he records SD little about it, is surprising.

Philip Franz von Siebold, who took up the duties of embassy surgeon in 1823, was a man with a wide human interest, and ascertained much about the economic plants of Japan. He lived for eight years on De shima, and made many friends among the Japanese. He sent the first tea-seed to Java, and on one occasion his intelligent enquiries aroused so much suspicion in the governing class that his collections were confiscated. He founded a small botanic garden in which he grew *D. opposita ;* but all that he recorded of it, was that it is a plant of cultivation. His successor H. Buerger, like von Siebold, collected *a,* specimen of it, but left no nBW information.

It is clear that Kaempfer, Thunberg and von Siebold had no other idea of the limits of the species than that " tsukne imo " represented it ; and Buerger's plant was assuredly the same.

In I860 the Russian botanist Maximowicz went to Japan and attached to his service Japanese assistants, whD brought him information which he might have otherwise failed to obtain. He thus ascertained that thB Japanese gDW more cultivated yams than " tsukne imo " and he drew up the following useful memorandum which is preserved in the Botanic Garden, Petrograd :—

" D. japonica,

Yamano imo,—wild : tuber relatively long and relatively tender :

Itse nen imo,—cultivated : tuber shorter, relatively delicate :

Naga irno,—cultivated : tuber relatively long, but scarcely delicate :

D. sp.

TsukunB imD,—cultivated : tuber flattened : supposed to havB been introduced from Dhina."

TD the memorandum some one has added the words " D. batatas, Dne " as an identification for " tsukune imo ". Tha words " yamano imo " mean yam of the mountain, " itse nen imo " mean annual yam or a yam in a year, and " naga imo " mean long yam.

Maximowicz had consulted the Japanese work *Phonzo Zufu,* and against " yamano imo " he wrote thB reference,___" 50, 11 verso and 12 recto," against " itse nen imo " the reference " 13 verso ," the yam there being called" ki-nen imo", and the botanist, who added the identification *D. Batatas,* added against " tsukune imo" the reference " Phonzo Zufu 50, 14." These figures are all to be found in the copy Df this beautiful work which is at Kew, but the numbsring of ths pages differs.

As Decaisne had in 1854 published the name *Dioszorea Bazatas,* it was extant before Maximowicz set out on the journey which took him to Japan : but Maximowicz cannot while in Japan have been aware of it: and as *D. batata,3* was founded on a race very like " naga imo " and " ichi nen imo", the annotator of the memoran-dum was hardly correct in quoting Decaisne's name against " tsukne imo "only, for though it belongs to it, it indicates the species which comprises all.

Maximowicz in making the memorandum evidently adopted a Japanese view—a gardener's view—that the tubers which required agreat deal of digging should belong tD a species different from the one which re quired but little. It is a view which reappears in Fesca's *B&itrdgz zur Kenntniss d. japanischer Landwirthschaft \2,* 1B!?3, p. 247) and in the writings of Japanese botanists such as Makino who call " naga ima " *D. japonica* and *D. japonica* var. *culta.* It is a view which we cannot follow, far man has exercised selection in regard to thB length of the tuber : and we must turn from it tD the foliage for our guide as tD what is *D. opposita* and what is *D. japonica.*

Though MaximDwicz had widened the knowledge *of D. opposita* considerably, he had not accounted for all the races in Japan : and even at the present time DUF knowledge is by no means complete. The Japanese use at least three more names fDr this species. They have " shishen imo", "jeche imD " and " ise imo " : but the last means only a yam of the province of Ise |sDuth-east cf Kyoto), which is celebrated far its yams, and may not indicate a particular race.

In the *Useful plants of Japan,* figures of " naga imo " |fig. 112), " iche-nen imo " |fig. 113) and " tsukna imo " Ifie. 11D) may befDUnd. " Iche nen imo " is described as a watery inferior yam. The evidence regarding "ieche imo " is conflicting, Dne writer saying that it is like the last, but another that it is superior and flattened If ascid ted) like " tsukne imD " indeed that it is the best flattened form of " tsukne imD." " Shishen imo " is like " naga imo " .

It will have been noted that the Japanese told Maximowicz that " tsukne imo " had come to them from China. This is a reasonable view. It may also be Dn the contrary that in some of the deep-rDDting races therB lie the results Df a local hybridization with Japanese *D. japonica.* If so, it may perhaps be indicated by the direction of the male spikes.

The *Chinese yam* |D. opposita) *in China itself.* We are unfortunate in knowing little about this species in cultivation in China. It is reported tD be grown in gardens near several of the Treaty ports, and to a less extent inland. Repeated sendings fram Shanghai to France have made students of the genus familiar with a race which is there common locally, a deep-rooting race ; and one of the authors in 1925 during a very hurried visit tD Shanghai in the month of March, saw "tsukne imo " with the name " fu-tsiang shu " or palm of Buddha's hand yam, which has already been mentioned, on sals in the market. It is unlikely that these two are the only races in cultivation in the country. Hosie in his *Report on the province of Ssu-chuan* |19D4, p. 12) and in his *Szechwan, its products* |1922, p. 24) mentions two yams as in Sze-chuan, calling them " pai shaD " and " chieh pan shao " ; and though he does not identify them, it seems likely that both are *D. opposita;* and as " chieh pan shao " means flat foot yam, this is apparently " tsukne imo." No other travellers have afforded any information. Moreover, only one collector—Mr. F. T. Wang—has as yet put on record what sort of a tuber the wild *D. opposita* has. He describes it as long and slender.

D. opposita is quite widespread in the mountains of China, though a few years ago when collecting in that country had been little organized, it seemed so rare that it was natural to believe it when wild an escape from cultivation. It occurs on hillsides among scrub and in thin forest, on roadsides and in ravines, and has been obtained from almost every province though it seems that of Kan-su province only the extreme south is suitable and of Yun-nan only the northern parts : while Kwang-si anb*Kwang-tung are in the main too hot. But much more information is desirable.

Its botanical name,.—Thunberg's curious confusion of *D. opposita* with the Indian *D. oppositifolia* had unfortunate consequences. The first botanist to write upon the flora of the Far East after the *Flora Japonica* had appeared, was the priest Loureiro : he had spent thirty-six years in Cochin-China and then three years in Canton, where it may be assumed he became familiar with *D. opposita* in the market Dr on the table. In Cochin-China he had learned of a " son duoc" or mountain yam, there relished, which proves to have been *D. persimilis* ; and in his uncritical way—probably in the main on account of the name—he equated with it the Canton " shan yu " or mountain *Colocasia,* and ended by giving to the combination the name *D. oppositifolia.* In thia way *D. opposita* confused with *D. oppositifolia* by Thunberg and given an impossible distribution, now became confused by Loureiro with *D. persimilis,* which occurs in intermediate countries.

Next came Bunge. He journeyed in 183D from Russia to Pekin and found *D. opposita* in cultivation. From the circumstance that it was in cultivation, he imagined it might be Linnaeus' " *D. sativa* ".

Hirilow was Bunge's companion, but remained in Pekin when Bunge returned, and lived there for ten years. Then he too returned to Russia with collections which included a specimen of *D. opposita.* On this specimen Turczaninow founded his *D. pdystachya* in the year 1837 : of names for the species, this is the first available after *D. opposita.*

Kunth in 1B5D in the fifth volume of his *Enumsratio plantarum* endeavoured without success to deal with these names : he placed *D. oppositifolia* among dubiie on p. 39D and quoted TurczaninDw's brief description of *D. polystachya* on p. 4D3, suggesting that it might be *D. quinqueloba.* He did not refer to *D. sativa,* Bunge.

When Kunth's work was published *D. opposita* was already in cultivation in France under the erroneous name of *D. japonica :* but Kunth does not refer to this either. Four years later Decaisne described *D. opposita* aa a new species under the name *D. batatas,* having obtained from Blume an undoubted specimen of *D. japonica* for comparison, and satisfied himself in regard to the differences. He did his work thoroughly, and the name which he had adopted became very well known.

Only Dne further name requires mention—, the name *D. Decaimeana* given by Darrière to a race like " tsukne imo " which subsequently arrived in Europe.

ThB possibility that *D. opposita* produces hybrids with *D. japonica* has already been mentioned: mention must be made also of thB existence of specimens in herbaria which appear to represent hybrids of *D. opposita* with *D. Potanini.* Aa the last named is confined to western China, it is only in that part of the country that such are found. But *D. japonica* haa a distribution almost co-terminous with *D. opposita* and hybrids may be found widely.

Hackel in 19D4 claimed to have crossed these two |Bull. SDC. d'Acclimatation, Paris, 51, 19D4, p. 235) >Jbut he was using the name *D. japonica* for " tsukne imD ", and therefore was only crossing two races of *D. opposita.*

Another and somewhat unconvincing claim had been made by Darrière when |Kevue horticole, 1882, p. 379) he reported that hB had obtained a hybrid between *D. opposita* and *Tamus communis.*

From Japan *D. opposita* seems to have been carried by man to the Benin islands : and we believe that thia mayhavebeen the yam used by the sailors of the short-lived northern Pacific whaling industry |see Cholmondeley, History of the Bonin islands, 1915).

The cultivation has been carried towards northern Japan and towards Manchuria beyond its natural boundaries by the device of protecting the lower parts Df thB plants with straw : for if frost reaches the tubers they are quickly destroyed. Vuitry |in *Joum. Soc. Centr. d'Hort. de. Franca,* 2nd ser., 8, 1874, p. 345) has recorded some observations on the effect of frosts Dn the plant.

The Chinese, yam in Europe.—Five years after Turczaninow had put forward the name *D. polystachya* thB potato blight first attracted notice in Belgium, and three years later, i.e., in 1842, Europe took alarm at ita spread not only through the potato crops of Belgium, eastern France and western Germany, but in Britain and yet further afield. Then among the possible substitutes for potatoes attention was directed to the yama, and in 1846 particularly to the Dhinese yam. The benefactor who sent the first tubers to Europe is sometimes stated to have been a French Consul #,t Shanghai, M. dB Montigny, and sometimes to havs been the Admiral C£cile. It seems that the latter was the first, but the formsr supplemented the Admiral's consignment by many subsequent sendings, posting bulbils almost ysaTly. It is recorded that de Montigny so maintained his intsrest that after retirement and tD the time of his death in 18B8, he continued to experiment with the plant on his estate near Auxerre in central France.

The first tubers ware planted by de Mirbel at the Museum in Paris under glass, for the plant waa not considered hardy ; and so protected, it was maintained there for four years : but to the practical mind of Louis de Vilmorin that kind of cultivation for something expected to rival the potato did not appeal, and in 1851 he tried it in thB open with success in hia experimental grounds near Paris. It was tried in the open also at the Museum. In 1852 and again in the next year dB Vilmorin published accounts of it in *Le Bon Jardinizr,* not exactly praising it. It produced its tubers deeply and was troublesoniB to dig, for the race which had been sent is one which buries its tubers very deeply. In 1852 Pépin exhibited a tuber a metre long and in the next year another weighing \\ kilogrammes (3 lbs. 3 oz.). Decaisne who had the expBriments at the Museum under hi? direction and was Pepin'a superior officer does not record quite such good returns, for even in 1855 he placed the limit of length at 35 cm. while giving the average weight as 3DD grammes or large tubers up to BQD grammes. He was indeed occupied in an effort to multiply hia stock as fast aa possible and he probably insisted on dividing his sets too excessively for large individual returns to be obtained. Naudin discovered that little fragments gave but little plants |see hia note in the Fbre des Serres on experiences of 1855).

Louis de Vilmurin and Pépin had tailed it *Dioscorea japonica.* Douaiduo haJ asked Blume fur an authentic apecimen of *D. japonica* and then deciding that his Chinese yam deserved another name called it *Dioscorea Batatas.* In a lengthy illustrated account of thB plant in 1854 he published this name ; and in 1855, the more securely tD fix his point, published a figure of the specimen Df *D. japonica* which Blums had sent to him, alongside a reproduction of one Df hia own figures of hia *D. Batatas.*

Decaisne was of opinion that the yam deserved advertising. His first account of it, had contained a life-sized coloured figure of the lower half Df a tuber and of foliage, together with a black and white figure Df a branch with male flowers and a reduced figure Df a root with two full-sized and one new developing tuber. The greater part Df the account and the figures which were in black and white, were reprinted in the *Revue Horticole* in the same year. It had been advertised in the *Monitvur Francaise,* and he arranged that it should be Dn sale in Paris and Ghent in the autumn ; and in the following February he exhibited a tuber at a meeting of the Horticultural Society in London. The editor of the *Floricultural Cabinet,* when reporting on this, published a composite figure made up from Decaisne's : two German horticultural magazines printed illustrated accounts taken from Decaisne's : de Vriese in Holland reproduced much of Decaisne's account and the Commissioner of Patents in the United States of America printed a long pretis borrowing one Df the figures.

Decaiane by hia thoroughness firmly established the name *D. Batatas.* By his insistence he procured a series of experiments with it from Aberdeen to Algeria; and in France, as Naudin said, every agriculturist from north to south had his eyes fixed on the plant. It is a pity that by the rules Df Botanical Nomenclature such a well-established name should have to be set aside : but as the reader will have observed the plant haa two older names.

PSpin's account of thB species in the *Mimoires de la Sociiti impirialz et centrals d'Agriculture* (1B54) ia very instructive in regard to thB experimental work done at the Museum : and instructive also ia an article slightly wider in range, by Naudin in the *Revue, Horticole* (aer. 4, 4, 1854, p. 422). Both were lieutenants of Decaisne ; and both held more or less favourable views regarding its utility in France. Naudin collected together in a very interesting way the published opinions of men whD had then tried it in Britain. SomB had been disappointed : some had succeeded : and those whD had succeeded had taken care of the tubers underground when cold came, and in thB beginning of the growing season had started the plant under protection. Dne had with these safeguards succeeded in growing the plant in Aberdeenshire in 57 ° N.

Fortune, whose travels in China were over, wrote in the *gardeners' Chronicle* that hB knew Df no vegetable more likely to replace the potato, should the latter die out or become so prone to disease as to be uselss for cultivation ; but bB added that he dmibtBd if the English summer be hot enough for the growth Df this Chinese yam. He explained further, that it is not a staple crop in China as thB sweet potato is, though sometimes preferred.

In France, it had been made clear that the yam cDuld be grown in the Dpen, from Paris southwards, and tubers left in the soil had not been injured by frosts in January of 10 and 21 degrees Centigrade.

Meanwhile France obtained from Shanghai more material for propagation: Greenland, in the employ of the firm Df de VilmDrin, sent it to Verrières, while de Montigny, who had revisited France and thence returned to Shanghai, sent it to Algeria.

The first plants to flower in Europe had been male; Carrière recorded this (Flore des Serres IS, 1854-55, p. 184) : then in 1855 female flowers were produced in Algeria, on a plant raised from one of de Montigny'a newest supply of bulbils. These flowers were pollinated and seeds were obtained. Most Df the seed was sown in France : and in 1857 plants from them flowered in the Jardin des Plantes, Paris, and in the garden of M. Aunée, at Passy near Paris, showing that their time from germination tD the first flowers was, say, 15 months. These plants provided Duchartre with the material for a new and excellent account of the plant in the *Journal de la Sociiti d' Horticulture de Paris.* He had studied the germination of the seed and the germinatiDn of bulbils, figuring the inception Df the new tuber on a shoot, and he had observed the circumnutatiDn Df the long tubers.

De Montigny had been sending bulbils repeatedly : but an examination Df the figures published by Decaisne, Pépin, Vilmorin, Duchartre and others, seems tD indicate that it was always the one race which he sent—a race apparently common about Shanghai.

In 1858 Hardy again obtained seed in Algeria ; and about the same time de Dal an j an obtained seed in the Department of the Drôme, central France. In 1854, i.e., six years later, Boisnard-Grandmaison obtained seed with the aid of a little forcing, in thB Department of La Manche, northern France.

Fortune, when asked what chance the yam had Df thriving in Britain, had declared that the English summer is too short and his opinion seemed justified by Robert Thomson's failure in the garden of the Horticultural Society : but others obtained success such as Ivery and Company of Dorking, in whose grounds a tuber weighing as much as 7 lbs. 2 oz. was obtained : and in the *Procezdings of the Horticultural Society* for 1859 mention is made of Dther tubers weighing nearly as much. France had not produced larger, or at any rate had not recorded larger. Three kilogrammes |ti lbs. ID DZ.) was subsequently recorded.

The length of Ivery's longest tuber was 84 cm. Bunyard at Maidstone also experimented and formed an unfavourable opinion, because his tubers were upwards of a metre long, which made digging very laborious ; and as a vegetable he found them heavy. No contemporaneous report was issued by him, but his conclusions may be found in the *Journal ofthe Society of Arts,* 50, 19D3, p. 179.

About 1B52, someone—perhaps M. Simon—introduced into France the race with abbreviated tubers, which Carrièrs described as *Dioscorea Decaisneana.* Its tubers were figured by Carrière when he described it as about twice as long as their diameter, and very irregularly lobed. They were figured again by Decaisne and Naudin, *Manual de V Amateur des Jardins,* 4, 1BB6, p. 1 DO |a figure copied intD Nicholson's *Dictionary of Gardening,* 1, 1B84, p. 478) as if ovoid with a constriction about the middle.

The race—for it is a race Df *D. opposita*—came too late. *D. Batatas* had not left a gDod impression : ani the potato had been largely rehabilitated by means of repeated introductions Df new stock from South America: and so, though Carrière propagated thB yam as freely as he could and Dffered material for experimental culti-Tation *Bsveue Horticoh,* 1855, p. 4Di$) to any who wished for it, few tried it; and moreover those who did were rather disappointed by its meagre return. Chappellier *[Bull. Soc. d'Acclimalation,* 45, 1899, p. 155) records that the produce underground was almoat nothing, though it grew well and gave bulbils : and Pailleux and Bois tell us *Potager d'un Curieux,* first edition, 1885, p. 139) that the tuber in the ground decreased in size from year to year, compelling resort to the bulbils in Order to maintain the plant. Remembering that Decaisne's *D. Batatas* had been in France fDr eight years before the stDck had been built up tD numbers sufficient for its adequate trial: it should have been 197D at least before *D. Decaisneana* obtained an adequate trial.

It is still in cultivation both in England and in France, but only in a few gardens. Bridel and Tougard and others who recorded experiments with *D. opposita* in the years following Carrière's description of *D. Decaisneana,* had not made those experiments with it, but with the race Decaisne called *D. Batatas.*

The Chinese, yam in India and, S. Africa.—Fortune had communicated an account of the yam to thB Agric-Horticultural Society of India, which was published in their *Journal* (9, 1857, p. 121). The yam itself was trie din India (see Watt, *Diet.),* and in many other parts of the world. Fortune, having arranged for supplies to be sent tD Calcutta, thB first arrived at the end of 1855 from Shanghai *[Proc. Agric. Hort. Soc. for* that year, p. clix) and was followed by another from Ning-po |p. clxxxiii). It is said that the Ning-po race differed from thB Shanghai race. It was taken to South Africa in 1832, and again to India, both to Calcutta and to Mysore, in the seventies. The plant which the collector Theodor Pichler distributed as *Tamus cretica* in 1871) from Dalmatia is also it. Whether it is in Africa still nr has disappeared the writers do not know. It soon disappeared from India ; and in 19D3 by a renewed introduction, due to thB kindness of M. Bois, the writers satisfied themselves that it will not grow reasonably in Calcutta. It has been tried in Madagascar also |Rapuc in Rev. Cult. Dol., 11, 19D2, p. 2 57).

The Chinese yam in Europe during the last fifty years.—In 1878 there was an Exhibition in Paris,—the Exposition Universelle of that year : and among the Japanese produce sent to it, were the fasciated tubers of "tsuknBimo." TheSB went intD cultivation at the Museum, whore they WBTB regarded as a valuable acquisition ; and about thB same timB the Socíeté d'Acclimatation offered a prize for the introduction into cultivation in France of a ra,cB of yam good to BBat, but not burying deeply. At least threB horticulturists set DDut on the quest for it by the simple method of growing together the deep rooting *D. Batatas* and a shallow rooting race, hoping to gBt contemporaneously mala flowers on the one and female flowers on the other ; when if seed cDuld be got thB cross must havBbBBnmadB, and thB ntW plant might be intermediate. For short-rooted both *D. Decaisneāna* and this new stock of " tsuknB imo " werB available in Paris. It is not clear with which Df them Chappellier worked, but hB obtained what hB wanted, it is said after fifteen years of work, and in 19D3 issued a brochure entitled *VIgname, de Chine d tuUrcuhs courts.* Wa call such yams half-long. From a photograph, they and the parental long yams arB figured in the *Journal de la Sociiti nationale d'Horticulture de France* (series 4 11 1910, p. 2B) ; and in Bois' *Plantes alim&ntaires* |1927, p. 479) may be found a woodcut. ThB reproduction of the photograph is not as clear as is desirable ; and the woodcut is too much modelled upon an old woodcut of *D. Batatas* to be quite convincing : but that the tubers are clavate is satisfactorily shown.

Daumet-Adanson ia said tD have made thu a..*mo* crows between long and short-tubo-red racES : but no mDra ia knuwn of his work.

Thirdly, HBckel in Marseilles crossed *D. Batatas* with " tsukne imo." That he used the latter ia clearly demonstrated by the good figures which he published. He had re-introduced it into FrancB for his work. At first 1lB planned to grow side by side *D. Batatas* and *D. Decaisneana,* but somehow he- could not obtain *'D. Decaisneana :* it was then that he sent to Japan a request for " tsukne imo ". But a new difficulty arose as his *D.Batatas* would not flower, though "tsukneimD " didso freely. At last in 1904 *D. batatas* flowered and he obtained his inter-racial crossed seeds. He gave a good account of " taukne imo " in the *Annahs du Muséum Colonial de Marseille.* |S, part 2, 19D1, p. 37), and recorded his success in 19D4 in the *Bulletin de la Socièetti d'Acdimatation,* |51,19Q4, p. 239).

The reader may now be referred to the figure of "ki-nenimo" in the *PhonzoZufu* |5O, 24 VBTSD in the KBW copy) because it is of a half-long tuber possessing relative dimensions—length in terms of the diameter—clDSBly corresponding with Chappellier's yam : and possible what Dhappellier wanted should really haVB been looked for in the gardens of thB East.

BDJS has written that he FBgards *D. Batatas* and *D. Decaisneana* as *D.japonica :* Heckel had used thB name *D. japonica for* "tsukne imo ": and as the nomenclature in this way has become greatly involved, WB will endeavour to clear it by bringing Maximowicz's statement up to date.

D. japoniaa—

" Yama imo," a wild plant with a relatively long tuber, which ia tender and excellent tD eat; and ia figuredinthB *Useful plants of Japan,* fig. I11; this figure was reproduced in *Le Jardin,* 1911, p.3l3,fig.lBD.

D. opposita—

|1) The wild plant of China, thB tubers of which are eaten and serve as a famine food : they would be BatBn more, were it not that the labour of digging them out is nDt adequately rewarded by the amount obtained. ND one had figured them.

(2) "Naga imo," i.e., long yam : a race cultivated in Japan; and directions for its cultivation by Sugita may ba read in Heckal's paper in the *Annales du Musium colonial de, Marseille,,* B, part 2,1901, p. 42. ThB yams are figured in the *Phonzo Zufu* 5D in a figure which. Bxtends over 22 VBrao and 23 rscto and in thB *Useful plants of Japan,* fig. 112 |a figure incorrectly reproducedin *Le Jardin,* 1911, p. 312).

|3) " ShishenimD,"saidtDbeaform of" Naga imo."

|4) DBcaisiiB's *D. Batatas,* the common racB of Shanghai : figured by Decaisnp in a coloured plate and in a much reduced line drawing which has been copied into seVBral works ; figured also by do Vilmorin and rather indifferently by several othors : the tuber usually solitary ; but both byDecaisne and de VilniDrin twinned tubers are figured:

|5) " Iche ncn imo," Dr yam of DIIB year's growth: a watBry tuber grown bBcausB of its quick return : figured in the *Phonzo Zufu* along with "naga imo," and in the *Useful plants of Japan,* fig. 113 ; this figure reproduced in *Le Jardin,* 1911, p. 312, fig. 173.

(S) "Kinenimo": a half-long tuber figured in the *PhonzoZufu,* vol. 5D, 24 verso.

|7) Dhappollier's half-long yam, figured by him and in thB *Journal de la Socîeête nationals d'Horticulture de France,* 11,1915, p. 2B, andbyBois, *Plantes alirnentaires,* p. 479.

|9) Camèra's *D. Decaisneana :* the tuber figured by Carrière as about twice as long as thick and very irregularly lobed : figured also by Decaisne and Naudin as more regularly obovoid with a constriction (Manuel de l'Amateur des Jardins, 4, p. 10D), the figure copied into Nicholson's *Dictionary of Gardening,* 1, p. 478.

|9) " Tsukne imo " or the abbreviated yam : figured in the *Phonzo Zufu,* vol. 50, 25 verso, in the *Useful plants of Japan,* fig. 11D, a figure copied into *Le Jardin,* 1911, p. 312, fig. 177; and figured again by Heckel in the *Annahs du Musium, Colonial de Marseille,* 8, part, 2, 1951, p. 41, and in *Revue des Cultures Coloniales,* 14, 1904, p. 39, thB tubers being very irregular, perhaps from unfavourable conditions, Sugita in ths former of these two giving directions for cultivation.

110) " JBche imo," said to bB a form of the last, and described aa if identical.

*Somz miscellaneous note**. The flowering of this speciea may be expected about five months after growth in the spring has commenced, and fruiting comes about 1^ tD 2 months later.

Autumn frosts may blacken the foliage, but not injure the tubers as they get protection from the soil : but it is obvious that such an occurrence, may catch the tuber immature and cut. ofi its further food supply. The tuber then undergoes a slow maturation : and perhaps it was this maturation which caused a writer in the *Bulletin de la Soziiti d'Acdimatation* |195B, p. 347) to recommend that the yams be kept after digging for two or three months before eating. In maturing they become more mealy.

More male flowering specimens have passed through our hands than female : and it is by no means improbable that in nature they are actually more numerous.

Hermaphrodite plants sometimes exist, with female flowers towards the base and male towards the apex of a spike. Sometimes the flowers actually appear hermaphrodite but it haa not been determined that they are functionally so. Carriers has figured a branch with both male and female flowers in aaaociation. He found the female flowers sterile.

Heckel says that in his experimental cultivation femals plants carried more and larger bulbils than thB male.

The bulbils are edible.

Collardeau |in *Journ. Soc. Imp. it Centr. i'Hortic. Franca,* 2nd series, 4, 1870, p. 270) adopted an original method of increasing his return in bulbils : he laid the stems on the soil and then buried them, the blades of the leaves extruding. This experiment should be tried again under strict scientific control, as perhaps what happened was that the stems were compressed and bent so that food elaborated in the leaves could nDt descend to th» roots, in which case, as other experiences suggest, the food would be lodged in the bulbils.

Heckel thought that perhaps by reproducing year by year from the apical part of the long tuber of *D. Batatas* he could get an abbreviated form. He thought that perhaps he had had some success ; but this ifl extremely improbable. Lamarckism would have been justified if he had succeeded. In one place it has been said that when *D. opposita* runs wild in Japan the produce is inferior to eat. This is possibly due to the circumstance that inferior kinds have the better chance of survival unprotected.

Some have said that the deep going *D. Batatas* has a more pleasant taste than the shallow-rooting "tauknei imo" : but on the other hand Pailleux and Boia in their *Potager d'un Curieux* |edition of 1892, p. 253) say that "tsukne imo" was found superior to any other yam for sweet dishes, cakes and souffles, and excellent when Berved up in other ways.

On thB art of the cook much depends : and we may be assured that some of the early expressions of disapproval were sequels to bad cooking.

JAPAN. **6 a. Northern Japan** |Hokkaido). Ishikari province. Sapporo, *Seiya Ito.* Dshima province, *Tchonoski.* Yeaso, near Hakodate, *Albrecht* ! Either this province or Shiribeshi province, *Kudo.* Kushiro province, *Kudo.* **6 b. Central Japan** (Nippon). Rikuchu province. Morioka, *Seiya Ito.* Mutsu province. AoniDri, *Faurie.* 811 ! Ugo province, without precise locality, *Yushun Kudo* 273 I. Shimotauke province. Nikko, *Enghr* 7652 teste R. Knuth. Sagami province. Kanagawa, *Maingay* 3B7 ! Musashi province. Yokohama, *M aximmuicz* ! Shinano province. Plain of Haruizawa, *Hara.* **6 C. Southern Japan.** (Shikoku island.) Ttsa province. Sakawa, *Malcino* 45 a ! 45 b ! 45 c ! Kamibu, *Makino* 45 b ! *K. Onuma* ! |Kiu-shiu island.) Hizen province. Nagasaki, *Maingay* ! Almost certainly Nagasaki, *Sitbold* ! *Buzrgzr* ! ZiJDiire near Nagasaki, *Buvrgzr.* **6 d. LlU-kiu islands.** Without further information, in herb Kew.

CATHAY. **7 a. Corea.** Considerably cultivated, *Roberts.* Without precise locality, *Warburg* 67 D9, tests R. Knuth. Kyeng-kwi province. Near Pha-jyu and Mount Namhansan (probably this speciea), *Uchiyama.* Que1part island, in thickets, *Faurie* 866 ! 2D89 ! 2131 ! at Hongno, *Tacquet* 1623 ! Chinnampo, *Faurie* 865 ! **7 b. Amur region and Manchuria.** Sui-yang province. Tsuetza shan, *Palibin.* **7 C. Northern China.** Province of Ho-pei. Near Pekin,.

Bunge ! *Kirilow* ! *Bretschneider* 73D ! 731 ! J W e r ! #. J[1]. CAow ! West of Peking in the mountains, *H F. Chow* 41451 ! Tsing Eastern tomb, *H. T. Tsai* 5D188 ! Fang ahan hsein, in the Fang shan, *H. F. Chow* 41789 ! Chang-lo south-west tomb, *P. H.* and *J H Dorsett* 789 ! Hou-hou-chai, *Chouet* 53D ! Kuen-tso-ling, Dn hillsides at 3DD m., *J C Liu* 1213 ! Summit of Shang-fang shan, at BDD m., *J. C. Liu* 22Dl ! Tang-ho, Pei-niu-ting mountain, *Mrs. Clemens* 7D9D ! Lei-chwang, near Tien-tain, in cultivation, *Mrs Clemens* 1754 ! Province Df S h a n - s i . Mount Tai-pai-san, *Hugh Scallan* ! Province of S h a n - t u n g. ChefoD, *Forbes* ! *Warburg* 6712 teste R. Knuth : in a ravine (approaching *D. japonica), Cowdry* 524 ! Tsing-tau, Iltisberg, *Nebel* 231 teste R Knuth. Lung-tung, Tsi-nan-fu, *C. Y. Chiao* 31DB ! Province of K a n - s u. On the southern border of the province, northern descent from the Ta-daD-ling pass, *Potanin* ! **7 d Mid-China.** Province of H D - n a n (which province is mentioned by T'ao Hung-kine) Ki-kung shan, in forest at 1DD m., *Steward* 9B7D ! Province of K i a n g - s u (which province is also mentioned). Shanghai, in cultivation, *Maingay* ! *Faber* ! At ths American Sanatorium. *Hickin* ! Nan-king, cultivated and very vigorous, in *Herb. Decaisne.* Province of C h B • k i a n g . Ning-po, *Warburg* B714, teste R. Knuth. Ning-po mountains, *Faber* 138 ! Sin-an hsien, *Y. L. Keng* 778 ! Dhing-han to the east of Ning-po, on a shaded slope, C. *Y. Chiao* 14D75 ! Ching-han, *Chang* 141 teste Matsuda. Hang-chow, *Henry* ! and in coarse grass at Hang-chow, *Merrill* 11307 ! Hang-chow, in scrub, *Steward* 2381 ! MD-kan shan, *Meyer ; Cheo and Wilson* 12777 ! Nan-che shan about 70 miles south-east of Ping-yung, between 125 and 185 m., *R. C. Ching\$5%* ! Province of N g a n - h w e i. Dhu-hwa shan, *R. C. Ching* 84B1 ! and Erh-sun-tien in the Dhu-hwa shan, *R. C. Ching* 8725 ! Province of H u - p e h. I-chang, *Henry* 1538 ! Pa-tung district, *Henry* 1857 ! Province of H u - n a n. Without locality, *H. F. Chaw* S. 351 ! Province of K i a n g - s i. Kiu-kiang, *Shearer* ! and Dn the city wall, *Carles* ! *Bullock* 24B ! Ling-chuan, in scrub at 115 m., *Y. Ts'iang* 9821 ! Lou shan, Feng-cheng, among tea-trees at 995 m., 7. *Ts'iang* 1D3D7! Province Df F o - k i e n, common, *Fortune.* Baek-liang and vicinity, with deformed fruits, *Chen Hsi Cheng* 314D ! Amoy Dr near thereto, *Cunningham* in Herb. Petiver !

SOUTH-WEST CHINA. **B a. Province of S z e - c h u a n .** Nan-chuan, *v. Rosthorn,* teste R. Knuth. Tchen-keDU-tin, *Farges* 9D bis ! Kwang-yuan hsien, Dhen-chia-pa at 1,1 DD m., *F. T. Wang* 22B3D a ! Ping-wu hsien, Mou-tsin-ling at 1,5DD m. *F. T. Wang* 22451 a ! and on the road to Tsung-chuan, *F. T. Wang* 22313 a ! Kiang-you hsien, Kuan-wu shan, *F. T. Wang* 22249 a ! Kuan hsien, in thickets between 3,ODD and 3,BCD ft., *W. P. Fang* 2147 ! Tsing-chen shan, *F. T. Wang* 22198 a ! and on the road to Shui-mo-ku at 8DD m. (var. *longifolia), F. T. Wang* 2D738 a ! 2D74D a ! Mou Hsi en, Kuan-yiiiff shan at 1,3DD m. (probably var. *longifolia), F. T. Wang* 22139 ! and in the Huan-ying shan at 1,2DD m., and at 1,95D m., *F. T. Wang* 22154 ! 21898 ! Mount D-mei, in thickets between 4,DDD and 4,5DD ft., *W. P. Fang* 2531 ! **8 b. Province of Y U n - n a n.** Mo-sD-yn, in hedges, *Delavay* 3854 ! 4DB9 ! Tong-tschouang, i¥aire3DB5, teste R. Knuth. **8 c. Province of W w e i - c h D W .** Hon-lou shan, *Bodinier* 164B ! Hill of Lou-tsing-kwan near Kwei-yang, *Bodinier* 1711 ! Thai-mey-tse, *Esquirol* 275 ! Tong-tcheou at 1,3D[) m., *Esquirol* 3755 ! Kwei-ting, Pin-fa, in the open, *Y. Tsiang* 5388 ! and in cultivation, *Handel-Mazzelti,* and in light woods, *Y. Tsiang* 5444 ! Yun-fou shan, near Pin-fa, on an open ridge at 5DD m., *Y. Tsiang* 5519 ! Liang-feng-yah in ths Tsun-yi hsien at l.DDD m., *Steward, C. Y. Chiao and H. 0. Cheo* 270 !

EASTERN INDO-CHINA. **9 a. Formosa.** North-eastern part of the island, *Wilford* ! Kelung, *Faurie* 551. Bankinsing, *Henry* 1B73 ! **9 b. The Kwangs.** Hong Kone, *Hance.* K w a n p - t u n g province. Canton, cultivated and persisting from **cultivation,** *Maingay* 3S7 !

PACIFIC. **14 b. Western Pacific.** B o n i n islands, cultivated, *Tchonoski.*

PLATE 1D4. Dioscorea Dpposita, *Thunberg.* |1) A branch with typical leaves and mala flowers, a few of the leaves alternate, from Henry's no. 2023, nat. size : (2) a male flower from the side, X ID : and |3) from the Dutside, X ID: (4), (5) and (5) a sepal, a petal and a stamen, x 10 : |7) a branch with somewhat unusually shaped leaves, and with male flowers from Henry's no. 1538, nat. size : |8) a pair of leaves and male flowers from a specimen in Herb. Fischer, nat. size : (9) a branch with capsules almost ripe, from a specimen collected by Potanin, nat. size: |1D) a seed, nat. size : |11) a female flower, X ID: |12) a tuber of the most usual shape, reduced to one-sixth : (13) a tuber of "tsukne imo", after "The Useful Plants of Japan", much reduced.

90. DIDSCDREA LINEARI-C DRDATA, Prain and Burkill in Kew Bull., 1925, p. 61 : Groff in Sci. Bull. 2, Lingnam Univ., 1930, p. 29.

Underground parts unknown. *Stems* attaining 2-5 metres in length, perhaps more, tawny when dry, terete, glabrous, about 2—3 mm. thick. *Bulbils* not seen. *Leaves* alternate in the lower parts of the stem and opposite above, from a narrow cordate baSB linear-lanceolate, up to 12 cm. in length by 14 mm. in width, evenly narrowing from the basal lobes to the apex where they end in a mucro, 7-nerved : the nerves of the first pair diverge from the midrib at 25° to enclose a very narrow linear-lancBolatB area : the nerves of the second pair diverge at 40° to become submarginal at the mid-length of the blade : the nerves of the third pair run into the lobes : secondary nerves elbowed : the upper surface smooth, glabrous : the lower glaucous, glabrous with the larger nerves prominent : petiole 15—20 mm. long.

Male flowers in solitary spikes which arise in leaf-axils : the axis of the spike up to 4 cm. in length, with about 23 — 3D flowers, which stand out from it at a right angle, and are not pressed down upon it ; bracts a little reflexed, narrowly ovate-acuminate, to 1*5 mm. long : bracteoles triangular-acuminate, shorter than the bracts. *Sepals* ovate, rounded above, 2-5 mm. long, brown-dotted. *Petals* a little smaller, otherwise very similar. *Stamens* 5, with anthers equalling in length their filaments, introrae, anrl standing close together in the centre of the flower. *Gynoecium* a small cone.

Female plant unknown.

CHINA, in the provinces of Hwang-tung and Kwang-si.

Thia species comes very close to *D. oppoaita,* and *D. japonicu.* It differs from them in its narrow leaves and to sums observers will seem a variety of the latter, especially if they have any inclination to merge the two. The labels of the specimens from the north Df the province of Kwang-tung gi?e the vernacular names "shan chuk shu", and "shan chuk ko shu" which mean respectively, mountain bamboo yam, and mountain bamboo pole yam. Tsang gives the name "tsuk ko shu".

The type plant is K. K. Tsuo's number 3712.

EASTERN INDD CHINA. **9 b. the K Wangs.** K w a n g - t u n g province. Near Iu, in the Lung fan mountains in ravines *[To and Ts'ang* in Herb. Canton Christian College) 12146 ! 124D6 ! Chong-uen shan, near Kan-fung in the Loh-ch'ang hsien, *W. T. Ts'ang* 20815 ! K w a n g - s i province. Wu-chow, just within the eastern limits of the province, *K. K. Tsoo* 3712 ! Without locality, *R. 0. Ching* 5896 !

PLATE 1D7, left hand side. Dioscorea lineari-cDrdata, *Prain and Burkill.* |1) A part of the type plant, **f** nat. size : |2) a male flower, X2£ : |3) the parts of the flower, x2£ : (4) stamens, x2£.

91. DIDSCDREA JAPDNIDA, Thunberg, Flora Jap., 1784, p. 51 : Siebold in Verhandl. Bataviaaach Genootsch., 12, 1833, p. 4 : Kunth, Enum. plant., 5, 185D, p. 388 : Zollinger, Syst. Verzeichn. d. im Ind. Archipel gesammelt. Pflanzen, 1854, p. 68, excluding the SaJayer specimen : Hoffmann in de Vriese, Tuinbouw Flora, 1, 1855, p. 269, plate 13 : Miquel, Prolusio Flor. Jap. 18B7, p. 385: Somoku Zusetsu, ed. Df 1874, 2D plate 55: Franchet and Savatier, Enuni. Flor. Jap. 2, 1878 (though dated 1879), p. 47 : Kanitz, Anthophyta Jap. 1878, p. 9: Matsumura, Names Jap. plants, 1884, p. B8 : Engler and Maximowicz in Engl. Bot. Jahrb. B, 1885, p. 52 : Makino in BDt. Mag. Tokyo, 1888, p. 25, and in 1889, p. 112 : Makino, Illustr. Flor. Jap., 1, 1889, p. 58: Bretschneider, Bot. Sinic, 2, 1892, p. 193 and 3, 1895, p. 415 : Matsumura, Shokubutsu Mei-i, 1895, p. 137: Kawakami in Bot. Mag. Tokyo, 11, 1897, p. 42 : Diels in Engl. Bot. Jahrb., 29, 19DD, p. 251 : D. H. Wright in Journ. Linn. SDC. Lond., Bot. 3B, 19D3, p. 91 : Matsumura and Hayata in Journ. Coll. Sci. Imp. Univ. Tokyo, 22, 1905, p. 433 : Pavolini in Nuov. Giorn. Bot. Ital., 15, 19D8, p. 441 : Kawakami,. List plants Formosa, 1910, p. 122 : Dshima and Tadokoro in JDUITI. Doll. Agric. Hokkaido, Imp. Univ. Sapporo, 4, 1911, p. 244 : Hayata, Vegetation of Mount Fuji, 1911, p. 52 : Makino, Somoku Dusets, ed. of 1912, p. 1212 |23, plate lvi) : Seiya Ito in Trans. Sapporo Nat. Hist. SDC, 4, 1912, p. 8 : Prain and Burkill in Journ. As. SDC. Bengal, N. S. ID, 1914, p. 28 : Rehder in Sargent, Plantae Wilsonianae, 3, 1915, p. 14 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 2B2 : YamamotD, Suppl. Ic. Plant. Formos., 3, 1927, p. 7 : S. S. Dhien in Dontrib. Biolog. Lab. Sci. SDC. China, 3, nD. 1, 1927, p. 24 : Yamazuba, List Manch. plants, 1930, p. 59 : Makino and Nemoto, Flora Jap., ed. 2, 1931, p. 1585 : Kudo and Sasaki in Ann. Rep. Taihoku Bot. Gard., 1, 1931, p. 21. and 3, 1933, p. 74: Kitagawa in Journ. Jap. Bot., 9,1933, p. I11: Masumunein Mem. Fac. Sci. Taihoku Imp. Univ. 11, 1934, p. 5B5 : Burkill, Diet. Econ. prod. Mai. Penins., 1935, p. 821 :

Dioscorea bslophylloides, Prain and Burkill in Journ. As. Soc. Bengal, N. S. 4, 19DB, p. 448 and 10, 1914, p. 36: Léveille, Flore de Kouy-t'cheou, 1915, p. 142 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 268, excluding his Indian specimens.

Dioscorea Fauriei, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 253.

Dioscorea Goeringiana, Kunth, Enum. plant., 5, 1850, p. 4D2.

Dioscorea kdungensis, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 2B3. Kudo and Sasaki in Ann. Rep. Taihoku Bot. Gard., 3, 1933, p. 74; but not of Hayata.

Dioscorea Jciangsiensis, *R.* Knuth in Fedde, Repert. Spec. Nov., 20, 1925, p. 80.

Dioscorea neghrta, R. Knuth in the same, p. 355.

Dioscorea pseudo-japonica, Hayata in Ic. Plant. Formes., 10, 1921, p. 42 with a figure cn p. 41 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 257 : Kucb and Sasaki in Ann. Rep. Taihoku Bot. Gard., 1, 1931, p. 21.

Dioscorea rhipogonoides, Hayata in Journ. DDII. Sci. Imp. Univ. Tokyo, 22, 19D5, p. 433 ; not of Oliver.

Dioscorea sativa, Thunberg in Herb, propr.

Prelinnean reference :—

1712. DJDSO sive Jamma imo., Kaempfer, AniDen. Exot., 5, p. 825. [DJDSU is equivalent to shu-yu and derived from it; butyama imt) is *D.japonica* as apart from *D. opposita,* so that Kaempfer referred to both species in the same line.]

Tuber elongated, even up tD 2 metres, descending deeply into the soil, slightly clavate, edible, and apparently of excellent flavour when cooked ; but the labour of digging it is excessive in comparison with the return : flesh white. *Stems* glabrous, unarmed, rather firm, solid and smooth except for faint longitudinal striae, green or greenish-purple. *Bulbils* freely produced, like small peas in shape and size. *Leaves* commonly opposite, glabrous, deltoid-cordate or cordate-ovate or ovate-hastate, acuminate, with rounded lobes and with a sinus generally wide and often very wide, the blade almost evenly narrowed from the lobes towards the apex, SD that there is scarcely a sinus in the margins above the lobes, up tD 8 Dr ID cm. long by 4 cm., or rarely reaching 5 cm., in width, 7-nerved : the nerves of the first pair enclose a narrowly lanceolate area having diverged from the midrib at about 25° : the nerves of the second pair diverge from the midrib at 55° and curve rapidily to the margin at about £ to \ the length and thence continue upwards submarginally nearly to the acumen : the nerves of the third pair enter the lobes and give off on the lower side in a pedate manner nerves into the lobes : the secondary nerves are few and irregular : the upper surface \'& glabrous, with the primary nerves distinct : the lower surface shining, with the primary nerves prominent and the secondary nerves somewhat distinct : petiole up to 4-5 and sometimes to B cm. long.

Male flowers to the number of about 3D, in solitary or paired spikes arising in the leaf-axils : axis in Japanese specimens distinctly negatively geotropic, but not so markedly ao in Chinese specimens, up to 7 cm. long, sterile in the lowest 1 cm., glabrous, angled : buds a little elongated, at right angles to the axis : bracts ovate-acuminate, scarious, repressed by the bud against the axis, and curving round its base, brown-lineolate : bracteole deltoid-Dvate, shortly acuminate and likewise brown-lineolate. *Sepals* slightly keeled down the back, ovate-elliptic, obtuse above, thin at the margins, 2 mm. long. *Petals* conspicuously shorter than the sepals, rounded above, think, 1-5 mm. long. *Stamens* 5, the filaments scarcely equalling the anthers in length. *Gynoecium* a three-lobEcl wart.

Female flowers on solitary decurved spikes : axes up to ID cm. in length, sterile in the basal 1-5 cm. and above that slightly zigzag, angled : bracts broadly ovate with a very short acumen, scarious, brown, with a paler margin : bracteole similar but very broad in proportion to its length. *Sepals* ovate, thick. *Petals* similar, but a little shorter and narrower. *Staminodes* minute. *Stigmas* as three pairs of sickle-like organs. *Capsules* parchmenty, facing somewhat obliquely downwards, tawny; stipe 2—3 mm. long; wings 13—15 mm. long along the placenta, making almost three-quarters of a circle owing to the way in which they are retuse above, 12—13 mm. broad. *Seeds* with a nearly circular wing surrounding them.

JAPAN, as far north as lat. 4D^{D} 3D' N., COREA and in CHINA in varieties.

This species was collected by Kaempfer during his short residence in Japan, and a leaf which he obtained is preserved in the British Museum of Natural History |Herb. Sloane, vol. 211, p. 1D5). In his *AmoenitateB* tbB Japanese name " yama imo " occurs in thB form " jamma imD."

Thunberg, eighty-five years later obtained it in the neighbourhood of Nagasaki and, quoting Kaempfer, carefully described it under the name *D.japonica*. In his herbarium a specimen is preserved correctly labelled, along with another Dne named *D. sativa,* while the name *D. japonica* occurs upon a sheet of *D. bulbifera.* These may be regarded as subsequent confusions, but the name " sativa " suggests that " naga imD " |see under *D. opposita)* which Thunberg possibly confused with *D. japonïca* , may have been known to him. Thunberg in his *Travels,* French edition of 1795 |VD1. 4, p. 84) states that the tubers of his *D.japonica* were frequently brought into the Dutch factory of De-shima along with the fodder for the animals kept there, and |vol. 3, p. 84) cut into slices and boiled they were found very pleasant tD eat. We find it difficult to believe that the Japanese supplied the tubers of *D. japonica* tD the Dutch : we think that it was the race " naga. imD " of *D. opposita* which they supplied, and that Thunberg, cooped up in the factory and unable to see the plants growing, confused it with the wild *D. japonïca.* Then some whisper of cultivation may have caused the name "sativa " to be attached to one specimen. It is clear from what has been said under *D. opposita on* page 251 above, that information derived through Japanese interpreters, being all that Thunberg could get, would lead him to understand that the long tubers Df the race " naga imo " should be regarded as *D. japonica* rather than *D. opposita* which was to him " tsukneimo " only. Among the later Dutch Embassy surgeons was Goering, after whom *D. Goe,ringiana* was named by Kunth. Miquel rightly referred Goering's plant to *D. japonica* : but it, which was in Luca's herbarium, is no longer to be found at Kiel where it should be. The number on which *D. Fauriei* was based is rather broad-leaved, and in that respect somewhat suggests *D. opposita.*

In Loudon's *Encyclopaedia,* 183B, (Supplement 2, p. 1541) it is said that *D.japonica* was in cultivation at that date in Britain ; but we know of no evidence in support of the statement. The date is earlier than that at which the French commenced in Paris the cultivation of *D. opposita :* but that one Df these species, either of which can be grown with ease, should have been in Britain then is quite likely. They appear above ground at Xew in the end of May and flower in the autumn too late for the formation Df fruit.

D. japonica has a few additional synonyms, resulting from the raising of varieties to specific rank. We classify its varieties thus :—

Leaves long-cordate or sometimes from the straightness of the sides above the auricles somewhat ieltoidly long-cordate, drying green :

Male spikes showing negative geDtropism .. .. .. var. *vera.*

Male spikes showing no marked negative geotropism :

Spikes with an axis which is not very thin : flower 1 -5 mm. long, .. var. *chinensis.*

Spikes with a very thin axis, and flowers a little smaller .. .. var. *tznuiaxon.*

Leaves with the auricles slightly thrust out laterally, SD that there is a bay above them in the margin of the leaf, not SD pronounced as in *D. opposita,* but of the same nature .. .. .. var. *kelungensis.*

Leaves shaped as in var. *vera,* but smaller and in length proportionately less .. var. *nagarum.*

Leaves long-sagittate, with the inside margins of the lobes almost straight, drying brawn, usually longer than those of the above, and with the sides very slightly arched .. .. var. *belophylloides.*

The variety *kelungensis* is Hayata's *Dioscorea ktlungmsis* as well as his *D. pseudo-japonica :* it is not R. Knuth's *D. kdungensis* but his *D.japonica* var. *Oldhami* and also his *D. neglecta :* and in an early publication Hayata called it *D. rhipogonoides.* It is a very interesting plant because it provides at least part of the Chinese medicine " shan yu " or in the form of clippings, " shan yu tsai." We were minded to call it var. *offidnalis* from this circumstance and our name will be found in various herbaria, where it was written before we were most kindly enabled by Dr. Hayata to see authentic specimens of his own. It seems to be abundantly found near thB eastern coasts of China. Var. *tenuiaxon* is found towards the west: and var. *nagarum,* as its name implies, is found in thB Naga Hills of Assam.

ThB medicinal " shan yu " is commonly seen as glistening shavings which are very brittle and get broken into fragments. The *Reports of the. Chinese Maritime Customs* show how it is carried in trade southwards ; and it reaches Singapore. The produce Df northern provinces seems to be held of greater value than that Df southern, the result is a pushing southwards Df the product, part of the produce of the north being able tD obtain a sale in competition in the south where the drug is equally produced. The most esteemed quality is called " huai shan yu," and connected by repute with the district of Huai hsien in the province of Shen-si: but as we have pointed out " huai " is the Mon word for a yam usually written " khoai," so that " shan yu " is " khoai shan " in the markets of Tonkin : therefore investigation into the origin of this belief is desired before the derivation is accepted as a fact.

The *Chinese Customs Reports* do indeed indicate Shen-si as a province in which it originates ; but only along with others :—for Dhi-li |Ho-pei), HD-nan, Shen-si, Hu-peh and Ngan-hwei equally send it to the coast under the name of "huai shan yu." Along the coast the larger part of the supplies travels southwards ; being joined in the southern ports by additional supplies which come from the provinces of Fo-kien, Kwang-tung and Sze-chuan, and in these ports trade is done with it under the name "chien shan yao" or "chien shan yu." E. M. Holmes |inPharm. jDurn., 1879—1B8D, p. 101) states that *D. japonica* furnishes the medicins in Japan, the tuber being scraped and dried ; and any manufacture in Japan would be from *D. japonica* var. *ve.ru*, but exactly what is used in the various Chinese provinces cannot be determined. Only as regards Formosa, Watters has left it on record that *D. japonica* var. *kelungsnsis* is the SDUTCB of the "valuable mBdicinB, shan yu tsai."

Bretschneider *Value of Chinese works,* 1870, p. 12) states that this medicine ia mentioned in the Material Medica of thB Emperor Shen-nung |SBB p. 24B above.) It seems to be nearly inert.

Fesca *Biitraga zur Kenntniss d. japanischur Landwirthschaft,* 2, 1892, p. 247) says that "yamano imo" or "jinen-jo" has tubers more tasty to eat than *D. opposita ;* and he cannot be referring to any other species than *D. japonica, BO* that his remarks suggest indirectly thB inertnBss of thB aame used medicinally. Rein in his *Japan nach Reism* |1B8B) had said that starch is prepared from it in Japan. Kellner |in LandwirthBch. Vers.-Stat., 30, 1884, p. 42) and Mueller-Becck |VerzBichn. d. sssbar. Pflanzen Japans, 1B8B) had stated that the tubers are eaten.

The interesting phenomenon of hermaphroditism in *Diosaorea* has been observed in this species. It occurs in Japan, for Makino's "naga imo" from Tokuwano is hermaphrodite and so is Faurie's no. 719B from Iwagasan.

Dno has written a paper on the ertraflural nectaries.

JAPAN |all var. *ve.ro).* **5 b. Central Japan** |Nippon). Mutsu province. Tokiwano, *Sci. Coll. Imp. Univ. Japan* ! Ugo province |?). Shonai, *Kawakami.* Echigo province, without precise locality, *Seiya Ito.* Shimidotauk$_B$ province. Central mountains, *Maries* ! Nikko, *Enghr* 7654 teate R. Knuth. Muaaahi province. Miyanoshti, *Warburg* 7512 teste R. Knuth. Komaba near Tokyo, *K. Dnuma* ! Tokyo, *Seiya Ito.* Sagami province. Yokohama, *Maximowicz* ! *Bisset* 377 ! 838 ! *Schott-Mueller* ! *Naumann* ; *Engler; Wichura* 8D3, tests R. Knuth. Yokusuka, *Savatier* 1248 ! Hakone, *Makino* ! Suruga province. Prairies at thB foot of Mount Fuji, *Hayata.* Shinano province. Iwagasan, *Faurie* 7 ! 95 1 Tamba province. Tanyu between Kyoto and Maizuru, *Doederlein,* tests R. Knuth. Izumi province. Koyaaan in thickets, *Faurie* 81 ! Dki Shima, *Seiya Ito.* Tau Shima, *Warburg* 8133 teste R. Knuth. **6 c. Southern Japan.** |Shikoku island.) TDSa province. Sakawa, *Makino* 4B *a* ! 45 b ! 45 c! Nanokawa, *Watanabe* ! |Kiu-shiu island.) Hizen province. Nagasaki! *Thunberg* ! *Maximowicz* ! *Weiss* ! *Oldham* 8B8 ! *Du Bois-Raymond : Wizhura,* teste R. Knuth. Presumedly Nagasaki, *Kaempfer* ! *Siebold* ! *Mohnicke* ! *Buerger*! *Oosring ex Zollinger* 122 ! 1171 ! Akunora on mount Masatake, and between Akunora and Niaitimari and also un mount Kawara yama, in woods, *Weiss.* Zijoure, *Buerger* ! Saga,

Doenitz teste R. Knuth. Hi go province |?). Mount Higosan, *Siebold.* Gotu Shima, *Warburg* 81BD teste R. Knuth. Satauma province. Kagoahima, *Warburg* 7507 teste R. Knuth : and probably in the same neighbourhood, TakewD-toge near Tsukasaki, *Herb. Demisne* ! **B d. LiU-kiU islands.** Yaku shima, Tanega shima, Amaiii O-shima and Okinawa, *Masumune.*

CATHAY. **7 a. Corea.** Que1part island (all var. *vera).* Without locality, *Fauris* 861 ! 2D82 ! 2D9D ! Seikiho on the south coast, *Wilson* 9522 ! HongnD in hedges, *Tacquet* 1520 ! 3317 ! 4097 ! 5232 ! 5233 ! Chimpat or Piento Thimbat, at 7DDm., *Tacquet* 1519 ! Towngma, *Tacquet*! **7 b. the Amur valley and Manchuria.** Province of Shing-king. Mang-tao island near Port Arthur, *Kitagawa.* **7 C. Northern China.** Province of Kan-su. Lau-chou-fu on the Hoang-ho river, *Piasezky* ! **7 d. Mid-China.** Province of Ha-nan. Ki-knng shan at BDD m., *Steward* D745 ! Province ofChe-kiang. Without locality, *Y. L. Keng* 3282 ! *T. N. Liou* 13S ! *K. K. Tsoong* 3D96 ! Ning-po mountains, *Faber* 8D ! Tien-mu shan, *T. N. Liou* 123 ! and |var. *chinensis) T. N. Liou* 134 ! on roadsides, *R. C. Ching* 5D38 ! *Tang and Hsia* 182 ! and |var. *kelungensis), Tang and Hsia34:2* ! At the back Df the temple in the Tien-mu shan on an open roadside, *S. S. Chien* 751 ! and an a rocky slope |var. *chinensis), S. S. Chien* 46B ! Sze-tou, south of Sia-chu, 15Dto BDDm., *R. C. Ching* 1725 ! Tien-tai shan, *H. H. Hu* 517 ! at 2,70D ft., on moist, shaded slopes, and at 1,3DO ft., *C. Y. Chiao* 14322 ! 1434B ! 14444 ! Sui-an hsien, *Y. L. Keng 7'a!* ! Province of Ngan-hwei. Chin-hwa shan, at 700—8D0 m., *8. C. Sun* 133 ! 119D ! and on the Ngan-hwei river, *R. C. Ohing* 8445 ! Huang ahan, in southern Ngan-hwei, *S. S. Chin* ! Province of Hu-peh. Patung hsien, in thickets at 930 m., *Wilson* ! Valley of Yuen-lao-lin in the Mu-pau shan, Sce-men and Kai shan near Siang-yang, *Silvestri.* Province of Kiang-si. Without locality [type of *D. kiangsiensis), H. H. Hu* 1034 ! also without locality, *S. H. Hsiung* 4293 ! Hsin-feng hsisn, in an open valley, *H. H. Hu* 1035! Lu shan, in the Ku-ling mountains (drying dark-coloured), *H. H. Hu* 4293 c ! |var. *chimnsis,* all the following), *H. H. Hu* 4293 b ! 4293 D ! *Steward* 2433 ! 4755 ! *Schihdhr* 350 ! Ku-ling, in shade among rocks, C. *Y. Chiao* 18677 ! Between 700 and 800 m., *H. H. Chung and S. C. Sun* 161 ! 445 ! 594 ! and at HDD m. |var. *belophylloides), Bullock* ! Kiu-kiang, *Shearer* ! *Carles* ! *C. Y. Chiao* 1876 ! Tung-hwa shan at I-hwang, 7D0m., *Y. Ts'iang* 10D59 ! Near Sa-tin-hong, Yung-shin, at 850 m., *Y. Ts'iang* 11638 ! Province ofFo-kien. Dn the Pao-chu shan, at Yen-ping, at HDD m., *H. H. Chung's collector* 2933 ! Buong-kang, Yen-pmg, in thickets at 700 m., *H. H. Chung* 3279 ! and without locality, *H. H. Chung* 5536 !

SOUTH- WEST CHINA. **B a. Province of Sze-chuan.** Nan-chuan, *v. Rosthom* 694. Nan-kiang hsien, on the road to Kwan-men-tze, at 800 m. (a little uncertain), *F. T. Wang* 22654 a! Mou hsien, Kuan-ying shan, at UDOm. |var. *tenuiaxon), F. T. Wang* 22181 ! Li-fan-fu {var. *kdungensis), Potanin* ! Ho-chuan hsien, Mu-lung-tung (var. *tenuiaxon), Lu and others* 41 ! Mount D-mei at 2,5DD ft. (var. *tenuiaxon) Faber* ! |var. *chinensis), W. P. Fang* 2531 ! **B C. Province of Kwei-ChDW.** Pin-fa, *Cavalerie* 235 ! Yun-fou-shan, near Pin-fa, in an open ravine at 6DD m. (var. *chimnsis), Y. Tsiang* 5534! Tou-chan |var. *kelungensis), Cavalerie and Bodinier* 2738 ! Liang-feng-yah in the Tsun-yi hsien at 1DDD and UDDm. (var. *belophylloides), Steward, C. Y. Chiao and H. C. Cheo* 231 ! 277 !

EASTERN INDO-CHINA. **9 a. Formosa** (var. *kelungensis).* Tamsui, *Watters* 37 ! *Wilford* ! *Oldham* 573 ! *Hayata.* Kelung, *Hayata : Makino* ex Hayata. By the shore, *Faurie* 548 ! Byoritsu, near Taiko, *Hayata.* Shichiseizan, *Hayata* ! *Nakahara.* Taihoku' *without collector's name* 21635 ! Taitokan, *Sirnada* 388 ! Soyan near Taihoku, in thickets, *Wilson* 1D791 ! Rarazan, Gukutsu, Ritozan, InarD, Gaogan and Taikokan, *Hayata.* Cape Pako and the Tsuisha coast of Lake Jitaugetusan in Central Formosa, *Kudo and Sasaki* 15063, 15274. Tsua island in the same *\D. pseudo-japonica), Kudo and Sasaki* 155D5. Kizan island, off the east coast |var. *kelungensis* and a form with elongated leaves

which thB collectors call var. *formosensis), Kudu and Sasaki.* **9 b, the KWangS.** K w a n g - t u n g province (var. *vera).* Tan-sha-shan at Yun-fa (between var. *vera* and *D. opposita), S. P. Ko* 50628 ! Loh-fau shan, *N. K. Chun* 41535 !

WESTERN INDOCHINA. **ID a. Khasi-Naga Hills** |var. *nagarum).* N a g a H i l l s . Kohima at 4,500 ft., *Prain* ! Cheswezuma at BCDD ft., *Bor* 4477 !

PLATE IDS. DioscDrea japonica, *Thunberg.* jl) A pendent branch with male flowers from a plant collected by Bisset at Yokohama, nat. size : (2) a sepal, xl[) : |3) a petal, XlO: (4) a stamen, XlO: (5) a pendent branch with fruits from a specimen collected at Yokohama by Maximowicz, nat. size : [5) seeds, nat. size : (7) a pair of leaves and abnormally elongated spikes from a specimen collected at Hakone, Japan, nat. size : |8) a leaf and male spikes of var. *nagarum,* nat. size : |9) a large leaf of var. *tenuissima* from a specimen collected by Dldham in Formosa, nat. size : (ID) small leaves and male spikes from a flowering lateral branch of the same, nat. size : (11) a tuber after "The useful plants DI' Japan," much reduced.

PLATE IDS, left side. Dioscorea japonica var. belophylloides. |1) A branch with male flowers from Bullock's no. 245, f nat. size : (2) male flowers, x6 : (3) a flower cut open : (4) a petal, X 12: |5) a stamen, X16: |B) a branch with capsules from Shearer's specimen, nat. size : (7) a female flower, xB: (8) the same dissected : |9) a seed, £ nat. size.

92. DIDSCDREA OWENII, Prain and Burkill in Hew Bull., 1925, p. 63 : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 822.

Dioscorea sp. "apparently D. belophylloides," Burkill in Gard. Bull. Straits Settlements, 2, 1918, p. 85, with a plate.

Tubers irregularly clavate, forked and divided into a variety of shapes, on short stalks and descending into the soil only about 20 cm., brown-skinned with white flesh, considered by the Dhinese who cultivate the species, to be a delicacy. *Stems* climbing to a height of about 4 metres, glabrous. *Leaves* generally hastate, or sometimes long-deltoidly hastate or towards the upper parts of the stems long-cordate, up to 14 cm. long by about 6 cm. in width measured across the lobes where they are widest, very rarely as much as 9"5 cm. wide, 7-nerved : the nerves of the first pair enclose a lanceolate area : the nerves of the second pair diverge from the midrib at about 9D° to curve upwards and to end submarginally about the mid-length of the blade : the nerves of the third pair enter the lobes and curve in them sharply with a fish-hook curve, and give off a branch on the lower side which repeats that fish-hook curve : secondary nerves weak and irregular : upper surface of the blade glabrous and smooth, with the primary nerves prominent but the others scarcely visible : lower surface glabrous, with ah" the nerves prominent : petiole scarcely half as long as the blade.

Flowers unknown.

SOUTH-EASTERN CHINA, in cultivation.

This *Dioscorea* is something which the Chinese have selected from *D. japonica* or *D. opposita* or an ally. It was brought to our notice by the late Mr. G. P. Dwen of Singapore who had received it from a Chinese of the island of Hai-nan. The Hai-lams of Hai-nan call it " kiu-tu " which means ginger tuber, probably on account of its shape. Mr. Owen received it in 1915 : and it was grown in Singapore by him and by one of us for ten yeara, without flowering.

EASTERN INDU-CHINA. **9b. the Hwangs.** Island Df H a i - n a n , whence brought to Singapore and cultivated there experimentally, *Burkill* 151D ! 2213 !

PLATE 1DB, right side. Dioscorea Dwenii, *Prain and Burkill.* Foliage, £ nat. size : tubers, reduced to ^ nat. size.

Group of D. BBfithamil (species 93). A species of China which differs from the group Df *D. japanica* in one character only, namely, the possession of leaves which are not cDrdats at all at the base.

93. DIOSCOREA BENTHAMIL, Prain and Burkill in Journ. As. Soc. Bengal, N. S., 4, 19D8, p. 448 and ID, 1914, p. 38 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 283 : YamamotD, Suppl. Ic Plant. Formos., 3. 1927, p. 5 : Syun'iti Sasaki, List Plants Formosa, 1928, p. 113.

Dioscorea glabra, Hayata, Ic. Plant. Formos., 6, 1916, p. 84 ; and in Journ. Doll. Sci. Imp. Univ. Tokyo, 3D, 1911, p. 355 in regard to Nakahara's no. 715 ; not Df Roxburgh.

Dioscorea oppositifolia, Bentham, Flora Hongkong., 1851, p. 3B7 : C. H. Wright in Journ. Linn. SDC. Lond., Bot. 31, 19D3, p. 92, excluding synonyms: Hayata, Ic. Plant. FormDS. B, 191B, p. 84 and in Joum. Coll. Sci. Imp. Univ. Tokyo, 22, 1905, p. 432 in regard to references only ; not of Linnaeus.

Dioscorea tarokoensis, Hayata, Ic. Plant. Formes. 10, 1921, p. 44 : R. Knuth in Engl. Pflanzenreich, iv-43,1924, p. 289.

Underground parts unknown. *Stems* glabrous, unarmed at least in the upper parts, slender, with slight angles, turning reddish. *Bulbils,* none seen. *Leaves* opposite, lanceolate-ovate or narrowly ovate, rounded at the base, acuminate at the apex and mucronulate, up tD 8 cm. long by 3 cm. in breadth, 5-nerved : the nerves of the first pair diverge from the midrib at only 15° or little more to enclose a lanceolate or sometimes broadly lanceolate area : the nerves of the second pair diverge from the midrib at about 3D° and, becoming submarginal, are evanescent in the upperhalf of the blade: the secondary nerves with some elbows cross the interspaces and are but little distinct from the network : the upper surface is glabrous, with the primary nerves rather distinct and the rest scarcely visible : the lower surface glabrous, reddish when dry, with the primary nerves prominent and the secondary nerves distinct : petiole glabrous, up tD 15 mm. long.

Male flowers many, in solitary or paired or 3-nate spikes arranged upon special leafless branches which may attain 25 cm. in length, and also more rarely in leaf-axils : axis somewhat zigzag, glabrous, ridged and almost winged, up tD 3 cm. long with 10—2D flowers : buda depressed ovoid : bracts deltoid-ovate, acuminate, 1 mm. long : bracteolea similar but smaller. *Sepals* subcircular, concave, 1 -5 mm. long. *Petals* obovate, a little shorter and thicker. *Stamens* 6, equal, their filaments D-5 mm. long, the anthers rather longer than the filaments, oblong, introrse. *Gynoecium* a small trifid cone.

Female flowers in spikes, 4—ID to each, these spikes solitary or two together in a leaf-axil : axis of the spike glabrous, more or less triangular : bracts ovate, acuminate. *Sepals* ovate, acute, thick, 1 -25 mm. long, brown-lineolate. *Petals* thicker, subclavate, 1 mm. long. *Staminodes* about half as long as the petals. *Capsules* glabrous : wings parchmenty, broader than semicircular, retrorse at the apex, fulvoua brown, lined, 12—14 mm. long by 11 — 12 mm. in width. *Seeds* with a smoky brown wing all round.

SOUTH-EASTERN CHINA and FDRMDSA.

Bentham, when in 1851 he distinguished thia species from the Dther DiDSuoreas of Hong Kong, allowed himself to be influenced by Thunberg's and LoureirD'a admission of the Indian *D. oppositifolia* into the FUra of the Far East, seeking for which, he placed that name upon the species under discussion. He had the specimens collected by Charles Wright, the naturalist of the United States exploring ship " Vincennes," and those of Hanceto guide him,—specimens which to ua appear exceedingly unlike the Indian *D. oppositifolia*.

He was followed in point of time by Henry in 1898, Matsumura and Hayata in 19D5, and Kawakami in 191D, who also sought to identify *D. oppositifolia* in Far-Eastern material but unlike him affixed the DMHB where Thunberg seemingly did, namely, on *D. opposite*. C. H. Wright in 19D3 took the name *D. oppositifolia*, for both, and *so* did Hayata in 1911. But the last named subsequently detected the error, and in an endeavour to set the nomenclature right, devised for Bentham's part the name *D. tarokotnsis*, though thirteen years after it had received the name *D. Benthamii*.

Hayata's action in 1921 leaves threB specimens which he quoted in 191B unaccounted for : one of them, Faurie's nD. 551, is certainly *D. opposita :* the other two are Kawakami and Shimada's no. 4217 from Tikutochi in Kagi and their nD. 4DD4 from Shimpoli in Shintiku. As we have not seen these, we cannot place them and we are equally uncertain what is the *D. Benthamii oi* Hayata |in 7c. *Plant. Formos*, ID, 1924, p. 3B) from Shinshu, Binkiho and Halisha. Bodinier collected a plant with hermaphrodite flowers under his number 739 : apparently he gathered it in the hills Df Hong Kong, the date being mid-June.

EASTERN INDD-CHINA. **9 a. Formosa.** Nankakei, *Nakahara* 252 ! Western approach to Nintakayama, between Namakaban and Tempo, above 2,7DD ft., *Bartlett* 6282. TaiDko, *Nakahara* 715 ! **9 b. The Nwangs.** Hong Kong, *Wright* 528 ! *Hance* 536 ! *C. L. Tso 21124:* ! Happy Valley, *W. Y. Chun* 5282 ! 74B8 ! Quarry Bay, *Bodinier* 1232 ! Hedges at Aberdeen and Dn Mount Gough, *Bodinier* 739 ! Repulse Bay, *Burkill* 4 ! Ravine leading to Pok-foD-lun, *Lamont* 787 ! Happy Valley and on Little Hong Kong, without collector's name ! Tytam, *Hance* ! Lantao island, *TsHang Ying* 381 ! Wu-kau-tin, *Ts'iang Ying* 29B8 ! K w a n g - t u n g province. Without locality, *K. K. Tsoong* B54 a ! Feng-leung shan, in dry places at 7D0 m., *McClure* B71D ! Tai-yeung shan, by a stream at 500 m., *McClure* B497 ! as well as upon a hillside at 3DD m., *McClure* 7251 !

PLATE 1D7, right side. Dioscorea Benthamii, *Train and Burkill.* |1) A branch with male flowers from Little Hong Kong, f nat. size : |1a) tip of branch of |1) : (2) amale flower, X3 : |3) the same dissected, X B : |4) stamens, X12 : |5) the gynoecium of the male flower : |6) a bract and a bracteole : |7) a branch with female flowers from the same locality, § nat. size : |8) a branch with capsules, also from Little Hong Kong, |- nat. size : |9) a capsule containing seeds, opened, f nat. size : |10) a seed, f nat. size.

Group of D. slogans |species 94). *D. ehgans* is a species described from inadequate material. Though male flowers and capsules are known, there is no reason tD believe that the attached leaves adequately represent the typical foliage, nor that the male spikes adequately show how they are grouped on well-developed plants. Possibly it is not very closely allied tD the plants among which, for the sakB of the key, we find OUTSBIVBS compelled to place it.

94. DIDSCDREA ELEGANS, Ridley ex Prain and Burkill in Kew Bull., 1925, p. B5.

Dioscorea papuana, Ridley in Trans. Linn. SDD. Lond., Bot. 9, 1915, p. 227: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 323 ; not of Warburg.

Underground parts unknown. *Stem* in the upper parts, which alone are known, unarmed, terete, quite glabrous. *Bulbils* not observed. *Lzavts* [only a few preserved

from the flowering part of the stem), lanceolate tD lanceolate-ovate, the base just cordate, rather gradually acuminate towards the apex, up tD 9 cm. in length by 2 cm. in width, 5-nerved : the nerves of the first pair enclose a linear-lanceolate area : the nerves Df the second pair are weak and run submarginally through the lowest third of the length of the blade : the secondary nerves are but little distinct from the network : upper surface glabrous, smooth and shining, with the primary nerves slightly depressed : the lower surface glabrous, with the primary nerves prominent, the others slightly prominent : petiole 2—3 cm. long.

Male flowers on spikes which are 2 — 3 together upon the termination of a branch ; axis of the spike up tD 7 cm. long, glabrous, angled, the flowers 3D—40 in number: bracts rather broadly Dvate, acuminate, repressed against the axis by the bass of the flower : bracteoles in texture similar, triangularly ovate : buds subgibbous. *Sepals* broadly ovate, very obtuse to almost rounded above, marked when dry with short brown lines. *Petals* rather similar, but smaller and almost mucronulate. *Stamens* 6, with very short filaments. *Gynoecium* a low wart.

Female flowers not seen. *Capsules* of a dull smoky colour, with a stipe 3 mm. long thickening upwards to a diameter of 2 mm : wings broader than semicircular, up to 20 mm. long by 15 mm. in width, a little oblique so that they are just retuse at the apex and spring at an angle of about 80° from the pedicel. *Seeds* with a broad deep-brown wing all round.

NEW GUINEA.

This speciea was founded upon rather meagre material and may piova a stumbling block until it is adequately collected.

PAPUASIA. 12 b. Western New Guinea. Between the first and the second camps of the Wollaston expedition to Mount Darstensz and ao between 500 and 2,500 ft., *Kloss* ! At camp Via of the Expedition, *Kloss* !

PLATE 115, right side. Dioscorea elegans, *Ridley.* |1) A branch with male flowers, from the first specimen, ^nat.size: |2) capsules from the other specimen, ^nat. size: |3) male flowers, x5.

Group of D. Mnultonii (species 95). A rather coriaceous speciBS of **Borneo, with long** male **spikes carrying** well-spaced flowers among the leaves.

95. DIDSDDREA MDULTONII, Prain and Burkill in Kew Bull., 1925, p. 62.

Underground parts unknown. *Stems* in their upper parts unarmed, wiry, terete. *Bulbils,* none seen. *Leaves* alternate, coriaceous, broadly lanceolate, rounded at the base, acuminate at the apex, up to 8 cm. long by 2 cm. in width, 5-nerved : the nerves of the first pair run 4—2 mm. within the margin of the blade so that the area which they SUIT Dund is almost that of the blade itself: the nerves of the second pair are weak and extend only close under the margin in the lowest part of the blade : the secondary nerves are completely absorbed in the network : upper surface glabrous, smooth, the nerves just distinct; lower surface glabrous, with the primary nerves prominent: margin distinctly rimmed : petiole short, about l)"5 cm. long.

Male flowers in elongated spikes: axis up to 10 cm. long, the flowers on each BO or more, glabrous, conspicuously angled : buda elongated, sometimes paired, with a

rather broad base : bracts repressed against the axis at the base, ovate, acuminate : bracteoles similar in shape, but much smaller. *Sepals* long-ovate from a broad base, very obtuse above, 1 mm. long, keeled. *Petals* shorter, thicker and rounded above. *Stamens* 3, the anthers as long as th& filaments.

Female plant \inknown.

State of SARAWAK in Borneo.

D. Moultonii received from us the name which it bears as a token of our admiration of the scientific attainments of the late Major J. C. Moulton, at one time Curator of the Museum in Sarawak and subsequently Director of the Baffles Museum, Singapore. It was collected by a native employed by him fur Dr. E. D. Merrill, who was at thB time Director Df the Bureau of Science, Manila, in which institution the type lies.

D. Moultonii has in leaf-texture and shape resemblances tD *D. Havilwndii* and *D. laiirifolia,* but differs greatly in the male flower-spikes.

The exact locality is unrecorded ; but the collector was employed at Kuching and probably did not **travel** far from his base.

MALAYSIA. **Northern Borneo.** Apparently in the neighbourhood of Kuching, without exact locality, *Merrill's collector,* 2612 !

PLATE 108. Dioscorea Moultonii, *Prain and Burkill.* |1) A branch with male flowers, nat. size : |2) its tip beyond the leaves, nat. size : (3) a portion Df a male spike, X ID-

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Group Df D. Siruinii |species 95). A species of Celebes, abundantly distinct in its very numerous male flower-apikes from each fertile axil, and in its diverse stamens.

95. DIDSCDREA SARASINII, Uline ex R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 291, excluding fig. 5B.

Underground parts unknown, and the lower parts of the stem also unknown. *Stem* in the upper parts unarmed, slightly grooved and as far as observable glabrous. *Bulbils* not seen. *Leaves* alternate or |in the female plant) so unequally alternate as to be nearly sub-opposite, elliptic or elliptic-ovate, abruptly acuminate, rounded at the base, up to 12 cm. long by 5-5 cm. in width, firm but not coriaceous, 7-nerved : the nerves of the first pair enclose a lanceolate-elliptic area : the nerves of the second pair diverge from the midrib at an angle of about 7D[D] and throughout their whole course approach the margin evenly : the nerves of the third pair are submarginal almost from their origin : the secondary nerves are scarcely distinguishable from the reticulation : the margin not strengthened, but not weak : the upper surface glabrous, probably quite smooth in life, when dry with the nerves and network distinct : the lower surface glabrous, with the larger nerves prominent and the network manifest : petiole relatively short, up to 2 cm. long.

Male flowers Dn spikes which arise in dense fascicles in the leaf-axils : the axis attaining and even exceeding ID cm. in length, angled, bearing upwards of BD flowers spaced about 1__2 mm. apart : buds facing obliquely forward : these flowers are described aa fragrant : bracts standing out at a right angle tD the axis, deltoid-acuminate, 1 mm. long : bracteoles deltoid, smaller. *Sepals* "greenish white", ovate, acute, 1-25 mm. bng, with ecarious margins. *Petals* similar, almost as long, a little blunter. *Stamens* B, Df two lengths, those opposite to the petals longer by the length of their anthers than those opposite to the sepals, connective wide below so that the anther-cells approach each other upwards : the filament narrowed downwards and at the base united to those on each side.

Female flowers in iecurved spikes which attain as much as 50 cm. in length, there being upwards of 1DD on a spike : axis glabrous, slightly angled : bracts deltoid-acuminate, scarious, 1 -5 mm. long. *Sepals* round-ovate, just over 1 mm. long. *Petals* a little shorter, of the game shape. *Staminodes* minute. *Stigmas* as three pairs of very short hooks. *Capsules* unknown.

CELEBES.

Our description and drawings have been made from the type specimens which were most kindly lent to U3 by the Director of the Botanic Garden, Berlin : and by a careful study of them we find that Dr. Knuth'a figure with ita opposite leaves and leafless inflorescence cannot represent this plant. A few comments to elucidate our illustration of it seem to be called for.

In life the male flowering branch was pendulous and leafy to the tip. The spikes arose in big fascicles in the leaf-axils and took their direction from the parental axis. The leaves were all alternate, though in the female plant a pair of them were carried in approximation : judging by the female plant, therefore opposite leaves are not unlikely tD occur though perhaps it is unusual for leaves to be SD placed.

A more striking feature, however, than any in the vegetative parts or the grouping of the flowers is in the unequal stamens.

Our drawing of the female plant is from one of two spikes which are preserved in Berlin, straightened aa it must havB been in life.

Dr. Knuth has described a *Diosuorsa celzbesiana* in Englers's *PJlanzenrsioh* |iv-43, p. 291) based on *a* leafy branch |Warburg's no. 15755 from Bojang in northern Celebes) which may possibly be immature *D. Sarasinii.* UlinB had called it *D. rhipogonoid&s* var. *cel&bssiana,* in manuscript. For the aid of students of thB genus we figure a leaf.

MALAYSIA. **11 I. Celebes.** Minahassa district. Tomohan, *Sarasin* 486 : Marasang, *Sarasin* 642 !

PLATE 1D9. Dioscorea Sarasinii, *Uline.* |1) Part of a male plant, from the type, nat. size : |2) part o± a male spike, XlO : |3) a flower in section showing the stamens of two lengths, with their filaments united in the centre of the flower : |4) a sepal, xlO : |5) a petal, x 10 : |5) the androecium from one side, XlO : |7) a stamen from the back: |S) the same from the side, and |9) the same from the inside, xlD : |10) a female spike folded upon itself and a leaf seen from the back : |11) a female flower, Xo : (12) a leaf, not of *D. Sarasinii,* but of *D. celebesiana.*

Group of D. hastifolia |species 97). A single species of Western Australia, differing from *D. transvzrsa* [which follows it) in thB great reduction of its leaves, and the frequence of hastate sun-leaves. The flowers are of thB same size and spaced in the same way.

97. DIDSDDREAHASTLFDLIA, Nees in Lehm. Plantae Preissianae, 2, 1847, p. 33 : Knuth, Enum. plant., 5, 1853, p. 379 : Bentham, Flora Austral., 5, 1873, p. 461 : F. v. Mueller, Select plants for extra-trop. cult. Ind. ed. 1880, p. 100 : Maiden, Useful native plants Australia, 1889, p. 22 : Diels and Pritzel in Engl. Bot. Jahrb., 34, 19D4, p. 113 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 30 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 3D9.

Tubers edible, their shape unrecorded, but penetrating deeply into the soil. *Stems* glabrous, faintly ridged, dark green except at the very base. *Bulbils,* none seen. *Leaves* alternate, of very diverse shapes, but almost dimorphous, sometimes extreme forms being closely associated on the same plant ; sometimes all are hastate and then 25 mm. in

length by ID mm. in width across the barb,? or B mm. in width above them, subobtuse and mucronulate, with 5 nerves : these hastate leaves are sun-leaves: more commonly the leaves are linear, with or without two small auricles at the base, then up to 100 mm. long by 4 mm. in width, the margin revolute and the whole suggestive of a pinna Df *Pteridium,* 3-nerved ; these leaves are associated with the flowers : intermediate conditions occur; the nerves of the first pair Df a hastate leaf vanish in rather rectangular loops about the mid-length of the blade : the nerves of the second pair do not extend beyond the barbs : in a linear leaf the first and only pair Df nerves similarly vanish towards the middle of the blade or are even absent: the secondarynerves are few and cross the interspaces slightly obliquely : the upper surface is glabrous, the midrib on it slightly prominent : the lower surface ia glabrous, with the midrib very prominent and the lateral nerves just prominent : petiole slender, 4 mm. long or longer in the hastate leaves.

Male flowers in solitary or paired spikes which arise in the leaf-axils : the axis zigzag, conspicuously angled, up to 12 cm. long with the lowest 3 cm. sterile, carrying about 35 flowers : buds ovoid : bracts thin, concave, narrowly ovate, acuminate, 0-5 mm. long : bracteoles similar, smaller. *Sepals* elliptic-orbicular from a slightly narrower base, 1-nerved, a little hooded along the upper margin, not dotted, 2-5 mm. long by 1 mm. in width. *Petals* equally long, similarly rounded and hooded, but a little narrower, without dots. *Stamens* 6 : filaments scarcely 0-75 mm. long : anthers arranged in two series, introrse, equalling the filaments in length. *Gynoecium* of three small points.

Female flowers in decurved spikes, few (2—6) on each : axis ridged, flexuous. *Sepals* triangular-ovate, rather thick, scarcely as much as 1 mm. long, strongly keeled at the back. *Petals* similar, but smaller and narrowed below. *Capsuhs* facing irregularly downwards, rather satiny : wings sub-triangularly semi-obcDrdate, being truncate at the apex or a trifle obcordate and at the base obtuse ; they are up to 20 mm. long by 12 mm. in width. *Szeds* dull grey-brown, with a pale reddish straw-coloured wing not quite evenly all round.

WESTERN AUSTRALIA, as far south as lat. 33^{D} S. and as far north as 27° S. here and there through the strip of country from the coast back to the Darling range, say 4D miles.

This *Dioscwea* persists with a rainfall varying from 2D to 4D inches, which falls between April and October, i.B, in the southern cold weather. It has never been in cultivation in other countries in a way which would demonstrate its climatic needs, yet is deserving of such study. It comes into flawer in Australia in May Dr June and fruits towards the end of July and in August. Suitability tD its conditions implies a considerable amount of physiological specialization, such as must have proceeded *pari passu* with the reduction of the size of the leaf-blades which, whether sun-leaves or shade leaves, are very small. Their variability should not remain unstudied. Da the different forms under any circumstances appear in all localities or are they altogether called out by exposure, insolation, etc.? Insolation is the whole cause Df hastate leaves in certain other species of the genus, and may well be the whole cause in this.

The natives find the tubers useful: they consume them considerably and give the plant enough encouragement for VDn Mueller to allude to it as " cultivation " adding that it is " the only plant to which theygivB any. " Sir George Grey in his *Journal of two expeditions* |2, 1841, p. 12) wrote that in one place he encountered " a fertile piece of ground three-and-a-half miles wide and a half-mile broad, literally perforated with holes the natives had made tD dig Dut the roots " and consequently " difficult to cross. "

AUSTRALIA. **13 a. Western Australia,** without precise locality, *Burges* ! Murchison river, *Oldflzld* ! Champion Bay, Geraldton, *Lucas : Oldfield* ! North of Mingenew, *Diels* 3040. Victoria on the Hutt river, *Diels* BlSi). East of Gingin, *Diels* 314D. Red point, *Oldfield* 1125! Swan river, *Drummond* 821! 822! *Preiss* 482! 1954! Greenmount, *Helms* ! Gooseberry Hill in the Darling range, *Clelani* ! Darling range in thick woods, *Pritzd* 303 ! Darlington, *Morrison* ! *Pritzel* ! Foot of the Darling range behind Perth, *Andrews* 980 ! Between WBlshpool and Kalamunda, *Maiden.* Pinjarrah, *Preiss* !

PLATE 11D. Dioscorea hastifolia, *Nees.* (1) A branch with male flowers from Pritzel's no. 303, nat. size : (2) a mature bud from the same, *8 : (3) a flower flattened out, x8 : ^4) a flower in section, x 8 : (5) petals, X 8 : (5) stamen, X 12 : |7) a branch with capsules from Cleland's specimen, nat. size : |8) a capsule, nat. size : (9) a seed, nat. size. : |1D) part Df a sterile branch with hastate leaves from a specimen collected by Cleland, nat. size. All from specimens preserved in the Herbarium of the Botanic Gardens, Sydney.

Group of D. transversa |specie3 98). A single species of eastern Australia, with rather large flowers ; the male spikes grouped in the leaf-axils.

93. DIDSDDREA TRANSVERSA, R. Brown, Prod. Flor. Nov. HDIL, 181D, p. 295 : Kunth, Enum. plant., 5, 185D, p. 4D2 : Bentham, Flora Austral., 5, 1873, p. 4SD : Maiden, Useful native plants of Australia, 1889, p. 23 : Holtze in Trans. Roy. Soc. S. Australia, 1892, p. 114 : Moore, Handb. Flora N. S. Wales, 1893, p. 409 : Maiden in Misc. Publ. ND. 282, Dep. Agric. N. S. Wales, 1899, p. 51 : F. M. Bailey, Queensland Flora 5, 19D2, p. 1615 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. 1 D, 1914, p. 3D : Domin in Bibl. Bot., 2D, 1915, 85-iv, p. 534 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 3D9.

Dioscorea punrtata, Thozet, Notes Dn roots, tubers, etc., used as food by the aboriginals of N. Queensland, 18BB, pp. 7 and 12 : and in F. v. Mueller, Rep. Veg. Prod. Intercol. Exhibition, IB 67, pp. 43 and 45 ; not of Robert Brown.

Tubers penetrating deeply into the soil, edible. *Stems* glabrous, unarmed, in their upper parts wiry, with distinct longitudinal ridges, in colour a rich brown. *Bulbils,* none seen. *Leaves* alternate, hastate-ovate and sometimes broadly so, acuminate or acute, up to 8 cm. in length by 3 cm. in width, 5-nerved : the nerves of the first pair enclose a broadly lanceolate or narrowly ovate area : the nerves of the second pair diverge from the midrib at an angle of 8D—90° and curve round to end just under the margin near the apex ; they give off close to their origin a strong nerve which curves in the lobe : secondary nerves cross the interspaces almost without elbows in many but not in all cases, the weaker not distinct from the network : upper surface glabrous, not shining, with the primary nerves distinct : the lower surface glabrous and shining, with the primary nerves prominent and the secondary just prominent : margin thickened and the secondary nerves outside the primary nerves forked as they reach it in the form of supporting arches : petiole glabrous and slightly frilled just under the blade, up to 2-5 cm. long.

Male flowers relatively large, spaced along zigzag axes which arise singly Dr in pairs in the leaf-axils, or on weak terminations Df the branches where the leaves are replaced by bracts : axis glabrous, winged, up to 7 cm. long with about 2D flowers : bracts ovate, acuminate, rather scarious and somewhat repressed in their lower half against the axis by the base of the flower, up tD 1-5 mm. long : bracteoles similar to the bracts, but only half as long. *Buds* somewhat elongated. *Flowers* strongly scented. *Sepals* nearly orbicular, concave, thin, red-brown, 1 -75 mm. long, with a broad base. *Petals* much smaller, elliptic, very obtuse above, thin, with a rather narrow base, 1-25 mm. long. *Stamens* 6, the filaments equalling the anthers in length ; anthers introrse. *Gynoecium* a short column with three minute warts.

Female flowers Dn spike-like decurved racemes which attain Dnly 2-5 cm. in length : axis conspicuously angled with about 10 flowers : bracts ovate, acuminate, up to 1 mm. long. *Sepals* nearly circular with a small subacute hook at the apex, concave, rather* thick, D-5mm. long. *Petals* ovate, very thick, 1 mm. long or a little longer. *Staminodes* small. *Stigmas* as three sickle-shaped hooks. *Capsules* imbricating downwards, thin, satiny in appearance : stipe about 4 mm. long, widening to 3 mm. in thickness where the wings arise from it at 45° : wings broadly semi-ob cor date, IB mm. long by 12 mm. in width. *Seeds* winged all round, but mature seeds not seen.

AUSTRALIA, in the north-eastern parts and as far south as 34° S. lat.

Dr. R. Knuth has defined seven forms, chiefly by the shape of the leaf-blade. HB cites thirteen specimens, assigning five tD the typical form with deltoid leaves, and four to forma *minoriflora*, the others being single specimens. Forma *minorijlora* may be entitled to recognition ; the others are doubtfully so, for the leaves upon the flowering part of the stem are never of the same form as the lowest leaves, and if sufficient specimens be examined possibly every one of the forms may be found in combination with every other. Beckler's material at Hew, shows forma *lanceolata* above and forma *ovata* below on the same stem : and a specimen collected by MoorB combines forma *ovata* with forma *multiflora*.

It must be added that Robert Brown described the leaves as truncate cordate, whereas " deltoid " is used by Dr. Knuth to describe the type form : they meant the same ; the latter term is the more accurate. For the shapes reference may be made to plate 111.

Just as there is a greater area with a fair rainfall in the east of Australia than in ths west, so *D. transversa* has a wider distribution than *D. haxtifolia*. It grows in the river valleys of coastal regions, through twenty-threB degrees of latitude, and occurs on the mountains as far back as two hundred and fifty miles from the coast. Sometimes it grows about openings in rain forest: at others in Eucalyptus forest. Like *D. hastifolia*, it is forced to grow, at least in part, in the colder half of the year, because that is when it receives the rainfall it requires. It flowers in August and September and fruits in October, November and December.

The aborigines eat the tubers ; and various vernacular names are recorded for it, as " ampu " on the Red river, " kowar " at Roehampton, and " guiaba " DT " gyabi " on the Barron river. Bailey recorded on the authority of Roth that they are eaten when roasted, and it is clear that Thozet indicated them when he said that the tubers of *B. punrtata* arB eaten. He states that young tubers may be eaten raw, and that older tubers are baked.

We acknowledge gratefully information as to its distribution, which hag been incorporated in the following list of known localities, from Mr. C. T. White, Mr. W. D. Francis, Dr. G. P. Darnell-Smith and Mr. E. Cheel.

AUSTRALIA. **13 b. Northern Australia.** Port Darwin, *Suhomburgk* 33 ! *Holtze* 7D ! *Brown* [not Robert Brown), teste R. Knuth. Melville island, *Holtze.* Goulburn island, *Cunningham* B8 ! **13 C. Eastern Australia** (Queensland). Somerset county. Escape cliffs, *Hulls.* Kenda 11 county. Kendall, *Bailey.* BankscDunty. Cooktown, *Warburg* 18394 teste R. Knuth. Naires county. Dairns, *Warburg* 16392 testa R. Knuth. Fitzrny island, *MacGillivray* ! Mount Toressa, *Bailey* ! Dardwe 11 county. Rockingham bay, *Dallachy* ! Herbert county. P_{Dr}t Denison, *Dallachy* ! Cannon valley near Proserpine, *Michael* 1091 ! Dar1is1e county! Mackey, *Nernst.* Eungella range, *Francis.* Palmerston county. Byfield, *White* 8D21. Livingstone county. Neerkool creek, *Bowman* ! Cook county. Biggenden, *White* 7254. March county. Wide bay, *Leichardt*! Fraser island, in forest, *Hubbard* 4395 ! *Young.* Nikenbah, *Tryon.* Gympie, *Swain* ! *Kenny.* CoDtheraba lake, *Francis.* Wicklow county. Eidsvold, *Bancroft*! Canning county. Glasshouse mountains, *White* ! Mount Conowrin at 6DO ft., *Hubbard* 4152 ! 4153 ! Lennox county. Blackall range, *White.* Stanley county. Brisbane river, *Herb. Hooker* ! *F. v. Mueller* ! Peechey'a scrub near Brisbane, *Shirley.* Enogera creek, *Bailey* ! Goodna, *White.* Mogill scrubs, *Bniley* ! Mount Gravatt, *Francis.*

Dhurchill county. Rosewood, *White.* Aubigny county. ToowDomba, cDnimon, *Longman* ! Ward county. Tamborine mountains, *Domin.* Beechmont, *White* b"197. Mount Lindesay, *Forsyth.* Merivale county. Ranges east Df Killarney, *Francis.* (New South Wales). Without locality, *Banks and Solander* ! *Fraser,* 2 of second expedition ! *Domin.* Rnus county. Acacia creek in the Macpherson range, *Dunn.* Murwillumbah, *Campbell.* Byron Bay, *Boorman.* Tweed river district, plentiful everywhere, *Pope.* Tweed river, *Simmonds.* Richmond county. Richmond river, *F. v. Mueller* ! *Ramsay* ! *Moore* ! Casino, *McAulijje.* Clarence county. Clarence river, *Wilcox* ! Copmanhurst, *Rupp* ! *Cheel.* Drake county. Drake, *Richards.* Gough county. Goff's gully in the New England range, *Stuart* 6D3 ! Macquarie county. Hastings river, *Beckler* ! Port Macquarie, *Maiden* ! FitzrDy county. Goff's Harbour, *Maiden and Boorman.* Coramba, *Heron.* Gloucester county. Wallsend, *Boorman* ! Hunter, Patterson and William rivers, *R. Brown* 554B ! Drawiord river near Bullahdelah, *Cheel* ! Port Stephens, *Boorman.* Durham county. Allyn river, *Bowman* ! Northumberland county. Toronto near Newcastle, *Cheel.* Bucca creek near Newcastle, *Boorman.* Gosford, *Moore : Fletcher.* Narara, *Fletcher.* Dunoon, *Fletcher.* Manly, *Hull.*

PLATE 111. Dioscorea transversa, *R. Brown.* |1) A branch with male flowers from a specimen collected by Cheel Dn the Crawford river, nat. size : |2) a leaf and young inflorescence from a specimen collected by Rupp at Copmanhurst, nat. size : |3) a mature male bud upon the bent axis, XlD : |4) a female flower forced open, and |4a), its stigmas, XlD: |5) a male flower forced open, XID : |B) the male flower in section : |7) sepal, X15: 18) petal, X15: 19) stamen : |1D) a branch bearing capsules from a specimen collected at Port Macquaria by Maiden, nat. size : |11) a capsule with very young seeds : |12—18) outlines of leaves from various specimens, nos. 12, 14 and 18 from the same branch, all nat. size. Figures 1—11 from specimens preserved in the herbarium of the Botanic Gardens, Sydney ; and figures 12—18 from specimens in the herbarium of the Royal Botanic Gardens, Hew.

Group uf D. cirrhosa (species 99—1D1). Large coarse plants with tubers which are scarcely edible, Dr at the beat very poor eating, firm to coriaceous leaves, and male flower-spikes grouped together on vigorous blanches, but not into well-shaped leafless inflorescences.

99. DIDSCOREA WATTII, Prain and Burkill in Journ. As. SDC. Bengal, N. S. 4, 19D8, p. 457 and ID, 1914, p. 35: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 279 : Burkill in Rec. Bot. Survey Ind., ID, 1925, p. 388.

Tubers going deep into the soil, rather fibrous, acrid in taste when raw, the flesh going red upon exposure : the Abors of the Eastern Himalaya state that they do not eat it; and other tribes have not been questioned. *Stems* vigorous, attaining at least 2D m. in length, glabrous with about eight raised lines, with scattered recurved prickles or in the upper parts unarmed, green, about 7 mm. in diameter at the base when well grown. *Bulbils,* none seen. *Leaves* rather coriaceous, opposite or rather rarely alternate, commonly lanceolate-ovate, acuminate, mucronulate at the very apex, obtuse or rounded at the base, up to ID cm. long by 5 cm. in width Dr the very lowest broadly ovate-cordate up to 3D cm. long by 24 cm. in width, 5-nerved or rarely 7-nerved : the nerves of the first pair enclose an elliptic-lanceolate area : the nerves of the second pair diverge from

the midrib at about 8D° or less and run nearly submarginally almost to the very apex or, in very large leaves where there is another pair outside them, embracing an elliptic space : the secondary nerves are intermediate in arrangement between a breaking up into loops and-- a crossing of the interspaces and are not much more conspicuous than the network : the upper surface is dull or shining, glabrous, with the larger nerves just prominent: the lower surface is paler, with the primary nerves very prominent and the others just prominent: the margin is distinctly strengthened by a light tawny rim : petiole glabrous, usually about 3—4 cm. long, but at times as much as 10 cm. long.

Male flowers in rather open spikes which are arranged on special leafless branches : the upper and the lower spikes are more or less equal in length : axis glabrous, straight or somewhat twisted but not zigzag, with about 2D flowers : buds globose, set upon the axis at a right angle, their base repressing the bract against the axis : bracts ovate, acuminate, red-brown, D-5 mm. long. *Sepals* from a broad base quadrangularly ovate, very obtuse or rounded above, the base so broad that where they touch an angle is produced because they mutually push each other outwards ; they are concave inwards, rather thick in the middle and deep red-brown, 1 -5 mm. long. *Petals* similar in thickness and colour, a little narrower at the base and in length 1 mm. *Stamens* 6, the filaments equal in length to the anthers. *Gynoecium* of three small points.

Female flowers few in number Dn decurved spikes. *Capsules* very large, glabrous, slightly rough, fulvous, the wings broader than semicircular and drawn out slightly at the base into the stalk, slightly cordate at the apex, up to 3D mm. long by 27 mm. in width, with a strong margin. *Seeds* surrounded by a deep red-brown wing which is slightly uneven from, being more or less conform to the cavity of the loculus.

NDRTH-EASTERN INDIA.

This large species flowers in March and April and retains its foliage to the very end of the year so that its season Df vegetative activity is a very long one ; and the limits of early rains which therefore it requires, are also the limits Df its distribution. It has long been in cultivation in the Royal Botanic Gardens, Calcutta, without flowering. TheKhasias apparently call it "phanskong" or bamboo yamandtheLepchas "palam bok," but in our records *D. Hamiltonii* is also "palam bok."

INDIA. **4 e. Sub-subregion of Rains from the Bay of Bengal.** (Brahmaputra valley). Nowgong district. Dimapur, *King's collector* 1D1! Sibsagar district. Rajahbari in the plains, *Watt* 11264 ! Lakhimpur district. Hobo and northwards to Pasirghat and the Abor Hills, plentiful, *Burkill* !

HIMALAYA. **5 d. Eastern Himalaya.** Darjeeling district. Tassiding at 2,D0D ft. *Lister* ! Rishap jhora, *King* ! Abor Hills. Above Pangi village, at 3,8DD ft., *Burkill* ! South of Pangi village at 2,4D0 ft., *Burkill* 37736 ! Near the Dihong river at various places between Yambung and the plains, *Burkill* ! Rotung, *Manbir* 3BD55 ! Balek, at l.BDD ft., *Burkill* !

WESTERN IND D-CHINA. **1D a. Hhasi-Naga hills.** Khasia Hills. Without locality, *Griffith* 1555 ! 5537 K. D. ! Dherrapunji, *Griffith I Hooker and Thomson* 5 ! *B. K. Das* 35551 ! Borpani, *Hooker and Thomson24:52* ! MambD at 3,DDD ft., *C. B. Clarke* 438D1 ! Naga Hills. Without locality, *Griffith* 5551 in part !

PLATE 112. Dioscorea Wattii, *Prain and Burkill* |1) A branch with male flowers from Griffith's no. 5537, nat. size : |2) a mature bud, X8 : |3) the parts Df a male flower from Lister's specimen, X8 : |4) stamens, X15: |5) the gynoecium of the male

liower, xlEi : (B) a branch with capsules from a Khasia hills specimen collected by Hooker and Thomson, nat. size : |7) a seed in the loculus of a capsule, nat. size : |8) a capsule in section : |9) a lobe of a capsule showing the insertion Df the seeds, nat. size : (ID) a large leaf and part of a stem from Lister's Tassiding specimen, nat. size.

1D0. DIDSDDREA DIRRHDSA, Loureiro, Flora Cochinch., 179D, p. 625, and ed. Willdenow, 1793, p. 757 : Kunth, Enum. plant., 5, 185D, p. 4D1 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 31 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 288: Prain and Burkill in Lecomte, Flore gén. de Tlndoch., 5, 1934, p. 738 : Merrill in Trans. Amer. Phil. Soc, N. S. 24, part 2, 1935, p. 112.

Dioscorea atropurpurea, Ha-tu Vi in Bull. Econ. Indoch., 4, 19D2, p. 517 ; and in the same volume, p. 571 ; not of Roxburgh.

Dioscorea Bonnetii, A. Chevalier in Bull. Econ. Indoch., N. S. 2D, 1918, p. 328, and in L'Agronomie Doloniale, 4 (3rd year), 1918, p. 57.

Dioscorea Matsudai, Hayata in Ic. Plant. Formos. ID, 1921, p. 39, with a figure Dn p. 4D : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 289.

Dioscorea camphorifolia, Uline ex Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 31 only in synonymy : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 288 ; but certainly not *D. camphorifolia* var. *celebesiana,* Uline.

Dioscorea rhipogonoides, Oliver in Hooker's Icones Plant., 1889, plate 18B8 excluding the fruit : Henry in Kew Bull., 1895, p 23D, 1893, p. 74, and in Trans. As. Soc. Japan, 24, 1898, suppl., p. 95 : Diels in Engl. Bot. Jahrb., 29, 19D1, p. 23D : D. H. Wright in Journ. Linn. Soc. Lond., Bot. 36, 19D3, p. 93 : Matsumura, Index Flora Jap., 2, 19D5, p. 224 : Dunn in Journ. Linn. SDC. Lond., Bot. 38, 19D8, p. 370 : Kawakami, List plants Formosa, 191D, p. 122: McClure in Lingnam Agric. Rev., 4, 1927, p. 31 : Yamamoto, Suppl. Ic. Plant. Formos., 3, 1927, p. 5: Syun'iti Sasaki, List Plants Formosa, 1928, p. 114 : Kudo and Sasaki in Ann. Rep. Taihoku Bot. Sard., 1, 1931, p. 21.

"Du-nau," in part at least, Bull. Econ. Indoch. 15, 1912, pp. 575 and 5D8 : Dharabot in L'Agric. prat, des pays chauds, 8, 19D8, p. 5D0.

Tubers descending into the earth from a very hard WDDdy knot, bulky, one or more to each plant, usually about three times as long as thick, generally cylindrical with a rounded end, but sometimes lobed at the apex which is thrust into the soil to a depth of about half a metre, sometimes the tuber tends to be globose upon a long stalk, grey-brown outside with reddish firm flesh, the surface rather rough, dark brown, more or less free from rDDts. *Stems* climbing to 8 metres (Chevalier) and to ID metres (McDlure), with plentiful recurved prickles about the base and with scattered prickles higher up, 5 — 8 mm. in thickness, green with brownish purple spots, quite glabrous. *Bulbils,* none seen. *Leaves* alternate below, but almost all opposite above, parchment-like or sub-coriaceous, the lowest suggesting strongly the leaves of some vigorous species of *Smilax* largely bv reason of the way in which the nerves are drawn together towards the mucrD, cordate at the base, rounded under the mucro at the apex, with 1—2 prickles at the back on each of the larger nervss, up to 2D cm. in length by IS cm. in width, 9-nerved : the nerves of

the first pair enclose an elliptic-obovate area ; the nerves of the second, pair diverge from the midrib at an angle of about 5D[D], to embrace an exactly Dvate area : the nerves of the thirfl pair diverge from the midrib at about 95° to approach the margin gradually and be evanescent under the mucrD : the nerves of the fourth pair run submarginally in the proximal half of the blade : the secondary nerves cross the interspaces without elbows or with widely angled elbows, and are not really distinct from the reticulation : the uppermost leaves are nearly elliptic or Dvate and extreme leaves are almost lanceolate, they are rounded below, obtuse under the mucro, about 14 cm. long by 5 cm. in width, and 5-nerved : in them the nerves of the first pair enclose a narrowly elliptic area, the nerves of the second pair are submarginal and evanescent in the distal third of the blade : the secondary nerves in these leaves are as in the larger leaves : upper surface of the leaves when dry with slightly depressed primary nerves, but the secondary nerves just raised : the lower surface with all the nerves raised, quite glabrous : petiole 3—4 cm. in length, sometimes in the lowest leaves carrying one or two prickles.

Male flowers in spikes in branched inflorescences which arise in leaf-axils or are terminal : axis angled, up to 5 cm. long, glabrous, with 15—25 flowers : bracts ovate, acuminate, 1—1"5 mm. long, slightly repressed against the axis by the base of the flower : bracteoles broadly triangular. *Sepals* rather broadly ovate, very obtuse above, brown, with a thin margin, up tD 2 mm. long. *Petals* a trifle shorter and narrower. *Stamens* 6, not quite equalling the petals in length, the filaments about as long as the anthers. *Gynoecium* of three small blunt points.

Female flowers to the number of about 2D in dependent solitary axillary spikes : axis glabrous, angled ; bracts ovate, acuminate. *Sepals* ovate, acute, thick. *Petals* smaller, obDvate, obtuse. *Staminodes* minute. *Stigma* with three bifid lobes : ovary at flowering up to 3 mm. long. *Capsules* conspicuously retusB at the apex: stipe 4—5 mm. long, widened to 3 mm. where the wings arise by a curve which runs through 95°, hence they are more than semicircular, the curve of the outline scarcely changed until the abrupt contraction is reached, about 2D mm. long along the placenta by 22 mm. in width, papery. *Seeds* with a smoky brown wing all round.

FORMOSA and southern CHINA, then southwards through TONKIN to ANAM, and in LAOS.

The identification by Uline of a Celebes specimen (Warburg's no. 15756) as *D. rhipogonoidzs* and the reference to it Df Warburg's no. 21D97 |!) from Ceram are both incorrect. It is almost confined to the Eastern Indo-Chinese phytogeographicsubregion which it helps to characterize.

The first gathering of this species was Loureiro's. He obtained it in the forests of Cochin-China, and recorded as its Anamese name "khoai leng." Though his description is a less abbreviated one than Linnaeus would have written, it is not detailed enough for modern purposes : and his species is not determinate entirely from it. But his mention of the Anamese name ia helpful; and as he gave a dried specimen to his friend Captain Riddel, who passed it on to Sir Joseph Banks, and he tD the British Museum, where it is preserved, we are able to interpret it.

A whole century after Loureiro passed before attention was recalled to the plant by Dr. A. Henry in an endeavour to trace to its origin the Chinese trade-product, " shu lang." Henry through Chinese collectors obtained botanic specimens which he sent to Kew ; but unfortunately fruits $_{D}$f *D. Benthamii* were intermixed with male flowering branches of the true " shu lang." TD the mixture Professor Daniel Oliver gave the name *D. rhipogonoides* and figured it. Neither tD him nor to any one did it occur that " shu lang " is the same name as " khoai leng."

, Uline, working in Berlin with the dried collections of the Botanic Garden, at a date very soon after *D. rhipogonoides* had been described, there found specimens collected in Tonkin Dn Mount Bavi by Balansa and numbered 4241 : to these he gave the name *D. camphorifolia.* Balansa had collected alao, as no. 4241), sterile material from the same mountain which as far as it goBS exactly matches the type material of *D. rhipogonoides.* We, when we had examined these specimens in DUr turn, were convinced that no. 4243 must be *D. rhipogonoides* and were unable to find in no. 4241 any characters sufficient to separate it : therefore we reduced *D. camphorifolia* tD *D. rhipogonoides* and both to *D. cirrhosa :* but we were puzzled in regard to the lesser size of Henry's capsules, and endeavoured tn procure new specimens from Hong Kong, though without immediate success.

In 1918 Dr. A. Chevalier turned his attention to the identification of a tuber sold by the Anamese under the name " su nau " |cu-nau) for export to China as well as for local use. He found a *Dioscorea* to form part of the trade articli:—the part called " su nau do "—and gave to it the name *D. Bonnetii* in order to honour M. Bonnet, Conservator *of* Forests in Tonkin, who had helped him to obtain his information. Because he found his capsules unlike those figured as belonging to *D. rhipogonoides,* he maintained very naturally that it differed specifically.

A year later Professor Hayata found himself called on to deal with a species of the genus found in Formosa, and took a parallel course : it tDD had largsr capsules than had been figured as those of *D. rhipogonoides,* and he called his plant *D. Matsudai.*

Meanwhile Mr. H. Green, Director of the Botanic and Afforestation Department, Hong Kong, had succeeded in obtaining the true capsules of " shu lang,"—the capsules which we figure ; and the whole difficulty was removed Dn understanding that Oliver's *D. rhipogonoides* as regards the male plant was *D. cirrhosa,* and as regards the capsules was *D. Benthamii.* As regards the economic information it was *D. cirrhosa.*

But there are small differences which seem to be varietal, and we view them thus :—

Leaves relatively large, up to the largest size in the species, drying green and rather pale Dn the lower surface, where the reticulation is very conspicuous var. *rhipogonoides.*

Leaves smaller, say to ID cm. in length, drying brownish and not pale below .. var. *vvra.*

Leaves as those Df var. *vera :* the capsules a little smaller .. .. var. *pauper.*

The first occurs from Formosa to the mouths of the Red River, and inland probably through Tonkin. It is *D. rhipogonoides* and *D. Bonnetii.* The second occurs in Formosa, where it obtained the name *D. Matsudai,* and is also Loureiro's type. The third is in Formosa.

It flowers in April and May, and fruits in July.

The tubers contain tannin in considerable quantity. L. and P. Ammann |in *L'Agronomie coloniah,* 1921, p. 552) found 2D per cent, of this along with 23 per cent, of starch after the tubers had been dried until they held only IB per cent, of water.

The tubers are used by the Chinese for toughening fishing-nets and lines, sail-cloth, or to some extent cotton cloth intended for other purposes. They are traded to the sea and along the coasts, and also are carried into Yun-nan. In the delta of the Red River, every labourer likes to hav» his working clothes waterproofed by their means.

The greatest supplies at present are obtained in the forests of Tonkin where the MuDngs assiduously collect it and trade it both to Anamese and Chinese middleman on the coast, or send it inland *[Bull. Econ. Indoch.,* 4, 19D2, p. B71). The Abbe Bon says that the Muongs give to it some cultivation ; but Darles *[Bull. Econ. Indoch.,* 19, 1917, p. B40) asserts that the collecting in the forests of Thai-Nguyen is done in a very destructive way, tubers of all sizes being extracted and the plant killed. Henry *\Kew Bull.,* 1898, p. 23D) believed that the natural supplies of the island of Hong Kong had been destroyed by the assiduous collecting of the Chinese : and possibly the search for tubers has moved southwards during the last century : in this connection it is interesting to observe that Loureiro who obtained the species did not record any use for it. As far as our information goes, its only use is aa already recorded. But we have assigned to *D. cirrhosa,* with a little hesitation, a specimen from Hai-nan, collected by McClure, who attached a note to ib alleging that the Lois hunt for and eat the tubers. The Lois would quite naturally search for the tubers seeing that they have a ready market ; and Groff, Ding and E. Gruff cite in tha *Lingnaam Agricultural Review* | 2, 1923, p. B3) a specimen collected by MtCluru | his no. 9494) on the south nf the Five-finger mountain in Hai-nan which the collector calls "shu lang" , aa if the tinctorial root. At present McClure is the only authority for their consumption as food.

The Chinese name for the tuber is " shu lang." We find this name in various forms in countries »ear China.: e.g. it is the " khuai leng " of the Anamese. Taintor in an account Df it in Formosa |see Henry in *Trans. As. Soc. Japan,* 24, suppl., p. 93) calls it " tz neng ". In the Liu-Kiu islands it is "kuu-ru". It is " tamak " in the Pepo language. The Tonkin name is " su nao |cunao) "; and according to Chevalier this covers not only the tubers of *D. cirrhosa,* but those of other plants thrust into the trade as substitutes and adulterants. Df "sunao " Tonkin exported in 1911 *[Bull. Econ. ie. I'Indoch.,* 15,1912, p. BD8) 4D87 metric tons ; and Chevalier states of the years just before 1918 *Agronomie Col.,* 4, 1918, p. 57) that the export was somewhere^ between 5DDD an d 8ODD metric tons, in addition to the unknown volume traded westward. He found threE grades of " su nao " in the markets of Thai-nguyen, namely, " su nao do " which is the true root, " su nao rua " and " su nao non," which he could not fully identify, but considered as undoubted DiDSCDreas. He found the names among the Mans Dr Yaos, who are hill folk of northern Tonkin, for " nao rua " tD be " thi ang dam ;" and for " nao non " to be " thi ang dia " and " thi ang day " : material of both was brought to him from the Nui-la forest reserve. Species of *Smilax* including *S. perfoliata,* Lour., also were brought to him as " su nao." From specimens of the true " su nau do " he described his *D. Bonnetii.* He was so kind as tD send a liberal supply of tubers to us and we grew them in the Botanic Gardens, Singapore ; but not to flowering.

" Su nau " is a name which was obtained between 1885 and 1889 by Balansa in Tonkin and attached to the specimens Dn which Uline founded *D. camphorifolia.* Balansa did not record the purpose for which the tubers (bulbils he says actually) enter into trade.

Remote records of the use of the dye in China have not been found, all the dates at which information about it was made available being recent. Taintor in the *Chinese Trade Reports* for 18B9 |p. 17D), mentions its use in Formosa for dyeing nets. Ford in 1881 sent the leaves and flowers to Kew with the information that thB Chinese dye cloth brown by means of the roots. Phillips in 1882, sent tubers to Kew from Formosa as a source of dye far fishing-nets and clothes. Henry in 1884 amplified the information and supplied the material which was used for the definition of *D. rhipogonoides.* In 1897 the British Consul at Wu-chow stated that it was traded in at his port.

The consumption of " shu lang " is not confined to cotton thread and cloth, though that is its chief use : it is employed to give grass-cloth and light silks a khaki colour Df similar tint, and it is thought to make the fabrics more durable. Chevalier describes how the khaki colour can be turned to a permanent black by stamping the dyed cloth into the mud Df the bottom of a pond.

The colouring matter is obtained by throwing the rasped tubers into clear water, allowing sufficient time for extraction to occur and then decanting. The dyeing is done by dipping the fabrics into the dye an adequate number of times with drying in the sun between each dipping. A method of fixing is adopted in Tonkin by the use after this of the root called " cay song."

JAPAN. **5 d. Liu-hill islands.** Yae-yama, *Matsumura.* Iriomote, *Warburg* teste R. Knuth.

CATHAY 5UBREGIDN. **7 d. Mid-China.** Province of Fo-kien. Ku-liang hills near Fu-chow, between 1,DD5 and 3.DDO ft., *Norton* 1218 ! Di-ong-loh, at Nang-bng, *Vhin Ping En* 2541 ! Province of Dhe-kiang. Tien-tai shan, in bamboo thickets at 7DD ft., *G. Y. Chiao* 146D9 ! and Sie-kung shan in Yin-tang shan, *C. Y. Chiao* 14509-2 !

EASTERN INDD-CHINA. **9 a. Formosa.** Kelung, *Makino.* Tamsui, *Faurie* 55D ! *Hayata.* Kotosho, *Kawakami and Kobayashi.* Nankakei, *Nakahara* 252 ! Mount Binsan, *Matsuda.* Between KantDpin and Sinsharyo, *Hayata and Tanaka.* Dchobi, *Hayata.* Lake Dandidius in the province of Nanto, common, *Wilson* 9999 ! Geltan shore of Lake Jitsugetsutan in central Formosa, *Kudo and Sasaki* 15324! Bankinsing, *Henry* 105! South Cape, *Hmry* 589 ! 970 ! 1297 ! **3 b. the HwangS.** HongKong. Without precise locality, *Ford* ID ! 24 ! 54/88! Black's Link, *Green* ! In woods by the Wong-nei-chong gap, *Ts'iang Ying* 284 ! Province of Kwang-tung. Without locality, *K. K. Tsoong* 654 b ! Thai-yong at sixty miles from Swa-tow, *Dalziel*! West river, *Henry.* Ho-nan island in the district of Poon-ue, cultivated at Ling-nam, *Fung-horn* ! Teng-lu mountain

near Tso-long in the Loh-fau shan, *Levines' collector* 3 D8D ! Loh-fau shan, *N. K. Chun* 41439 ! Naam-kwam shan in the Tseng-shing district, *W. T. Tsang* 2D145 ! Ting-wu shan, in the open, *W. Y. Chun* 6418 ! Lok-chong, *C. L. Tso 2D214:* ! 2D3DO ! Near Fung-wan in the North river region, *Canton Christian College* 12823 ! Lung fan mountain, near Yueng-uk, *Canton Christian College* 12758 ! Province Df K w a n g - s i, tests *Henry.* H a i ɹ n a n island. Without locality, *C. Wang* 33326! Southern slopes of the Five-finger mountain (somewhat doubtful), *McClure* ! Fan-yah at 45DD ft., *N. K. Chun and G. L. Tso* 44214 ! Dung-ka at 24DD ft. (not quite typical), JV. *K. Chun and C. L. Tso* 439Dl ! Yai-chow, in mixed forest, *H. Y. Liang* 52232 ! **9 c. Tonkin.** Province of L a o-k a y. Dhapa, *Pételot* 4-156! plentiful about Lao-kay and Pho-lu, teste *Bull. Econ. Indoch.* Province of Q u a n g - y e n. Bay of Along, *Chevalier*! and transplanted into the Botanic Gardens, Singapore, *Burkill* 417D ! 4171 ! 4172 ! 1DDDB ! Tien-yen, *Bonnet and Casabianca: Fleury* 37927 ! Province of T h a i-n g u y e n, plentiful, *Darles :* Nui-la forest reserve, *A. Chevalier* ! Province of S o n -1 a y. Mount Bavi, *Balansa* 424D ! In the valley of Lan-kok Dn Mount Bavi, *Balansa* 4241 ! 9 d. An am. Province of T h a n - k D a. Thien-Thon, *Bon* 511D ! Presumedly in the neighbourhood of Hue, i.e., just within the northern limits of Anam in the province o f T h u a n - t h i en, " Woods of Cochin-china," *Loureiro* !

WESTERN INDD-CHINA. **ID h. Laos.** State Df L u a n g P r a b a n g. Between Ban Ngo and Bacbac, *Poilane.* 2D47D ! Province of T r a n - n i n h. Muang Cha, at 1,2DD m., *Kerr* 2D985 !

PLATE 113. Dioscorea cirrhosa, *Loureiro.* |1) and |2) branches with male flowers from a plant cultivated in Hong Kong, nat. size : |3) and |4) parts of the male flowers, X b" and 8, respectively: |5) and |5) stamens, X 10 : |7) a branch with female flowers, nat. size : |8) capsules from Mr. Green's specimens, nat. size : |9) immature seeds, nat. size : (ID) a very large leaf, from Ford's Happy Valley specimens, nat. size : |11) the stem near the base from a plant collected by Dr. A. Chevalier, nat. size.

lDDa. DIDSCDREA sp., probably *D. cirrhosa,* LoureirD : Merrill in Trans. Amer. Phil. SDC, N. S. 24, part 2, 1935, p. 114.

Dioscorea aculeata, LoureirD, Flora CD chin chin ensis, 179 D, p. 525 : and ed. WilldenDW, 1793, p. 768; not of Linnaeus.

Tubers described by Loureiro as oblong, esculent, pale yellow outside and white within, beset with small roots, which description he seems to have taken from Rumpf's figure of *Combilium,* and misapplied, i.e., he had not seen the tubers Df his plant. *Steins* firm, described by him as much branched, 3—4 mm. thick with scattered small slightly curved prickles (Loureiro calls them straight), angled, glabrous, straw-coloured. *Leaves* alternate on the flowering part of the stem, elliptic-ovate (Loureiro calls them ovate), of all the six preserved leaves the glandular apex dead leaving them abnormally rounded, 7-nerved (LoureirD did not count the outermost pair, and recorded them as 5-nerved) : the nerves of the first pair diverge from the midrib at about 3D° to meet again in the apex enclosing thus a very narrowly obovate area : the nerves of the second pair diverge from the midrib at about 53° and embrace an area almost conform with the leaf-blade : the nerves of the third pair run as far as the mid-length of the blade almost marginally : the secondary nerves are scarcely distinct in the network: upper surface with nerves and network just prominent, glabrous : lower surface with the primary nerves prominent, and the others just prominent, equally glabrous : petiole half as long as the blade.

Male spikes upon special leafless inflorescences, one only preserved, which is 8 cm. long, its axis quite glabrous : the spikes about 3-5 cm. long, sharply angled, glabrous, with

about 3D well-spaced flowers : bracts ovate-acuminate, 1 mm. long, repressed against the axis by the broad base of the flower. *Sepals* broadly ovate from a broad base, obtuse at the apex, 1 • 5 mm. long. *Petals* obovate, a little shorter. *Stamens* six, not *quite* equalling the petals in length.

Female plant not seen ; its capsules described by Loureiro in the words used by Linnaeus in denning the genus : so that it is probable he had never recognized any which he could associate with the male plant.

DO CHIN-CHINA, in fields, without locality, *Loureiro* !

Loureiro recorded for this a vernacular name,—"khDai ID "—which has been assigned by Dr. Chevalier tD *D. esmlenta.* Loureiro gave a specimen of his " khDai ID " tD Captain Riddel whohanded it to Sir Joseph Banks ; this is now preserved in the British Museum, Natural History, and seems to be a poor specimen of *D. drrhosa* : the parts Df LoureirD's description which do not accord with this view, we believe tD be unwarranted additions to it, borrowed from Rumpf's *Herbarium Amboinense.* De Lanessan *Plantss utiks dtss Col. Franc,* 1883, p. 7B5) borrowed Loureiro's statements uncritically.

100 b. DIOSDDREA FDRMDSANA, R. Knuth in Engl., Pflanzenreich, iv-43, 1924, p. 268 : Syun'iti Sasaki, List plants Formosa, 1928, p. 114.

Dr. Knuth has brought together, under this name, two specimens from Formosa, —*Warburg* 9682 from Tsunan, and 969D from Kelung. Having seen both, we doubt if they be identical and in any case consider neither adequate for recognition. As it is recorded of the first that its tuber furnishes a dye, we mention the species after *D. drrhosa,* because that record suggests that *D. nrrhosa* may perhaps be the right name for that part at least of *D. formosana,* |see *Kew Bull,* 1025, p. 118).

101. DIDSDDREA INTEMPESTIVA, Prain and Burkill in Kew Bull., 1933, p. 243 : and in Lecomte, Flore gén. de l'lndoch., 6, 1934, p. 739.

Tubers said to be reddish in colour, edible but not valued as food (Poilane). *Stems* climbing to 12 metrss, their lower parts not seen : in the upper parts altogether unarmed, glabrous, firm, marked with faint longitudinal lines, up to 5 mm. in diameter, drying dark in colour. *Leaves* in shape, texture and surface exactly like those of *D. laurifolia,* but in var. *vera,* drying reddish, alternate or more rarely opposite, coriaceous, ovate, the broader exactly rounded at the base but the narrower obtuse, shortly acuminate at the apex, 5-nerved or rarely 7-nerved, in length usually to ID cm. by 4 cm., but sometimes broader even to 6 cm., but then still not longer than ID cm., the nerves of the first pair diverge from the midrib at about 3D° to enclose a broadly oblanceolate area with an acumination towards the apex : the nerves of the second pair diverge at 60° and, running at a little distance within the margin except when seven nerves are present, attain the apex : nerves of the third pair when present usurping the place of the second pair, which run then intermediate between them and the first pair: secondary nerves about as far from each other as the distance which they cross, with slight elbows, between the primary nerves, linked together by nerves of the reticulation which are almost as conspicuous as they are : margin strengthened : upper surface glabrous, with all the nerves just prominent: lower surface glabrous, with the primary nerves distinctly prominent, the secondary and the reticulation just prominent: petiole up to 2-5 cm. in length, glabrous.

Male flowers in spikes, in the rather poor specimen from which we describe them in the axils of new leaves on short lateral branches : it may be that more vigorous plants produce them on special leafless inflorescences ; the spikes solitary or paired, not geotropic, up to 4 cm. long : axis angled, with about 3D flowers : bracts Dvate-acuminate, repressed

against the axis by the broad base of the shortly columnar buds, 1 mm. long : bracteolea broadly deltoid, D-5 mm. long. *Sepals* rather ijuadrately ovate, obtuse, 1-25 mm. long. *Petals* shorter, obovate. *Stamens* 6, on filaments shorter than the anthers, the whole D-5 mm. long. *Gynoecium* of three points.

Female flowers on decurved spikes, upwards of IS of them forming capsules. *Sepals* very broadly ovate, much arched, obtuse, 1 mm. long. *Petals* obovate, but nearly as broad at the base as above, rounded above. *Stigmas* as three pairs Df hooks. *Capsules* with a stipe 5 mm. long, which can be divided into a basal part 1 mm. long—the pedicel of the flower—and an upper part 4 mm. long which is the sterile base of the Dvary or the stipe proper : this stipe widens to 4 mm. where the wings spring from it at an angle of 9D — 95,° thence to curve evenly to the truncate apex : the length Df the capsule along the placenta 22—25 mm. and the greatest width of the wings 18—2D mm., the colour light tawny. *Seeds* with a rich red-brown wing all round, conform with the loculus.

NDRTHERN ANAM, where there is a heavy rainfall in the cold-weather months.

We distinguish two varieties. The first, var. *vera,* has been collected only by Poilane, but under three different numbers. We judge that it is common locally, for he obtained abundant material of it in fruit. He obtained only a single branch with male flowers for apparently his collecting tDur in northern Anam took place a month Dr two tDD late for these |p. fi0/8).

The capsules are nearly rips in the month Df May and quite ripe in June, with a seasonal precocity due obviously tD the heavy cold-weather rains of northern Anam. We shall discuss this very early flowering when reviewing the genus phytDgeDgraphically. Poilane says that the tubers are edible, but are not used when better food is available. He does not describe them except to say that they are reddish, leaving us to assume that this colour is external. We would like more precise information regarding them, and to know whether the base of the stem be prickly.

Poilane records three Moi names,—" pnon-put," " punh-te," and "ka-rinh." The reader may be reminded that the term " Moi " as commonly used in Indo-China, covers all the simpler jungle races, and so several languages.

ThB second variety we have called var. *Chevalisri,* but we are not certain that when fully known it can be retained as a variety Df *D. internpestiva.* It was obtained by Dr. Chevalier in the Langbian hills of southern Anam, and by Dr. A. Kerr in Laos. The leaves are more elliptic and the axis of the male spikes stouter and stiffer. Dr. Kerr called it " hoi-wei " which name in equivalent to the Tonkinese khoai, and the Burmese kywe. **But** in Burma kywe ia restricted in use to *D. hispida.*

EASTERN INDD-DHINA. **9 d. Anam.** Province of Quang-tri. In the mountains of Dong-tain-ve, at 7DD m., *Poilane* 1D825 ! Lang-vieng-ap, *Poilane* 1D879! Mai-lanh at 4DD m., *Poilane* 1D44D ! Mountains Df Dong-cho at 6DD m., *Poilane* 1D717 ! 11246 ! Province of Haut Donai. Da-lat at 15D0 m. (doubtful, having longer leaves), *Boden Kloss* ! Lang-bian hills |var. *Chevalieri), A. Chevalier* 4D375 !

WESTERN INDD-DHINA (all var. *Chevalieri).* **IDg. Siam.** Circle of Udon. Kao Krading, at about 1,2DD m. Dn the edge of evergreen forest, *Kerr* 2DD85 ! **ID h. Laos.** Province of Tran-ninh. Ta-wieng, at 4DD m. in bamboo jungle, *Kerr* 2D9D8 ! Province of Vien-tiane (Wung-chan.) Pak-munung, in evergreen forest by the river at 1BD m., *Kerr* 21231 !

PLATE 114, left side. Dioscorea intempestiva, *Prain and Burkill.* (1) A branch with male flowers from Poilane's no. 1D44D, \ nat. size : (2) a spike of the same, x5 • |3) large leaves from Poilane's no. 1D717, \ nat. size: |4) fruits from Poilane's no. 1D879.

\ nat. size : |5) a leaf seen from below from an unlocalized specimen collected by Poilane which is not quite typical in that the leaves are smaller and ovate-elliptic, \ nat. size : |G) a sepal, |7) a petal and [8) a stamen from the male flower, x5 : |9) a female flower, X5 : (ID) a sepal, **jll)** a petal and (12) the stigmas, X5.

Group of D. Bonii |species 1D2). The male flower-buds are nearly globose and in that respect this species is very unlike the group of *D. cirrhosa* which it rEsembles in other respects.

1D2. DIDSDDREA BDNII, Prain and Burkill in Kew Bull., 1933, p. 244 and in Lecomte, Plore gén. de l'lndoch., B, 1934 p. 741.

Underground parts unknown. *Stems* (the lowest parts unknown), in their upper parts altogether unarmed, the stoutest seen 5 mm. in diameter, giving off lateral branches with a diameter of 3—4 mm. and strikingly rigid in their lower parts though in the thin distal parts twining to the right, glabrous, with slight longitudinal ridges. *Leaves* on the lower parts of the branches alternate, above opposite |or some ternate), lanceolate Dr sometimes broadly lanceolate, obtuse or rounded at the base, very acute and somewhat acuminate at the apex, 5-nerved : the nerves of the first pair diverge from the midrib at about 3D° to enclose a lanceolate area which is acute below : the nerves Df the second pair diverge at about 5D° and are weak, being evanescent in the lowest quarter of the length Df the blade : secondary nerves relatively few, with some elbows crossing the interspaces between the primary nerves : upper surface glabrous, dull-green, smooth, with the primary nerves distinct and the others almost invisible : lower surface pruinDse except the primary nerves which are prominent : the secondary nerves just distinct, and the network scarcely visible, the largest leaves up to 8 cm. long by 2-5 cm. in width : petiole to 2 cm. in length, quite glabrous.

Male flowers in spikes which are arranged 1, 2, 3 or sometimes 4 together along the angular axes of short leafless inflorescences : these leafless inflorescences usually about 4 cm. long but sometimes up to 8 cm. : spikes to 3 cm. long with about 20—3D flowers spaced at their own diameter apart along if: bracts ovate, 1 mm. long, glabrous, a little repressed by the globose flower-buds: bracteoles deltoid, D-5 mm. long. *Sepals* ovate from a broad base, obtuse above, glabrous, 1 mm. long. *Petals* 0-75 mm. long, obovate. *Stamens* only just over D • 5 mm. long.

Female plant unknown.

TDNKIN, towards the west.

EASTERN INDD-CHINA. **9 c. Tonkin.** Western Tonkin, without precise locality, but apparently from the hills of Muang-lamg in the Province of H o a - b i n h, *Bon* 4321 !

PLATE **114,** right side. DisDCDreaBonii, *Prain and Burkill.* (1) Intertwined flowering branches with male flowers from the type-specimen, \ nat. size : [2) part of a spike, X 5 : |3) a sepal, |4) a petal, and |5) a stamen ; allx5.

Group of D. Wallichii |species 103—104). With large leaves, the male flowers upon leafless branches which da not nlongate to much more than the length of the petiole of the subtending leaf. *D. Wallichii* has a long vegetative SBason and carries its ripe fruits one or two months later than do associated *Dioscoreas*. The second species of the group, *Dpulverea,* is inadequately known.

IDS. DIDSDDREA WALLIDHII, Hooker fil., Flora Brit. Ind., 5, 1892, p. 295 : Wood in Rec. Bot. Survey Ind., 2, 19D2, p. 143 : Prain and Burkill in JDurn. As. SDC. Bengal, N. S. ID, 1914, p. 31 : Duthie, Flora Upper Gangetic plain, 3, 192D, p. 255 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 274 : Haines, Bot. Bihar and Drissa, 1925, p. 112D : Fischer in Gamble, Flora Madras Presidency, 1928, p. 1512 : Prain and Burkill in Lecomte, Flore gén. de 1' Indoch., 6, 1935, p. 741.

Dioscorea aculeata, Linnaeus, Spec, plant., 1753, p. 1D33, in reference to Rheede but excluding the bulbils figured by Rheede : Lamarck, Encyclop. meth., 3, 1789, p. 232, with the same limitations : Kunth, Enum. plant., 5,1850,p. 399: Hooker fil., Flora Brit. Ind., B, 1892, p. 29B in synonymy: Prain, Bengal plants, 2, 19D3, p. 1DS7 : Heinig, List plants Dhittagong DollectoratB, 19 D7, p. 58 : Haines, Forest flora Dhota Nagpur, 191D, p. 531 : Witt, Descriptive list trees, herbs, N. and Berar Forest Circle, D. P., 191B, p. 22D : Prain and Burkill in Kew Bull., 1919, p. 352.

Dioscorea sativa, Herb. Madras in Wallich, Cat. lith., 1S3D, nos. 5108A, and51D8B.

Pre-linnean references.

1B88. Katukatsjilinpart only, and Katu kelengu, also in part, in both confused with *D. bulbifera,* Rheede, Hort. Malab. 7, tab. 3B &, 37.

17D4. Katu katsjil and Katu kelengu, quoted from Rheede with the same confusions. Ray, Hist, plant. Suppl. p. 133.

1737. , Dioscorea foliis cordatis caule aculeato bulbillifero. Linnaeus, Hort. Dliffort. p. 459, from Rheede and embodying his confusions.

1745. Dioscorea Indiae orientalis, folio Tamni longiore, floribus spicatis, spicis plurimis ex uno puncto exeuntibus, scapo eorum msdio geniculato, Ammann, Herb. Ammann. in Mus. Imp. Petrop, 1, pars 2, p. 257.

Tubers descending deep into the soil, a metre or more long, with soft and edible flesh, which is white when quite young but becomes yellowish in the older parts with the result that the upper somewhat thinner parts of the tubers are coloured but the tip scarcely so : the skin brown with numerous small rootlets. *Stems* attaining the thickness of a goose-quill, somewhat prickly towards the base, glabrous. *Bulbils* never seen. *Leaves* alternate, cordate, acuminate, up to 25 cm. long by 25 cm. in width, 7-nerved : the nerves of the first pair enclose an elliptic to oblanceolate-obDVate space, having diverged from the midrib at about 35° : the nerves of the second pair so diverging and curving as to embrace what is almost a circular area : the nerves of the third pair enter the auricles and give off in them a stout submarginal nerve : secondary nerves numerous, crossing the interspaces with elbows in a distinct network : upper surface glabrous, dark green, very smooth, with the primary nerves lying almost flush with the surface, and the network all but invisible : lower surface glabrous, somewhat glaucous in life, with the nerves prominent : margin scarcely strengthened : petiole quite as long as the blade and often a little longer, with the pulvini almost always tinted violet.

Male flowers in spikes which are grouped upon short leafless branches in such a way that the whole branched inflorescence makes a pyramid, up to ID cm. from the axil

to its apex : the pyramid is effected not SD much by an unusual length in the spikes themselves as by the abbreviation of the leafless axis bearing them : these spikes are up to 5 cm. in length and carry *20*—3D flowers ; they are solitary or sometimes paired in the axils of small ovate bracts, the axis quite glabrous, angled with the flowers on it about 2 mm. apart : bracts ovate, acuminate, glabrous, 1 mm. long, red-brown : bracteolea similar, smaller. *Sepals* Dvate, obtuse, incurved, glabrous, 1 mm. long, red-brown with a pale margin. *Petals* almost obovate, shorter than the sepals, otherwise similar. *Stamens* 5, not quite equalling the petals ; the filaments a little shorter than the anthers. *Gynoecium* asmalltrifid cone.

Female flowers tD the number of about 2D, well spaced along the axes of decurved slender spikes : these spikes are sometimes two together : axis very straight, glabrous, angled, about equalling the leaves in length : bracts broadly ovate, shortly acuminate, glabrous. *Sepals* very broadly ovate and very obtuee, 1 mm. long, glabrous, thick. *Petals* similar but a little smaller. *Staminodes* very minute. *Stigmas* as three pairs of short sickle-like organs. *Capsules* usually not more than 4 or 5 to each spike, glabrous, glaucous in varying degree, marked with flecks of dark brown ; the stipe to 4 mm. in length widened upwards to 4 mm. ; wings 2D mm. long, truncate or almost retuse above, almost truncate below, evenly rounded along the margin, 15—18 mm. in breadth. *Seeds* with a smoky brown wing all round which is more or less conform to the loculus.

INDIAN EMPIRE from MALABARIA to the SHAN PLATEAU and TENASSERIM, in discontinuous distribution, because it is restricted by its need of considerable moisture to hilly forested districts. Absent from the Himalaya.

The broken area which this interesting species occupies is most readily realized by the use of the small map inserted intD the corner of plate 115. From that map it will be observed that it occurs throughout the Western Ghats upon the face on which the south-west monsDDn plays freely ; and right and left Df the Bay of Bengal where the Bay current D!" the same monsoon spreads fan-wise ; but the sodden plains of Bengal do not harbour it, nor the corresponding plains of the delta of the Irrawaddy. The Eastern Ghats are evidently too dry through its season and it does not occur in them. It is not in Ceylon,— an unexplained phenomenon. Outside the three larger areas indicated on the map, it may be found in B—8 other neighbourhoods, all mountainous. To the east of the Gangetic delta its capsules are more glaucous than tD the west; and we have given to the more glaucous Burmese plant the name var. *Christiei,* after Mr. G. F. S. Christie, formerly of the Burmese administrative service. It is interesting that the Gangetic delta should serve as a break which parts the varieties; for this indicates the failure of the species upon the "Bengal mud " to be due, not to the intensive operations Df agriculture, but to its natural unsuitability.

D. Wallichii was obtained first by Rheede's staff, apparently growing in association with *D. bulbifera,* just as the authors have seen it themselves. The association misled Caaearius or whoever of Rheede'a staff had ita figuring and describing to do, the consequence being that an entirely misleading representation waa made, embodying the bulbils of *D. bulbifara.* In the *Kew Bulletin* |1919, p. 35D) we made reference to this. We find that " katu katsjil " of his plate 35 of VDI. 7, is *D. Wallichii* by virtue of the vernacular name quoted, by its stems climbing to the right, by its capsules and by its seeds, but at the same time is *D. bulbifera* by virtue of ita bulbils, and from the description Df its tubers : we find further that " kattu kelengu "—plate 37__i$_a$ the species with which we are dealing by the pricklea represented upon its stem, by the shape attributed to its tubers and by its male inflorescences, but is *D. bulbifera* in its bulbils, in the name " carando " attributed to it, and in the properties credited to the tubers.

The plate of " kattu kelcngu " became Linnaeus' *D. aculeata* in 1753 *\8pncies plantarvm,* p. 1D33) : it had been the "DioscDreafoliis cordatis caule aculeatD bulbifero" of his *Hortus Cliff orti anus* (1737, p. 459) : and our finding is that because the species had been based Dn a chimera, " D. aculeata, Linn."hasno standing. Linnaeus himself failed as soon as he tried tD follow his own lead ; for in 1754 he ascribed his name to Rumpf's excellent figures of *D. ssculenta* |in Stickmann, *Herb. Amboinense,* p. 23). Lamarck in 1789 used " D. aculeata " as a name for the same confusion, though more fcr *D. escuhnta* than for the plant under discussion. Rottler in 1814, untrammelled by not having at hand the old figures, finding our plant, wrote upon the label that it

seemed tD be an autumn form of *D. appositifolia* ; but getting back to his work-room and hia books, he wrote it up as perhaps *D. sativa.* Wallich in 1830 sent it out into the world as " D. sativa, Herb. Madras." In 1B92 Sir Joseph Hooker disentangled the species so far as to found on Rottler's gathering his *D. Wallichii.*

It is now obvious that the name " D. aculeata, *Linn."* should, like the name " D. sativa, *Linn.",* be, as far as possible, discarded.

The two varieties *of D. Wallichii* are distinguished thus :—

Capsules scarcely glaucous : the plant which occurs to thB west of the Bay of Bengal .. var. *vsra.*

Capsules distinctly glaucous and generally a trifle longer than in var *ve.ra* : the plant as it DC curs to the east of the Bay of Bengal .. var. *Christiei.*

One of the most interesting of the characters which this species shows is its relatively late flowering and fruiting. In Malabaria it flowers quite at the end of the rains and seed may still be in the capsules when March comes, which is long after other Dioscoreas have scattered theirs. Up to date ripe capsules have not been collected in Dhota Nagpur. Perhaps its absence from the Himalaya is due to inability to reach fruiting there. In Burma it is not found in the driest districts. The seed time is December and January.

The digging DUt of the deep-burying tubers is a laborious undertaking ; and they are, when won, slightly inferior to those of other species used as food. Nevertheless, they are much eaten by the needy jungle tribes of some parts of India. The HDS, KDIS, Baurus, Khonds, Sontias, Lodhar Savaras, Matias and Sahars of Dhota Nagpur, Sihgbhum and the Circars all eat them in times of famine. The Warlis of the Bombay Ghats do SD also. The Chins of Arakan as well. The upper part of the tuber is stringy and, as the eaters say, needs chewing. From Arakan a statement has besn received that excessive use causes dropsy |] beri-beri,) but the statement is quite unconfirmed.

The plant possesses a rather widely used series of vernacular names in Dhota Nagpur and the Dircars, the commonest of which is "tunga." Enquiry within the districts Df Balasore, Cuttack, Puri and Angul, and within the neighbouring states of Nilgiri, Narsingpur and Dhenkanal for "tunga," will in any convenient season lead to its production. The KDIS add their word " sanga " after the tunga, making it " tunga sanga" : the Uriyas add " alu " making it " tunga alu". In the Dhanda district " tunga gaddi " is heard. The Savaras have a name " tumangai " which possibly has had a common origin. " Jugur kanda ", from the Bilaspur district may be distortion.

Along with these," cherango " is met with in the Puri district, and passes westward into the Baipur district and southwards into the Ganjam district.

The Santals call it " dura sanga " or little yam, but are not consistent in the use Df the name. The Korkus callifbai-ili."

Two names only are known for it from the eastern part of its area of dispersal:—" gunga " from Sylhet, and " kadat " from Burma. This Burmese name is very well known.

INDIA, south of the Himalaya (except in the Surma and Brahmaputra valleya, all var. *vera).* **4 a. Malabaria.** Thana district. Near Mahim, *Ryan* 2D49D ! Bassein, very common, *Burkill* 16521 ! Sawantwadi state. Under Amboli, which is on the crest of the Ghats, and near Danoli, *Burkill* 175D4 ! 1751D ! Goa territory. Under Castlerock, *Burkill* ! North Kanara district. Halial, *Talbot* 2D22 ! South Kanara district. Without locality, *Beddome* 7745 ! Sampaji, *Barber,* 2191 ! Jahlour, *Barber* 2479 ! Mangabre, *Hohenacker* 21B2 ! Malabar district. Taliparamba, *Barber* 7633! Nilgiri district. Wynaad, *Beddome* 7746! Gudulur, at 3,0D0 ft., *Gamble* 15515 ! Travancore state. Without locality, *Rottler* 51D8 ! *Colder and Ramaswami* 58 ! Quilon, *Barber* 5722 ! Madathurei, *Bourdilhn* 1481 ! Malayattur, at 1DD ft., very common, *Bourdilhn* 1253 ! 1264 ! 1441 ! 1445 ! Varur, at 1,5DD ft., *Meebold* 1277D ! **4 C. Deccan.** (Mysore). Tumkur district. Dhiknayakanhalli, at 3,0DD ft., *Meebold* 109DD ! (Bombay above the Ghats.) Belgaum district. Between Poondra and

Amboli, *Burkill* 16988 ! W e s t K h a n d e s h district. Rapapur, under the Akrani plateau, *Burkill* 33239 ! **4 d. Hindustan.** (Northern Escarpments of the Deccan.) J h a n s i district. Lalitpur, *Mus. R. E. P.* 15245 ! **4 e. Sub-subregion of Rains from the Bay of Bengal.** (Central Provinces.) A m r a o t i district. In the Ban valley of the Melghat, between Dhargarh and Somthana, *Burkill* 33142 ! B e t u 1 district ! C h a n d a district ! B h a n d a r a district ! R a i p u i district. Raipur tehsil, *Drake-Brockman* 15441 ! B i 1 a s p u r district. In the Bitkuh reserve of the Kanar jungles, *Turner* 15448 ! (Circars-Orissa.) R o d a v e r i district. Bison hill, *Barber* 5176 ! Dn the road to Sesharagi, about the edges of rice fields, at 500 ft., *Narayanaswami* 611 ! V i z a g a - p a t a m district. Palkonda, *Barber* 1982 ! Gunupur, P. *Birajee* 25883 ! G a n j a m district. Chatrapur, *Mus. R. E. P.* 11D67 ! Tarasingi in the Gumsur taluk, JV. *Tenkatarad* 17818 ! Parlakimedi, plentiful, *Burkill* 17484 ! 17957 ! *Grant, Candlerand Burkill* 20444 ! 20454! *Rama Murti* 180D3 ! P u r i district. Chatarbar, *Hainzs* 5118 ! Khurda, J. *C. Mitra.* D u 11 a c k district. Talgar hills near Madhupur, *G. M. Roy* 15487 ! Jajpur, *Alien* ! N a r s i n g p u r state. Common, *Mohamed Atahar* 14036 ! A n g u 1 district. Tulka forest, *Raines* 2463 ! D h e n k a n a l state ! N i 1 g i r i state, *Kalka Pzrshad* 343D5 ! B a 1 a s o r e district. Patharchakri, *Kalka Pmhad* 34325 ! M a y u r - b h a n j a state. Baripada, *Kalka Pzrshad* 34315! 34328! *Holmes* 33178 ! (Dhota Nagpur and Sonthalia.) S i n g b h u m district. Without locality, *Haines* 186! Sangajata forest, *Haines* B95 a! Gidung near Monoharpur, *Kalka Pershad* 19715! Santara forest, *Hainzs* B90 ! 693 ! R a n c h i district. Gumla, *Allen.* Ranchi at 1,500 ft., *0. B. Clarke* 20369 ! Between Kobbira and Biru, *Kalka Pershad* 34388 ! H a z a r i b a g h district! P a 1 a m a u district! (Surma valley ; all var. *Ohristizi.)* S y 1 h e t district. Without locality, *Porteous* 13970! Perhaps within the district, but if not, from the hills to the northward, *F. d* (e *SUva)* in Herb. Wallich 5108 b !* and perhaps also within the districts" Chittagang or Sylhet," *Hooker and Thomson*! (Brahmaputra valley ; var. *Christiei.)* L a k h i m p u r district. Lakhimpur, *-Meebold* 5658 testB R. Knuth. Sadiya, uncommon, *Burkill*!

WESTERN INDO-CHINA. (AU var. *Christizi.)* **10 a. Khasi-Naga Hills.** K h a a i a H i l l s. Nongpriang, at 2,500 ft., *C. B. Clarke* 15234 ! N o r t h C a c h a r. Haflong, *Burkill*! and without locality *Keenan* ! **10 b. Northern Burma.** B h a m o district. Bhamo, *Burkill* 22756 ! Palin to Nampu, at 500 ft., Lace 4494 ! M y i t k y i n a district. Myitkyina, *Mokim*! M a n i p u r state. Mookoo, at 1,500 ft., *G. B. Clarke* 42291 a ! **ID C. Chittagong-Arakan.** C h i 11 a g o n g district. Sungor valley, *Heinig* 26149! C h i t t a g o n g H i l l . t r a c t s . Sitapahar, *Heinig.* Kodala hill, *Badal Khan* 203! A k y a b district. Nat-toung on the Pi-choung, *Burkill* 27935 ! Kyoung-doung on the Upper Kalapanzin river, *Burkill* 28028 ! Pethadu on the Kalapanzin river, *Burkill* 2BD24 ! Ponakwan on the Koladan river, *Burkill* 28276 !" N o r t h A r a k a n district. Waseru choung, near Nataran, *Burkill* 27952! K y a u k p y u district. Without precise locality *GaitskelV.* S a n d o w a y district. Common everywhere, *Gaitskdl* 15033! **10 j. Dry Central Burma.** T h a y e t m y o district! P r o m e district. General, *Gaitskdl*! **10 B. Lower Burma.** T h a r r a w a d d y district! P e g u district, without precise locality' *Christiei* Kyauktaga, *Burkill* 21996! 22122! "Kurz's first camp," *Kurz* 4819! H a n t h a w a d d y district. Rangoon, *M c Clelland* ! S a 1 w e e n district. Papun, *Meebold* 1705B ! **10 f. Shan plateau.** (Northern Shan States.) State of H s i - p a w '. Hsi-paw, common, *Burkill* 24027 ! Mansam falls at 2,000 ft., *Lace* 5469 !

MALAYSIA **11 b. Tenasserim.** A m h e r a t district. Moulmein, *Wallich*! *Burkill* 23912 ! 23931 ! 239B0 ! *Kalka Pershad* 29265 ! Amherat, *Ram Chandra* 24663 !

Burkill! Thingan-nyi-nawng, *Burkill* 24332 ! 24449 ! Myawadi on the Siamese frontier, rare, *Burkill* ! T a v o y district. Tavoy, *Gomez* in Herb. Wallich 51D8 F ! General in the district, *Gaitskell* 14098 ! **11 j. Peninsular Siam.** Circle Df S u r a t. Chumpawn, at Siep-yuan, in forest, *Kerr* 1B244 !

PLATE 115 Dioscorea Wallichii, *Hooker fil.* |1) A branch with male inflorescences from Haines' no. 595 a, nat. size: |2) a flower flattened, X1D: |3) a stamen, X15 : 14) a bract, X1O: |5) capsules from Burkill's nD. 27935, nat. size: |3) a capsule cut transversely : |7) and |8) seeds, nat. size. Inset, the distribution of this species.

1D4. DIOSDDREA PULVEREA, Prain and Burkill in Journ. As. Soc. Bengal, N. S. 10, 1914, p. 31 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 275.

Underground parts unknown. *Stems* rather robust, glabrous, hollow when old and then when dried shrinking so as to produce longitudinal grooves, unarmed as far as seen, apparently rather wide-climbing, glaucous tD a very marked degree and appearing as if covered with white dust. *Bulbils* not seen. *Leaves* firm, large, exactly cordate with a moderately open basal sinus, acuminate above, up to 20 cm. long by 18 cm. in width when well grown, the upper leaves are relatively narrower, 9-nerved : the nerves of the first pair enclose a narrowly obovate space having diverged from the midrib at an angle of about 20° : the nerves of the second pair diverge at an angle of about 80°, and curving round gracefully reach the margin at a small distance below the acumen, embracing thus an almost circular space : the nerves of the third pair curve into the lobes and continue tD the margin at about mid-length : the nerves Df the fourth pair run entirely within the lobes and in the larger leaves give Dff on the outer side a branch : the secondary nerves cross the interspaces between the primary nerves almost without elbows : the network is abundant: the margin is just strengthened by a nerve-like thickening : the upper surface has the primary nerves conspicuous : the lower surface has them prominent: the secondary nerves on the lower surface are just prominent : this surface is so glaucous as to appear, like the stems, as if covered with white dust: petiole up to 12 cm. in length.

Male plant unknown.

Female flowers with sepals ovate from a broad base, obtuse above, 1 mm. long. *Capsules* borne on stiff deflexed angled glaucous axes which are up to 25 cm. in length : they face forwards, are very glaucous and very firm : the apex is retuse ; the stipe 3 mm. long, thickening upwards to a diameter of 3 mm. where the wings arise at 5D° and therefrom are semi-obcordate : they expand to a maximum width of 15 mm. at rather above mid-length; along the placenta they measure 2D—22 mm. *Seeds* winged all round but unevenly so, the wing being thrice as broad at the broadest part as at the narrowest.

SOUTH-WESTERN CHINA in the Province Df Yun-nan.

Though the material is not as perfect as we could wish it to be, we are satisfied that *D. pulvzrza* is closely allied to *D. Wallichii.* The latter extends from India eastwards to the borders of China : beyond the border *D. pulvirea* perhaps represents it.

SOUTH-WEST CHINA. **8 b. Province of Y u n - n a n .** Meng-tze, at 4,5D0. ft., *Henry* **9288 !**

PLATE 115, left side. Dioscorea pulverea, *Train and Burkill.* (1) A branch with capsules: (2) a capsule longitudinally opened, showing one seed: and |3) a capsule in section : |4) a seed. All \ nat. size.

Group of D. alata (species 105—113). Tubers comestible, as free from any poisonous substance as the most esculent of the genus, usually solitary, but sometimes a few together. Leaves more or less cordate. Male flower-spikes zigzag, except in one species arranged on special leafless inflorescences : the flowers with a flat base, and sometimes with a wart on the base immediately above the axis on the side opposite to the bract.

105. DIDS0OREA BREVIPETIOLATA, Prain and Burkill ex Craib in Kew Bull., 1912, p. 407, name only, and in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 38 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 287: Prain and Burkill in Kew Bull., 1927, p. 241, and in Lecomte, Flare gén. de 1' IndDch., 5, 1934, p. 729.

Tubers elongated, deep-going, edible. *Stems* vigorous, sometines climbing over several trees |Mrs. Collins), usually rough with numerous ur few minute hard warts, glabrous between the warts, with about eight ridges. *Bulbils,* none seen. *Leaves* ovate, acuminate, opposite, up to 12 cm. long by about 4 cm. in width, 5-nerved : the nerves of the first pair diverge from the midrib at about 25° to enclose a narrowly obovate-elliptic area : the nerves of the second pair are weak and soon approach the margin : the secondary nerves cross the interspaces with some elbows and are scarcely distinct in the network : the uppeT surface glabrous, with the primary nerves distinct, the others indistinct: the lower surface glabrous, with the primary nerves prominent and the others distinct: petiole notably short, only 1 — 3 cm. long.

Male flowers in spikes grouped together in long leafless inflorescences, pleasantly fragrant (Mrs. Collins) : axis of the spike zigzag, angled, 3—4 cm. long : bracts lanceolate, acuminate, with red dots, 1 mm. long, not repressed against the axis as the flexure at the flower leaves space for it: bracteole similar to the bract, but shorter : buds nearly globose. *Sepals* rounded-ovate, very obtuse, 1-25 mm. long, abundantly marked with red-brown dots. *Petals* much smaller and thicker, obovate, D.75mm. long. *Stamens* B, equalling the petals in length, the anthers as long as the filaments. *Gfynoecium* a small three-pointed cone.

Female flowers in solitary or paired spikes, often on short leafless branches two together in the axils of bracts : axis of the spike with raised angles : bracts ovate-lanceolate, acute: bracteoles triangular, 0-5 mm. long. *Sepals* Dvate-triangular, thick. *Petals* suborbicular, a little shorter than the sepals. *Staminodes* exceedingly minute. *Stigmas* as three pairs of small Tecurved hooks. *Capsules* relatively small, shortly stalked, cordate above, up to 18 mm. long, the wings much broader than semicircular, 15 mm. long by 13 mm. in width, glabrous, marked with faint reddish splashes.

SIAM and FRENCH INDO-CHINA, in the mountainous region on the east of the Gulf of Siam, and eastwards to the southernmost provinces of Anam.

Fruiting plants of this species suggest *D. faiipitns* because the capsules are similar in size and may be grouped in the same way : but it has no vary close affinity to *D. dznpizns.*

D. brevipdiolata seems to be abundant in the warm muist parts of French Indo-China which lie east and north-east of the Gulf of Siam, where the durian is grown and other features appear in the vegetation so markedly Malaysian that we have placed those parts in our Malaysian Subregion |s_Be the map, plate 91).

In doing this we have been constrained to adopt aa Dur limits the political boundaries of Cambodia and Lower Indo-China, which *D. brevipetiolata* disregards, overstepping them juat into our Western and also Dur Eastern Indo-Chinese phytDgeDgraphic Subregiona.

The tubers are eaten, apparently wherever it grows. The Siamese call them " man tien" or candle tubers and "man dong" or forest tubers. The Cochinchinese call them "khoai mai." Mrs. Collins, Dr. KBIT and M. Poilane all mention that they are eaten. Mra. Collins calls them the most delicate of all ths wild yams, and adda "long, slender and creamy."

The time Df digging is about November.

We distinguish two varieties:—

Stems rough with warta . . . . . .var. *vera.*

Stems smooth . . . . . .var. *laevicaulis.*

EASTERN INDOCHINA. 9 d. An **am.** Province of Nha-trang |var. *laevicaulis).* Hui-han near Nha-trang, at 3DO m., *Poilane.* 4794! Province of Binh-thuan. Between Phan-rang and Pran, *Finet and Leoomte* 1485 ! Cana, at BDOm., *Evrard* 2359 !

WESTERN IND D-CHINA. **1D g. Siam.** Circle of Rachasima. Bua Yai, Korat, *Put* 4305 ! Circle of Chantaburi. Kaw Chang island, Klawng Rloi, at 50 m., *Kerr* 243! Circle of Prachinburi. Sriracha, general, *Kerr* 2047 ! *Mrs. Collins* 982! 1043! **ID h. LaDS.** Province of Saravane. Near the town of Saravane, *Poilane* 15457 !

MALAYSIA, **11 a. Warm moist French Indo-China.** (Cambodia, var. *vera,* except where stated.) Province of Battambang. Siem-reop near the mountains of Dang-rek between Kon-kril and Anlong Veng, *Poilane* 13894 ! Province of Kamp Dt. Mount Kamchaybor, the Mount of the Elephant, near KampDt, *Poilane* 3D3 ! Kampot |var. *laevicaulis),* • *Geoffray* 5 ! Phu-quok island at Da-bac, *Godefroy* 849 ! (Cochin-China, all var. *vera).* Without precise locality, *Thorel* 1341 ! *Talmy* ! Province of Tay-ninh. Tay-ninh, *Pierre* Bb97 ! Province of Bien-hoa. Vri-an, *Lecomte and Finet* 1982 ! Province of Baria. Mount Dinh, *Pierre* 6598 ! Cap S. Jacques, *Poilane* 549 ! Province of Gia-dinh. Dng-iem, *Lecomte and Finet* 192S ! Cay-iong on the Saigon river, *Pierre* 7D0D ! Island Df Poulo Condor, *Germain* 49 !

PLATE 117. Dioscorea brevipetiolata, *Prain and Burkill.* |1) A branch with male flowers from Pierre's no. 5598, nat. size : |2) a male flower, XlD : (3) the same dissected, XlO : |4) a bract and a bracteole : |5) capsules from Finet and Lecomte's no. 1485, nat. size: 15) a capsule in section: |7) a capsule opened showing immature seeds, nat. size. Inset, the distribution of the species.

1DB. DIDSCOREA HAINANENSIS, Prain and Burkill in Kew Bull., 1935, p. 494.

Underground parts unknown. *Stems* only known in the flowering region : there completely glabrous, firm, with slight ridges which end in turn in the petioles, their greatest diameter as far as seen 4 mm., twining to the right. *Bulbils,* none seen. *Leaves* for the most part opposite, but here and there alternate leaves occur, broadly lanceolate or lanceolate-ovate, the larger obtuse at the base, the smaller subacute, all somewhat acuminate, 3—5-nerved, the largest seen to 10 cm. in length by 3-5 cm. in width : petiole to 3 cm. in length : the nerves of the first pair diverge at a narrow angle from the midrib and with a very slight curve run to the apex : the nerves of the second pair, when present conspicuously weaker and ending submarginally without reaching the apical part of the blade : the secondary nerves cross the interspaces almost straight and are nōt interrupted : upper surface of the blade quite glabrous, dull, with the primary nerves

conspicuous, but the others scarcely visible : lower surface also quite glabrous, almost cDncolorous, with the primary nerves prominent, and the secondary distinct and slightly raised, the network just visible.

Male flowers in spikes which are grouped in leafless inflorescences : the inflorescencea seen attaining 18 cm. in length and appearing to be decurved in life, their axes glabrous and slightly angled : axes of the spikes zigzag, glabrous, angled : bracts very small, only D -3 mm long and not in any way embracing the base of the buds : bracteales not seen. *Buds* elongated. *Sepals* broadly ovate, 1 -25 mm. long, obtuse with red-brown dots." *Petals* smaller, D -75 mm. long, ovate from a narrower base, also with red-brown dots. *Stamens* 5, the anthers bent inwards on, and rather longer than, their filaments, the whole stamen D -5 mm. long.

Female plant unknown.

HAINAN ISLAND.

This species is closely related tD *D. brevipetiolata.* It was collected twicB in the first instance by the same botanist, who unfortunately seems to have allowed his specimens to get flaccid before pressing them in the plant-press and to have disposed the parts in unnatural positions. We had difficulty, in cunsBquence of this, in ascertaining the pose of the inflorescences, and cannot feel sure that they stand in life as we have drawn them. He obtained it in bud in August and with DDen flowers in September, 1927, his two localities being within the same hsien or district Annar +i *i* . , ., ,. . r ,, ,, . ' •"I'.P&rently he recognized them as representing one species, iQr the same note "six feet long: flower yellow" as on the labels of both. But the one he calls " kan luen shue " and the other " chuk yam fans* "

Additional specimens have reached us which indicate that the species is common. They confirm the months of flowering as August and September. Dne collector states that it grows on sandy 11 J well-drained slopes and is partial tD roadsides. It seems that in the summer months its tubers are at times full ug that the may be boiled and eaten.

EASTERN INDD-DHINA. **9 b. The Kwangs.** Island of Hai-nan. With out localities, *0. Wang* 33945 ! *H. Y. Liang* 52745 ! In the Taam Yeung district at Mei-yeung-tsuen, in a small ravine, *Ts'ang Wai-tak* 787 ! and at Tin Wh' " the Sha-po shan, *Ts'ang Wai-tak* B54! 1B1D3 ! Fung-leng in the Ngai district, *S. K. Lau* 492! Between Dung-ka and Waug-fa-shi at 2DDD ft. (somewhat doubtful), *N. K. Chun and C L. Tso* 43855 !

PLATE 118, left hand. Dioscorea hainanensis, *Prain and Burkill. i\)* a branch with male flower-buds from Ts'ang's no. 6D4 and *\2)* a branch with almost mature buds from his no. 787, both \ nat. size : |3) a male flower-spike, with the flowers open v 5 • \&\ a flower forced open: |5) a sepal: |B) a petal and |7) a stamen in face and in side view all X5, and from no. 787.

1D7. DIDSDDREA KRATIDA, Prain and Burkill in Kew Bull., 1927, p. 241, and in Lecomte Fbre gén. del'Indoch., 5, 1934, p. 731.

Tuber long, going deep into the soil, eaten |Kerr). *Stems* glabrous, thicker than a crow quill, when dry deeply grooved, dull, apparently quite unarmed. *Bulbils,* none observed" *Leaves on* the lower parts of the stems alternate, above becoming more or less OB opposite cordate at the base and upwards long lanceolate-ovate, abruptly acuminate under the up to 24 cm. long by 7 cm. in width, 7-nerved : the nerves of the first pair diverge from the midrib at only 1D°, run approximately straight from it through about two-thirds of the length Df the blade and then bend round to meet the midrib in the acumen : the nerves of the second pair diverge from the midrib at about 4D° and curve into the margin towards the mid-length of the blade : the nerves of the third pair are weak and more or less

aubmarginal in the lowest part of the blade : the secondary nerves cross the interspaces almost without angles : the network is abundant: upper surface glabrous, with the primary nerves conspicuous and the others just visible : lower surface also glabrous, with the main nerves prominent, the secondary conspicuous and the network just visible : petiole up to B cm. in length. Among the flowers may be small leaves which, from the loss of their basal lobes, are long-ovate, but are otherwise characteristic, and by intermediate stages are derived from the larger leaves.

*Mahflowers*in short spikes arranged along elongated axillary leafless branches: branches two together, up to 12 cm. long, angled : spikes ID -15 mm. long, with upwards of 12 flowers ; axis angled, zigzag : buds directed slightly forward, a little elongated : bracts shortly ovate, scarcely repressed. *Sepals* ovate, very obtuse, 1 mm. long, glabrous. *Petals* shorter, narrowed below, obtuse above. *Stamens* 5, a little shorter than the petals, the anthers equalling their filaments in length.

Female flowers in axillary spikes which in length equal or exceed the leaves, ID or more Dn each spike : bracts deltoid-ovate, acute, 1 mm. long : bracteolea shorter, deltoid. *Sepals* ovate, scarcely 1 mm. long. *Petals* as long as the sepals, obtuse at the apex. *Staminodes* minute. *Capsules* of a smoky brown and rather thick, obcordate above, with a stalk about 4 mm. long at the base : wings slightly oblique, but evenly rounded with a width of 2D mm. and the same length. *Seeds* with a broad deep brown wing, 18 mm. across.

South-eastern SIAM and DAMBDDIA.

The affinity Df *D. kratica* is clear: it belongs to the group *of B. alata* and is DIIB of a series of species which can be arranged gBDgraphically from north tD south thus :— |i) *D. Fordii* in south-eastern China, *ii) D. hainanensis* in Hai-nan, *iii) D. kratica* in south-eastern Siam and Cambodia, *iv) D. gibbifiora* in the southern parts of Peninsular Siam and in British Malaya and finally, *v) D. myriantha* rather widely in Malaysia. *D. kratica* has larger leaves than the other four of this close alliance, and is evidently a more robust plant.

The rainfall of the mountainous tracts where it is found is heavy, and its habitat ia about the edges of evergreen forast, usually near sea-level.

Kerr obtained as a Siamese name for it "man dong " which is given also to *D. brtvipHiolata* in thB same part of the country, and " man dam ".

EASTERN INDO-CHINA. **9 d. Anam.** Province of Nha-trang. Phu-hu, *Poilane.* !

WESTERN INDOCHINA. **ID g. Siam.** Circle of Payap. On the Doi Pa-mawn spur of Doi Angka at 15BD m., *Qarrett* 933 ! Circle of Dhantaburi. Baw Rai near Krat, in evergreen forest, *Kerr* 9453 ! Kao Saming near Krat, *Kerr* 9415 ! Circle of Prachinburi. Banking, Krabin, in evergreen forest, *Kerr* 198D1 ! 19836 ! *Marcan2551* !

MALAYSIA. **11 a. Warm moist French IndD-China.** |Cambodia.) Province of Kam-pot. Thpong, Knang-repoen, *Pierre* 1875! Island of Phu-quoc, *Contest-Lacour* 69 !

PLATE 118, right side. Dioscorea kratica, *Prain and Burkill.* |1) A branch with male flowers from Contest-Lacour's specimen, \ nat. size : |2) a spike from the same, x 5 : |3) a sepal, slightly flattened, X 5 : |4) a petal, x5 : |5) a stamen, x 5 : |b) a branch with fruit from Marcan's specimen, \ nat. size : |7) a seed in the IDCUIUS, \ nat. size : |8) a large leaf from Ken's no. 9453, \ nat. size. Inset, the distribution of the species.

1D8. DIOSDOREA FDRDII, Prain and BurkiU in Journ. As. SOD. Bengal N. S. 4, 1908, p. 45D and ID, 1914, p. 3B : R. Knuth in Engl. Pflanzenreich' iv-43, 1924, p. 26B.

Dioscorza Batatas, Bentham, Flora Hongkong., 1851, p. 358 in regard to Wright's specimen : D. H. Wright in Journ. Linn. Soc. Land., Bot. 31, 19D3, p. 91 in regard to Wright's specimen also ; not Df Decaisne.

Dioscorea glabra, D. H. Wright in be. cit, as regards Ford's specimen 5 : not of Roxburgh.

Dioscorea hongkongmsis, R. Knuth in Engl. Pflanzenreich, iv-43, 1924 T>. 288.

Underground parts unknown. *Stems* glabrous, rather slender, unarmed, green. *Bulbils,* none seen. *Leaves* opposite, chartaceous, ovate-hastate or ovate-sagittate, acuminate with the basal sinus widely deltoid Dr sometimes broken into two bays by the rib expanding a little into the base of the blade, 7—8 cm. long by about 4 cm. in width, 5—7-nerved : the nerves of the first pair enclose a narrowly obovate area : the nerves of the second pair diverge from the midrib at about 9D° to curve round into the margin towards the mid-length of the blade : the third pair are submarginal in the lobes or are replaced by a branch given off from the second pair : the secondary nerves are scarcely distinct in the network : the upper surface very glabrous, with the larger nerves not prominent but distinct: the lower surface glabrous, when dry browner than the upper surface, with the primary nerves prominent and the others just visible : the margin very narrowly edged : petiole glabrous, about 2—3 cm. long.

Male flowers in crowded spikes which arise in false whorls along leafless branches or branch-endings, the upper spikes, in rather a noticeable way, as long as the lower ones so that the branch is like a bottle-brush : these branches are solitary, ID—15 cm. long, the axis of the spikes about 15 mm. long with 14—2D flowers, narrowly ridged, rather stout : bracts ovate, acuminate, D-5 mm. long, strongly repressed in the basal part against the axis by the broad base of the flower-bud : bracteole broadly ovate. *Sepals* very broadly ovate, very concave, very obtuse to rounded at the apex, 1 mm. long, brown-lineolate, with a hyaline border. *Petals* smaller, broadly spathulate, with red-brown dots in the thickened centre. *Stamens* B, their filaments and their anthers of equal length, but the anthers of the inner series a little smaller than those of the outer, the filaments D-25 mm. long. *Gynoecium* a small cone.

Female flowers to the number of 12 in downwardly directed solitary spikes which when the fruit is ripe may have attained 18 cm. in length, their details unknown. *Capsules* directed forwards and downwards with wings much broader than semicircular, these 2D mm. long by 2Dmm. in width, dark straw-coloured. *Seeds* with an unequal red-brown wing all round which is conform to the loculus.

HONGKONG and neighbourhood.

It is difficult to understand 1IDW Bentham came to reduce this species to *D. opposita* (under the name *D. Batatas),* for Charles Wright's Hong Kong specimen of it is very dissimilar from typical *D. opposita.* SDB specimens collected subsequently were not so named by the later botanists who determined them : for instance, Ford's Lantao specimen, gathered in 19D3, was assigned by Mr. D. H. Wright to *D. glabra,* Roxb., and became the basis of our *D. Fordii :* and Hance's Tytam specimen became the basis Df Dr. R. Hnuth'a *D. honakongensis.* Flowering is recorded as occurring in July and November and fruiting in April: but November and April must be considered abnormally late, the one month for flowering and the other for fruiting.

DATHAY. **7 d. Mid China.** K i a n g - s u province. To the south Df the Yellow river, *Heude.*

EASTERN INDD-CHINA. **9 b. the HwangS.** H o n g K D n g territory. Hong Kong, *Wright*! *N. K. Chun* 43308 ! Ravines of the Peak, Hong Kong, *Bodinier* 1301 ! Ravine leading to Pok-fu-lun, *Lamont* 787 ! Wonkae, *Lamont* 758 ! *Ford's collector* 359 ! LantaD island, *Ford* B ! Tytam, *Hance* 458 ! K w a n g - t u n g province. Tseh-kon-yen shan, near Wu-kan-tin, *TsHang Ying* 102 ! Loh-fou shan, *3. P. Ko* 5D124 !

PLATE 119, left hand side. Dioscorsa Fordii, *Prain and Burkill.* |1) A male flowering branch from the specimen used in defining *D. Furdii* (Ford's no. S) in the herbarium of the Hong Kong Botanic Garden, \ nat. size : |2) and |3) male flowers from above and from the side, X 8 : |4) the parts of the same, X 3 : |5) stamens : |B) the gynoecium of a male flower : |7) a capsule from Ts'iang Ying's no. 102, \ nat. size : |8) the upper and the lower seed of a single loculus, nat. size. Inset, the distribution of the species.

1D9. DIDSCDREA GIBBIFLORA, Hooker fil., Flora Brit. Ind., 5, 1892, p. 294: Curtis in Journ. Roy. As. SDC. Straits branch, 25, 1894, p. 149 : Ridley, Mat. Flora Mai. Penins., Monocot. 2, ^907, p. 82 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 36, excluding certain specimens' from eastern Malaysia : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 255 : Ridley, Flora Mai. Penins. 4, 1924, p. 317 : Prain and Burkill in Gard. Bull. S. S., 5, 1930, p. 51, and in Lecomte, Flore g6n. de 1 'Indoch., 6, 1934, p. 73D : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 818.

Dioscorea, glabra, Wallich, Cat. lith., 1830, no. 51 DIB ; not of Roxburgh.

Dioscorea sp., Prain and Burkill in Kew Bull., 1927, p. 239.

Tubers deeply descending into the soil and expanding very gradually downwards to their maximum diameter which is only a short way back from the tip, this diameter about 2cm.: skin light brown: flesh white or nearly so, soft, edible. *Strnis* glabrous, quite unarmed, green with purplish mottlings when grown in the shade, or with pink in the sun. *Bulbils* produced. *Leaves* mostly alternate, but some opposite : if the shoots are produced in the sun they are hastate or hastate-sagittate : when, as is more usual, they are produced in shade, they are ovate-cordate with the broadest part well above the level of the insertion of the petiole and the lobes not evenly rounded but somewhat obtuse : the lobes of the upper leaves are diminished until they vanish at the level at which flowers appear, an ovate-elliptic leaf-blade resulting : when the lobes are small, the sinus takes the appearance of having been bitten out from the base of the blade : the nerves of the first pair diverge at 45° or a little less to enclose a narrowly elliptic area which is twice as long as broad : the nerves of the second pair diverge from the midrib at 9D° and soon become submarginal, not passing beyond the mid-length of the blade : the nerves of the third pair are weak and confined to the lobes : the secondary nerves cross the interspaces with some elbows : the upper surface smooth, dull when dried, with the primary nerves distinct and the others indistinct: the lower surface dull and in leaves produced in the shade with a rose-red colour along the larger nerves which are prominent, the network just raised : petiole 2—5 cm. long, equalling about f Df the blade.

Male flowers in spikes both in leaf-axils towards the branch-tips and on leafless branch-en dings : the spikes up to 1 '5 cm. long, 1—2 together in each axil of the more Dr less

opposite bracts, so that they appear as if in whorls : axis zigzag, with 2D-3D flowers arranged with a divergence of about $\frac{1}{2}$, which means that each successive flower is nearly upon the opposite side of the stem to the last; the low ridges which make the axis roughly triangular end in turn in the bracts under the flowers, new ridges so arising that there are six at any level, three very low and three making the angles of the axis, which is thus approximately triangular in section : bracts ovate, acute, curved round the broad flat base of the flower, 1 -5 mm. long : bracteole triangular : a solid wart at the base of the flower on the upper side (this wart led Sir Joseph Hooker to give the species the name *gibUflora).* *Sepals* broadly ovate, obtuse, 1 -25 mm. long. *Petals* elliptic-ovate rounded above, about equalling the sepals in length. *Stamens* 5, the anthers equalling the filaments in length, the whole shorter than the petals.

Female plant not yet identified.

LOWER SIAM, the MALAY PENINSULA and SUMATRA.

This *Dioscorea* was collected in a slightly immature condition by Porter in Penang in the year 1925 but h s not been met with in the Settlement by anyone since. In 1915 one of us obtained it in a ste .1 Kuala Lumpur, and subsequently it was obtained in several places within British MakU i^rt. "t V' ne"* parts of Siam, and in Sumatra. In 1927 Mr. M. R. Henderson found male flowers up!n *ZSZ^H*-p T ' anang boundary.

It grows on a well-drained soil, often among boulders.

Its tubers are eaten by the Sakai, though they rarely can obtain much of them owine tn *th A* «. * i. thBy extend. The Malay-speaking Sakai of western Palmng call it " wauh " and the P„ p. J L 7n-?„ „ " which ™ULL *VUG* irangan ol Ijalinr Bnb " but apparently this name is not entirely restricted to it. " Hou ", used by'4hB W rtf. 8 t . form of it and with this form we approach the Mon word "khoai. " KBIT obtained the species from the Patt States with the Malay name " ubi tanyo ," its meaning uncertain.

Possibly *D. gibbiflora* should bB united to *D. myriantha.* It difiers in being more vigorous with kr and these dull on thB under surface. It occupies part of the area in the Malay Peninsular w'her n ^ 6 1 1BaVBa has been observed, and extends a little beyond it. It is found often on limestone. *myr'Mntha*

MALAYSIA. **11 d. Lower Siam.** Circle of P u k e t. Under the limestone caves of Pang-nga |a little doubtful), *Mohamed Haniff and Mohamed Nur* 3858 ! Circle of S u r a t. Tong Seng, *Mohamed Haniff and Mohamed Nur* 428 B ! Circle of P a t t a. Banang, at 3DD ft., *Kerr's collector* ! **11 B. Malaya.** State of K e d a h Islands Langkawi, *Curtis* 2512 ! Baling, *Schebeata* ! Settlement of P e n a n e Wthout precise locality, *Porter* 51D5b! State of K e 1 a n t a n. Kuala Rek, *Mohamed Haniff and Mohamed Nur* 1D188 ! State of P a h a n g . Bukit Senai near Chegar Perah *Henderson* 19418 ! Raub, *Burkill and Mohamed Haniff* 16765 a ! Base of Enu nong Senyum, *Hzndzrson* 22377 ! Six miles north of Bentong, *Burkill and Mohamed Haniff* moiM Pelangai, *Burkill and Mohamed Haniff* 16787! Island of Tiuman, about Juara bay among granite boulders, *Burkill* 9B9 ! 1D12 ! and at Lubok Lanun, at 8DD *it* *M J,* *ed* *Nur* 1886D ! State of P e r a k. Kuala Kendrong near Grik, *Burkill and Mohamed HaZiff* 124D2 ! Temengoh, *Schebzsta* 14 ! Padang Rengas, under the limestone cliff, *Burkill and Mohamed Haniff* 12438 ! State of S e 1 a n g D r. Batu Caves, under the limeston ' rff *Burkill* 2269 ! 4417 ! 4418 ! 5340 ! 6353 ! B354 ! States of the N e g r i S e m b i l a n. Tampin, on granite, *Burkill*! Tebong forest, *Hulttum* 9622 ! **11 f. Sumatra.** J? esidency of the E a s t C o a s t. Bukit Kramat Kuda near Sibolangit, *Mohamed Nur* 7265 !

PLATE 12D, left side. Dioscorea gibbiflora, *Hooker fil.* |1) Leaves and male inflorescences from a specimen collected by Henderson, \ nat. size : |2) a leaf from near th*e base of the stem, \ nat. size : |3) a male flower showing bract and bracteole from the side, and also the upward spur: |4) the same in section, X5 : |5) a leaf, \ nat. size. Inset, the distribution of the species.

11D. DIDSDDREA MYRIANTHA, Kunth, Enum. plant., 5, 185D, p. 382 : Deron, Cat. plant, herb. Domis. forest., 1892, p. 171 : KDorders-Schumacher, Syst. Verzeichn. d. Herbar Reorders, Lief. 9, 1912, genus 1252 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 38 : Merrill in Journ. Roy. As. Soc. Straits branch, special no., 1919, p. 118: BeumSe, Flor. Analyt. Onderzoek. Kunstmatig Djati-plantsoenen, 1922, p. 132 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 271 : Prain and Burkill in Kew Bull., 1927, p. 239, and in Lecomte, More g6n. de 1' Indoch., B, 1934, p. 731.

Dioscorea filiformis, Prain and Burkill ex Koorders-Schumacher, Syst. Verzeichn. d.Herbar Koorders, 3, Abt. 1, 1914, p. *20 :* Merrill, Enum. Philipp. Flower, plants, 1, 1922, p. 217 ; not of Blume.

Dioscorea Koordsrsii, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 292.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in very small part; not of Linnaeus.

Dioscorea periplocifolia, Jussieu in Herb, propr.

Dioscorea salicifolia, Uline ex Koorders in Mededeel. 'sLands Plantentuin, 19, 1898, p. 312.

Dioscorea sp., Koorders-Schumacher, Syst. Verzeichn. d. Herbar Reorders, Lief. 9, 1912, genus 1252.

Tubers produced at a depth of half a metre or more, attaining 8—ID cm. in length by about 1 cm. in diameter, but the long stalk rather gradually expands into them, smooth. *Sterns* glabrous, very faintly angled or not angled at all, turning a dull chestnut when dried. *Bulbils* as short fusiform bodies. *Leaves* some subopposite or more commonly alternate, ovate-sagittate, the basal sinus so rounded as to form a segment of a circle or twin bays, the auricles rounded : the lesser, i.e., the uppermost, leaves ovate ; all acuminate and up to ID cm. long by 5-5 cm. in width at a little below the mid-length of the blade, 5—7-nerved : the nerves of the first pair diverge from the midrib at about 30° to curve so as to be submarginal and tD enclose a narrowly elliptic to obovate area : the nerves of the second pair markedly weak and disapperaing in the lower half of the blade as soon as they reach the neighbourhood of the margin : the nerves Df the third pair still weaker, and submarginal in the auricles : the secondary nerves few and for the most part lost in the network without crossing the interspaces : margin not rimmed : the upper surface glabrous, dark green, with the primary nerves distinct but the others scarcely visible : the lower surface glabrous with the primary nerves prominent to distinct, the secondary just prominent or indistinct : petiole up tD B cm. long, glabrous.

Male flowers very fragrant (Rensch), in spikes grouped on special leafless branches, which may be as long as 15 cm. : axis of the spikes up to 3 cm. long with 2D—25 flowers but this rarely, generally scarcely more than 1 cm. long with a dozen flowers, zigzag, angled',

glabrous : buds with a broad flat base, aubgibbous laterally; bracts lanceolate-ovate, acuminate, about 0-5 mm. long, pressed down against the axis by the flat base of the bud or flower, transparent, but reddish with red brown dDts : bracteole exceedingly minute : from the base of the flower a small wart projects forwards over the axis. *Sepals* ovate from a broad base, 1 mm. long, with red brown dots. *Petals* much smaller, thick in the centre, thin at the margins, incurved, almost spathulate, D-75 mm. long. *Stamens* 6, the anthers as long as the filaments. *Gynoezium* a trifid cone.

Female flowers on decurved spikes up to the number of about 12 on a spike : axis angled, up to 23 cm. long: bracts broadly ovate, 1 mm. long. *Sepals* ovate, very thick, nearly 2 mm. long. *Petals* narrower and shorter, thick. *Staminodes* half as long as the petals. *Capsule** rather large, grey-brown when dry and somewhat shining, having faint wrinkles across them, 3D mm. long, including the 3 mm. long stipe, retuse at the apex, the wings slightly oblique and broader than semicircular, 24 mm', bng by 22 mm. in width. *Seeds* with a smoky chestnut uneven wing all round, which in outline is more or less conform to the cavity of the loculus.

MALAYSIA, more or less throughout, but not common in the western parts.

It may be that £. myriad is not distinct from *D. gibbiflora :* if thBy be united the above statement of dispersal would be made correct if modified, by the omission of the remark that it is not common in the western parts of Malaysia. We find it more slender than *D. gibbifvra,* the leaves smaller on the whole, and liver-coloured and bright on the lower surface. The size of the leaf is the most important character. Leschenault waa the firat botanist to collect it : he obtained it in Java, but recorded no locality : as he visited many in which it is likely to grow, surmise as to the source would be valueless. Later collectors have confirmed its presence in Java from sea-level tD a considerable elevation : Koorders[1] extreme being u high as between 2,100 and 2 4D0 metres above sea-level, it is by no means confined to the coast.

AH it occurs on both sides of the Equator, it flowers in various months. In T™» «; .* j . , nr.iL , . „ TII-i- • i i . iiuwer oiam, it does so in September and October ; and in the .Philippine islands in November and December. It has b n c11(tel in fruit in Lower Siam in November, and in fruit in the Philippine islands in January and February. ^On "thT other side Df the Equator, e.g., in Java and Lombok, flowers are formed in May and fruit in Tr \\ TT- • " ? I* they haVB been obtained in Marcn. d uiJune: in the Kei islands

Leschenault recorded as a Javanese name for it, " elDs eloa hoi ", which should be written " huwi alus " and means a rather slender yam. Collectors in the Philippine islands have recorded for it the nan^ ^^J" " Neither name indicates this species to the exclusion of others.

WESTERN INDD-CHINA. ID g. **Siam.** Circle of Ayuthia, Saraburi at Ban Nawng Bua, *Put* 1083 11128!

MALAYSIA. **11 A. Peninsular Siam.** Circle of Surat. Kaw Samui, *Put* 1299 - Circle of Nakawn Sntam.rat. Terutau, at Telok Apau, *Mohamtd Haniff and Mohamed Nur* 7D98 ! and at Telok Wau, *Mohamad Haniff and Mohamed Nur* 7473 ! **11 e. Malaya.** State of Perlis. Besih Hangat, *Hendzrsun* 22882 ! State of Kedah Langkawi islands, at Kuala Huah, *Mohamed Haniff and Mohamed Nur* 7059 ! **Java.** Without locality, *Leschenault* 318 ! *de Vriese* ! Bantam residency. Gon Karang, near Dessur, *Koorders* 4D648b ! Batavia residency. " DschungTZ? Depok, *Hallier* 535! Parang, *Blume* Buitenzorg, at and below Desa Kalibata *Hallier* 249! and without no.! Kiawang, *Beumée.* Pekalongan reside Subah, *Koorders* 2253 0b ! In the forest reserve of Margasari, plentiful JBwfl Semarang residency. Regaloh, very common in teak forest *BaLfr* <^1 I Kedoengdjati and Ngarengan, *Beumee.* lempoeran, in teak forest, *Docters van Leeuwen* ! Rembang residency. In teak plantations, *Beumee* Kedi residency. Paru, near Kediri, *Docters van Leeuwen* 392! Beeoeki resd ency.

Bj ember, *Ultée* ! K a n g e a n islands. Sepandjang, in scrub, abundant, *Backer* 28938 ; 29D32 ! SabDenten |not typical), *Backer* 29757! **11 g. Northern Borneo.** B r i t i s h N*o r t h B o r n e D. Without precise locality, *Airs. Clemens* ! P a l a w a n island. S. Antonio bay, *Merrill* 857 ! Puerto Princesa, *Bermejos* 209 ! Tanabag, *Bermejos* 33D ! **11 k. Philippine Islands.** (Luzon.) N u e v a E c i y a province. Bayocboc near Penaranda, *Zschokks* BD35 ! R i z a l province. Dueva Montalban, *Loher* 1884! Dierra Bigaa near Montalban, *Loher* 1888! Antopolo, *Ramos* 222 3B ! La g u n a province. LDS Banos, *Copeland* 4BO ! Laguna, *Vidal* 2945 ! Dalawan, *Cuming* 547 ! D a l a m i a n t j s islands. Dulion island, in dry thickets, *Merrill* 44B ! B o h o 1 island, *Ramos* 43137 ! [Mindanao.) Z a m b o a n g a district. Bagasan river, in thickets near sea-level, *Merrill* 8244 ! Malasugat, Dn open slopes, *Msrrill* 812D ! and in a damp ravine at about 1D0 m., *Msrrill* BD58 ! S u l u archipelagD. Fayuntad, *Vidal* 3229! **11 I. CelebB5.** M i n a h a s s a residency. Ratahan, in forest, *Koorders* 15731b! S al ey er islands. Saleyer, among coconuts at 250 m., *Docters van Leeuwen* 1B88 ! Kaloa Taea, near the shore, *Docters van Leeuwen* 1394 ! 14D3 ! Hajoe adi, at 5D m., *Docters van Lezuwen* 1338 ! **11 m. Lesser Sunda islands.** L o m b o k. Ekas, plentiful, *Mrs. Rensch* 412 ! S D 1 o r, *Reinhardt* ! *Blume* ! T i m o r. Flares de Coral, *de Castro* ID! **11 n. Amboinese Moluccas** A m b o i n a , *Forstenl*

PAPUASIA. **12b. Dutch New Guinea.** K e i islands. Dhoitieh, near Toeal, in bush, *Jensen* 32D !

PLATE 12D, right side. Dioscorea myriantha, *Kunth.* |1) A branch with male flowers from Mohamed Haniff and Mohamed Nur's no. 7D59, \ nat. size : |2) a flower-spike, X5 : 13) a male flower from the side, showing the small solid spur which is directed forward from its base, X5 : |4) the bud from below showing the shape of its flat base and the spur : |5) the same from above, showing the spur : |B) a sepal and |7) a petal, X5 ; |8) capsules from Mohamed Hanifi and Mohamed Nur's no. 7473, \ nat. size. Inset, the distribution of the species.

111. DIDSDDREA DEPAUPERATA, Prain and Burkill in Kew Bull., 1933, p. 245, and in LecDmte, Flore g6n. de 1' Indoch., 5, 1934, p. 736.

Tubers penetrating deeply into the soil, about 1 cm. in diameter at the top and scarcely thickening at all downwards, with a brown surface sparingly beset with small roots, and with white edible flesh. *Stems* glabrous, angled above the very base, copper-red. *Bulbils*, none seen. *Leaves* alternate in the lowest part of the stem, then opposite and opposite also Dn all lateral branches, alternate again close to the apices among the flowers, hastate Dr subsagittate with the margins above the auricles curved inwards, or straight in smaller leaves, the apex acute rather than acuminate, the petiole just winged at its insertion in the sinus, the broadest part of the blade across the auricles at or just below the level of the insertion of the petiole, the length measured along the midrib up to 8 cm., and from the tip of the auricles to the apex up to 9·5 cm., while the maximum width is to 5 cm., nerves 5—7 : the nerves of the first pair diverge from the midrib at an angle of about 3D[a] tD enclose a lanceolate area : the nerves of the second pair diverge from the midrib at an angle of SD—9D[D] to run to the margin just above the auricles whence they continue submarginally almost to the apex : the nerves of the third pair run in the auricles : the secondary nerves are only a little more distinct than the net work Dr sometimes scarcely so : upper surface glabrous, dull, with the primary nerves distinct, but the others Dnly just visible : the lower surface glabrous, with the primary nerves prominent and also reddish-brown, the others just raised : the margin is just strengthened : petialB glabrous, up to 2·5 cm. in length.

Male flowers in spikes which are almost all axillary among the leaves : but at the ends of the stems a few nodes carry spikes in the axils of bracts : at the most there are three spikes together, usually they are solitary: axis zigzag, up to ID mm. long, with 5—ID flowers placed upon the flexures, appearing rather slender in the dry specimen, but if the tissues be softened then nearly D'5 mm. in diameter, ijuite glabrous, angled and'under the bracts the angles rising into wings : bracts ovate, slightly acuminate, curved round the base of the flower, glabrous, thin, up to D'75 mm. long : bracteoles thin, deltoid, small, only D'25 mm. long. *8spate* glabrous, ovate, very obtuse, 1.25 mm. long, crested in the middle line outside towards the base, at the margins thin. *Petals* glabrous, smaller, rather angularly obovate, obtuse, thick, 1 mm. long. *Stamens* 6, D-75 mm. long, the anthers rather more than one half of their length. *Gynoezium* of three small points.

Female flowers to the number of ID upon axillary spikes : bracts ovate. *Sepals* rounded ovate, about 1 mm. long, glabrous. *Petals* similar but a little smaller. *Ovary* at flowering up to 3 mm. long. *Capsules* copper-coloured, but not seen mature : those seen with a stipe up to 3—4 mm. long and widening a very little upwards until 1 mm. through, where the wings arise with a curve which runs through an angle of about BD°; these wings curve evenly to a retuse apex, the length along the plancenta of the largest capsule seen 15 mm. and the wings 8 mm. across.

SIAM, chiefly on limestone hills, and in LADS.

We regard this species as a calcicole representative of the group of *D. alata,* and consider that owing to the poverty of the soil upon which it grows, it fails to develap the large characteristic flowering branches of its congeners, and is smaller in ita vegetative parts : but its zigzag spikes clearly indicate its relationship. Also upon the sepala where some of thB species Df the group of *D. alata* have characteristic warts, it has outgrowths but as short crests. In foliage it approaches *D. calcicola* ; but the stiffer spikes distinguish that species. It flowers in August.

WESTERN INDD-DHINA. **ID g. Siam, excluding the Peninsula.** Circle of Prachinburi. Aran-pratet, *Put* 3128! **iDh. Laos.** Province of Saravane. Samia, *Poilane* 15495 !

MALAYSIA. **11 d. Peninsular Siam.** Circle of Rachaburi. Kanburi, on the limestone hill of Sni Yok, at 5DD m., *Marcan* 240D ! and on the same hill, elevation not recorded, *Put* 18D4 ! Dn the hill of Kao Tawng, below 1DD m., among bushes and in herbage between boulders, *Kerr* 19647 ! 19648 !

PLATE 119, right side. Dioscorea depauperata, *Prain and Burkill.* |1) A branch with male flowers, from Kerr's no. 1964B, \ nat. size : |2) the base of Kerr's no. 16947, 4 nat. size: |3) the largest leaf seen, from Kerr's no. 19648, \ nat. size: |4) leaves from the middle of the stem of no. 19547, \ nat. size : |5) a piece of the stem at a somewhat higher level, with young capsules, \ nat. size : |6) a male spike from Kerr's no. 19348, *X5* : |7) a sepal, |8) a petal and |9) a stamen from the same, all x5 : (ID) an immature fruit from Marcan's no. 24DD, \ nat. size : |11) a leaf from Poilane's no. 15495, \ nat. size. Inset, the distribution of the species.

112. DIDSCDREA PERSIMILIS, Prain and Burkill in Journ. As. Soc. Bengal N. S. 4, 19D8, p. 454 and ID, 1914, p. 39 : R. Knuth in Engl. Pflanzenreich' iv-43, 1924, p. 267 : Groff, Ding and E. Groff in Lingnaam Agric' Rev. 2, 1923, p. 63: Yamamoto, Suppl. Ic. Plant. Formos., 3,1927, p. 8: Syun'iti Sasaki, List Plants Formosa, 1928, p. 114' Groff in Sci. Bull. 2, Lingnam Univ., 193 D, p. 29: Prain and Burkill in LecDmte, Flore Gén. de l'Indoch., 6, 1934, p. 732: Merrill in Trans. Amer. Phil. Soc, N. S. 24, part 2, 1935, p. 114.

Dioscorea glabra, D. H. Wright in Journ. Linn. Soc. Lond., Bot. 31, 1903, p. 91 as regards Henry's nDS. 84D7 and 869D; not of Eoxburgh.

Dioscorea japonica, D. H. Wright in the same, p. 92 as regards Ford's collector's 33D ; not of Thunberg.

Dioscorea oppositifolia, Loureiro, Flora Dochinch., 1790, p. 624 and ed. Willdenow, 1793, p. 50D: de Lanessan, Plant, utiles des CDI. franc, 1886, p. 785 : Eberhardt and Bloch in Bull. Econ. Indoch., N. S. 12*, 1910, p. 355 and in Bull. Sci. Pharmacolog., 1909, p. 509: Drevost and Lemarié, Cat. prod. Indoch., 1917, p. 123 and in Bull. Econ. Indoch., N. S. 23, 1921, p. 137 ; not of Linnaeus.

Dioscorea oppositifolia or D. japonica,'" DrevDst and Lemarie, Cat. prod. Indoch., 1, 1917, p. 12. ?

Dioscorea raishaensis, Hayata, Ic. Plant. Formes. 10, 1921, p. 44 with a figure on p. 45 : R. Hnuth in Engl. Pflanzenreich, iv-43, 1924, p. 237.

Tubers deeply penetrating, swelling downwards very gradually, edible. *Stems* glabrous, with low ridges, unarmed, reddish. *Bulbils* similar to those of *D. alata*. *Leaves* opposite, subopposite or alternate, rather firm, very glabrous, ovate-subhastate or ovate-cordate, generally rather long-acuminate, at the very apex mucronulate, the sinus at the base generally broadly deltoid, the margins evenly curved, 8 -10 cm. long by 5 -8 cm. in width, 7-nerved or rarely only 5-nerved : the nerves of the first pair enclose a lanceolate or rarely lanceolate-ovate area : the nerves Df the second pair become submarginal in the distal half of the blade : the outermost nerves give off a strong submarginal branch to run in the lobes : the secondary nerves cross the interspaces rather obliquely : the upper surface glabrous with-ttie primary nerves distinct and the rest just visible : the lower surface with the primary nerves prominent and the rest just prominent: margin not strengthened : petiole glabrous, 5 — 8 cm. long.

Male flowers in spikes which are arranged, for the most part singly along special leafless branches ; these branches may be 4D Dm. long: the axis of the spikes zigzag, glabrous, ID -12 mm. long, with upwards of 20 flowers : bracts curved round the base of the flower,' reddish, ovate, 1 mm. long: bracteoles reddish, broadly ovate, acute or acuminate, glabrous, reaching to the middle of a fully grown flower : buds ovoid-globose. *Sepals* brDwn-lineolate, navicular-concave, rather acute. *Petals* equalling the sepals in length, elliptic-obovate, roundish, acute. *Stamens* 5, the anthers just longer than their filaments.

Female flowers in decurved axillary spikes, which attain 2D cm. in length : axis angled, with 8-15 flowers. *Sepals* ovate, obtuse, relatively large, attaining 2 mm. in length! *Petals* similar. *Staminodes* minute. *Stigmas* as three pairs of hooks. *Capsules* parchmenty, straw-coloured with a reddish tint, their wings much broader than semicircular, the stipe 2-3 mm. long, expanding to 4 mm. in diameter: wings measured along the placenta 18-20 mm. long, 15 mm. in width. *Seeds* with a smoky wing all round, which is conform to the loculus.

South-eastern CHINA and TONKIN.

It would be rash to assert that this species ia the parent of *D. alata* ; but it seems most reasonable to aay that no other living species more nearly represents the condition from which *D. alata* came. *D. Hamilto*," I closely represents the ancestral stock ; and all three must have had a common line of descent. Prob bl *th* can ba hybridized without difficulty, and it may be that intermediates exist, though we are unable to t *T* any specimens undoubtedly hybrid.

Loureiro stated that his "D. Dppositifolia", which proves to be this species, furnished tubers which were dug wild and served up on the tables of rich men, cooked and sweetened; and he adds that they were considered a remedy against pulmonary complaints. Drevost and LemariS say that the tubers are highly prized and they add that the plant is cultivated for them in the sacred groves of Dinh-bang in the Bac-ninh province of Tonkin : they mistakenly call it *D. japonica,* apparently as a result of Loureiro's suggestion that *D. japonica* Thunb., is synonymous with *D. opposita,* Thunb. Perrot and Hurrier in their *Materiamedica dzs AnnamilL* |19D7, p. 97) mention " cu mai," presumedly this species, as medicinal.

Flowers are recorded as produced in Canton in July and August: fruit follows in October, and has been collected as late as January in Tonkin.

"Dhukko shu" is a vernacular name from southern China and "su mai" |cu mai) from Tonkin. The first means mountain bamboo yam, and is not restricted to the species, but is shared by *D. lineari-cordata.*

SDUTH-WEST CHINA. **8 b. Province of Y u n - n a n.** Mong-wong, *Buns d'Anty* ! **B C. Province DfHwei- Chow.** Huang ts'aD pa, *Cavahrie* 755 ! Pin.fa, *Cavahrie* 152 !

EASTERN INDO-CHINA. **9 a. Formosa** |the form described as *D. raishaensis,* Hayata, which is not quite typical). Ako, *Matsuda*! Raisha, *Soma.* **9 b. the HwangS.** KDWIDDH by Hong Kong, *Ford's collector* 183 ! H w a n g - t u n g. Loh-fau shan, *Ford's collector* 33D ! Wa shan toi monastery, at 100 m., and at about lSDm., *Merrill* 1D878 ! 1D8DD ! 10892! *Levine* 1488! 1497! Wan-tong shan, Taai Tsan and Yan Tak, in the North river region, *Ts'ang Wai-tak and Wong Kam-chow* 14382 ! 14854 ! Tai-pui village, Yueng-uk, in the T'an shan, *To and Ts'ang* | *Canton Christian College)* 12798 ! Geo-wai, Tai-chun, Ying-tak, *C. L. Tso* 21D4B ! 21296 ! Between Tai-chun and Wong-fu town, Ying-tak, *C. L. Tso* 22234! Chi-hing, *3. P. Ko* 5075B ! LD-ting, on the way to Ho-lan, *Tsiang- Ying* 1172 ! Kwang-tan, at Ho-chow, in scrub, *Tsiang-Ying* 930! K w a n g - s i province. Ta-tze Tsuen, in the Yung hsien, on roadsides in valleys, *Steward and C. C. Chzo* 851 ! In the direction of Long-tscheou *Simond* ! H a i - n a n . Without locality, *Henry* 8407 ! 8590 ! C. *Wang* 33939 ! 34249 ! *H. Y. Liang* 53354 ! B38B0 ! B3888 ! BBD52 ! Yai-chow, *H. Y. Liang* 53157 ! Near Nodoa *McClure* 7B41 ! Between Dung-ka and Wen-fa-shi at 200D m., *N. K. Chun and C. L. Ts'o* 43843 ! Wong-kam shan in the Ngai district, *S. K. Lau* 544 ! 9 C. T **o n h i n** . Province of L a o - k a y . Lang-son, Lang-nac, *Eberhardt* 3385 ! Province of B a c - g i a n g In the mountains of Dai-kinh on the road from Than-moi to Van-linh, *Bois* 551 ! Minh-le, *Colani* 2217 ! Province of Q u a n g - y e n . Near Quang-yen, in hill forests *Balansa* 297 ! 3D0 ! Province of B a c - n i n h . Dinh bang, cultivated, *Crevost and Lemarie!* Province of S o n -1 a y. Moe-ha, *Balansa* 4454 ! Province of H o a - b i n h Cho-giDi, *Bon* 2354! Province of H a - n a m . But-son on Mount Calami |Mons Elephantis), *Bon 2132* ! Kien-khe on Mount Dong-ban, *Bon* 2743 ! Lat-son on Mount Dong-ban, *Bon* 2814! Province of N i n h - b i n h . Dho-ganh on chalky hill-sides *Pitelot* 1159 ! 1184 ! 1923 ! and not quite typical in that it dries blackish, *PUelot* 1474 ! **ID d. Anam.** Province of T r a n h - h o a . Ngoai-thon on Mount Vat-son *Bon,* 521 ! Hao-nhD on Mount Trui, *Bon* 572 ! and (probably this province) Mount of the Cross, *Bon* 727 !

WESTERN INDOCHINA. **ID h. Laos.** Province of T r a n - n i n h . Pu-bia near Chieng-khouang, at 1100 m., *Kerr* 21D77 !

PLATE 121. Dioscorea persimilis, *Prain and Burkill.* |1) A branch with male flowers from Ford's no. 183, nat. size : *\2)* flowers on the zigzag axis of the spike, X 10 : |3) a flower flattened, XlO : |4) a stamen : |5) a branch with female flowers also from Ford's no. 183, nat. size: |5) a female flower, X1O: |7) capsules from Ford's no. 330, nat. size : |B) a seed, immature.

113. DIDSDDREA HAMILTONII, Hooker fil., Flora Brit. Ind., B, 1892, p. 295, excluding the two names quoted among synonyms—*D. ovata* and *D. alata*, Griseb. : Wood in Rec. Bot. Survey Ind., 2, 19D2, p. 143, and Bengal Plants, 2, 1903, p. 1867 : Haines, Forest Flora Dhota Nagpur, 191D, p. 532 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 39 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 265 : Haines, Bot. Behar and Drissa, 1925, p. 1121 : Prain and Burkill in Kew Bull., 1927, p. 239 : Fischer in Gamble, Flora Presidency Madras, 1928, p. 1512 : Prain and Burkill in Lecomte, Fbre gén. dt? l'Indoch., 5, 1934, p. 733.

Dioscorea anguliflora, Steudel in Herb. Ind. Dr. Hohenacker.

Dioscorea Hookeri, Prain ex Wood in Rec. Bot. Survey Ind., 2, 19D2, p. 143.

Dioscorea incrassata, Buchanan-Hamilton in Herb. Wall, propr., no. 51D8.

Tuber deeply penetrating, long-stalked or very gently swelling from its point of origin downwards through the length of a metre or more until about 2 cm. through : skin dark or black, sometimes rather uneven and rough : flesh white and good to eat. *Stems* glabrous, angled, generally with six angles at any level, but sometimes with eight near the base, hollow in age, turning a CDpper-red colour when Did and dying, attaining a height of 3 - 4 metres. *Bulbils* produced, often in large numbers, in appearance like those of *D. alata*. *Leaves* opposite on the thicker stems, but often alternating towards the ends of the stems, long-cordate or often subsagittate at the base, acuminate at the apex, drying reddish, up to 7 cm. in length by 5 in breadth, 7-nerved : the nerves of the first pair enclose a narrowly elliptic area, converging towards the mucro in curves which closely correspond with those by which they left the midrib : the nerves of the second pair diverge from the midrib at an angle of about 9D° and curve to approach the margin very gradually and to become submarginal close under the acumen : the nerves of the third pair curve in the lobes and give off in a pedate manner a set of nerves to the rounded angle of the lobe : secondary nerves crossing the interspaces with some elbows and almost at right angles to the primary nerves : the upper surface glabrous, with the primary nerves just prominent and the rest visible : the lower surface glabrous, with the primary nerves very prominent and copper coloured, the secondary nerves just prominent, and the network distinct: the margin very slightly strengthened: petiole up to 9 cm. long.

Male flowers in spikes upon special leafless branches or upon the leafless terminations of the branches: spikes 3 — 5 together: the axis zigzag, slender, angled, glabrous, with 15—2D flowers : bracts very small, triangular, with red-brown dots, each terminating one of the ridges Df the axis, acute : bracteoles deltoid. *Sepals* ovate, obtuse, thick, 1 -25 mm. long. *Petals* obovate, rounded above, a little shorter than the sepals, equally thick. *Stamens* B, just reaching the middle of the petals, the filaments as long as the anthers. *Gynoecium* a small cone.

Female flowers in spikes which are solitary or two Dr sometimes more than two together in leaf-axils near the apices of the branches : flowera about eight on each : axis angled, in section triangular. *Sepals* thick, triangular ovate, 1 -5 mm. long. *Petals* similar, rather smaller. *Staminodes* very small. *Stigmas* as three pairs Df short sickle-like hooks. *Capsule* up to 35 mm. long, the stipe being about 5 mm. so that the wings are 30 mm. long : it is slightly retuse at the apex from a very small amount of obliquity in the wings, which are 20 mm. broad, and so broader than semicircular, copper-coloured. *Seeds* with a slightly unequal reddish horn-coloured wing all round, more or less conform to the loculus.

NORTH-EASTERN INDIA and eastwards to the LADS country and southwards to TENASSERIM : and also over an isolated area in MALABARIA.

D. Hamiltonii is a montane plant obtaining, in the hilly country which it inhabits, the abundant rain necessary for its growth. In the Darjeeling Himalaya it is common up to 7BD metres and in North Cachar has been collected at BDD metres. It is not known tu occur west of Sikkim, Dr. R. Knuth's record for it in Nepal being an error. It does not spread from the hills into the plains, but descends to their very base.

Bourdilbn records that it is found only in the interior Df Travancore : but Hohenacker's labels suggest that at Mangabre it descends to the coast, though possibly the localization of his specimens is not very precise. Barber's localities,—Jahlsur, Sullia and Samfagi,— are villagBS under the Ghats at a little distance back from the coast.

The tuber is excellent to eat: but it lies so deep in the soil that the labour of digging it out is very inadequately rewarded. Nevertheless it sometimes is brought to market in the Sikkim Himalayas and then it fetches a higher price than any other yam. The Lepchas say that it is pleasanter to eat than *D. alata*. Bourdillon states that in TravancDre it is the most esteemed of all the wild yams.

The Lepchas call it "pu-um bok" and "pa-sok bok," the latter name meaning nD more than wild yam. The hill-tribes who dwell between the Brahmaputra valley and Upper Burma, have various names for it: the Mikirs call it "uj vat" the Cacharis "ta-rem;" the Kukis "ranahak;" some of the Nagas "gagarubro" and the Chins "wa-t-weh." As Siamese names "man nok" and "man rak " are recorded, but the first is used also for other species of the genus. As a Laos name "khita manh" is recorded.

In the hills of Chota Nagpur the Sontals call it "bir sanga," but this name is not restricted to it and the Khediya people of the Mayurbhanj State call it "chun alu " referring tD the chalky colour of the flesh.

In TravancDre it is "venni" or "venni kilangu"—twiner or tuberous twining plant.

"Buchanan-Hamilton seems tD have been the first botanist who noticed the species ; so that it is most appropriately named after him. He got it at Goalpara in Assam in 1BOB, and gave the name *Dioswrza incrassata* to it, but did not publish it. Two years later Roxburgh obtained it in Dhittagong. Wallich in 133D associated Buchanan-Hamilton's specimens erroneously with the species to which Sir Joseph Hooker subsequently gave the name *D. Wallichii,* calling both *D. sativa.* Sir Joseph then [1892) gave tD the species under discussion the name which it now bears : but he too did not fully isolate it, for he ascribed to it as a synonym the name *D. ovata,* Buch.- Ham., which rightly belongs to *D. alata.*

The larger capsules, thinner stems and copper red colour when dry, are characters making it easy to distinguish from *D. alata.*

INDIA. **4 a. Malabaria.** North Kanara district. Near Mangalore, *Hohenacker's collector [Mrtz)* 699 a ! Jahlsur, *Barbvr* 2465 ! 2483 ! Sullia, *Barber* 214D ! Samfagi, *Barber* 2280 ! Malabar district. Without locality, *Barber* 25B3 ! Nilambur, *Lawson* ! Nilgiri district. Carcoor ghat, *Lawson* ! Cochin state. Trichur, *Lawson* ! Perambicolam, at 3,000-4,01)0 ft., *Meebold* 12374 ! TravancDre state. Malayattur, at 1DD and 630 ft., *Bourdillon* 1444 ! and without no.! **4 B. Sub-SUbregion of Rains frDm the Bav of Bengal. I** Circars- Drissa.) Angu 1 district. Without precise locality, *Mus. R. E. P.* 13923 in part! Balasore district. Patharchakri, *Kalka Pershad* 34321 ! Mayurbhan] state. Baripada, *Holmes* 33130 ! 33135! 33180 134313! (DhDtaNagpur.) Sinebhum district. Saitba forest, *Haines* 5108 ! Manbhum district. Without precise locality, *J. Campbell*.* Dhandili Hills, *R. K. Das* 34532! Purulia, at 750 ft., *C B Olarke* 20789 ! Ranchi district. Ranchi at 1,5DD ft., *0. B. Clarke* 20396 ! Hundrugagh, *Wood.* Bariatu, *Prain* ! Horhap forest, near Ranchi, *Haines* 5115 ! Hazaribagh district. Madhobun, at 1,003 ft., *G. B. Ularkt* 33550 ! Parasnath, *Prain* ! and at 2,000 ft., *0. B. Olarke* 21304! Sontalia. Narganj, Korchin hill and Banshoiriver, *Haines* 2464 ! Silungi, *Haines* 24B5 ! Maijur kola, *R. K. Das* 3473b[1] ! Fulzhuri hills near Deoghar, *R. K. Das* 34510 ! |Behar.) Monghyr district, bably but locality uncertain, *Buchanan-Hamilton.* (Western Bengal.) Midna- district. Dhandrakona, *R. K. Das* 35461. (Northern Bengal.) Darjeel- terai. Between Kuprail and Goridora, *Kurz*! Jalpaiguri district.

pro T pu ing

Muraghat forest, *Haines* 581! Mahakalguri, *Hsawood* 67 ! Madarihat, *Kalka Pershad* 355BD in part! |Brahmaputra valley.) Goalpara district. Goalpara, *Buchanan-Hamilton* 51D7 d ! 5108 ! *Burkill* 2747 D ! Kamrup district. Gauhati, on hills at 750 ft., *C. B. Clarke* 40715! " Gowhatty hills," *Wallichl* Nawgong district. Lumding, *Burkill* 353D2 ! Sibsagar district. Borpatta, at 3DD ft., *C. B. Clarke* 4D751 ! Darrang district. Phulbari, near Tezpur, *H. H. Mann* 23890 ! Bamuni hill near Tezpur, *Burkill* 324B8 ! (Surma valley.) Dachar district. Bostelah, *Keenan* ! (Eastern Bengal.) Mymensingh district. Madhupur, *C. B. Clarks* 7756 !

HIMALAYA, **5 d. Eastern Himalaya.** Darjeeling district, local but plentiful where found, *Prain* ! and without precise locality, except " 2,5D0 ft.," *King* ! Sivok at l,0D0 ft., *Russell* ! Silake, *Gage* 34222 ! Ryang, *Prain I* Mungpu at 2,D00ft., *C. B. Clarks* 3B17B ! 3B442 ! Rishap, *Prain's collector* ! Pashok, *Lister* !

WESTERN INDD-CHINA. **ID a. Mhasi-Naga Hills.** KhasiaHi11s. Without locality, *Hooker and Thomson* 14 ! Ridumeo near Dherrapunji, *R. K. Das* 34942 ! Dherrapunji, *R. K.* Das 35BD5 ! NorthCachar subdivision. Mahun, *Shaik Mokim* 235 ! Kayang in the Jatinga valley, *Burkill* 34982 ! Kukicherra, *Shaik Mokim* ! Jatinga, *Shaik Mokhnl\)2* ! Haflong, at 2,ODD ft., *Burkill* 3581D ! *Baker* 13945 ! *Gopal Chandra Das* 21215 ! **ID b. Northern Burma.** Bhamo district. Irrawaddy banks, opposite Bhamo, *Burkill* 2281B ! 22823 ! Momouk Dn the east of Bhamo, *Burkill* 21511 ! 21512 ! **1D C. Arahan.** Chittagong district. Dhittagong, *Roxburgh* 229 ! *Cowan* 1784! Bhariadhala, *Hooper* 25912 ! Barjaytoli, *Hooper* 258B5 ! Jaldi, *Cowan* ! Chittagong Hill-tracts. Kodala hill, *Badul Khan* 571 ! 573 ! Akyab district. Pethadu, *Burkill* 28019 ! Kalapanzin valley, in the hills over Yin-ma, *Burkill* 28D10 ! Between Buthidaung and Maung-daw, *Burkill* 28049 ! 2805D ! 28051 ! 28D52 ! Pi-choung valley at Kanjangouk, *Burkill* 27937 ! 27938 ! Boronga island, in evergreen forest on Mingu hill at BDD—1,2 DD ft., *Kurz* ! Northern Arakan district. Pi-choung valley at Naya, 3DD ft., *Burkill* 27944! **ID f. Shan Hills.** Without Mocality, *Abdul Khalil* ! **iDg. Siam, excluding the Peninsula.** Circle of Payap. Doi Chang (not quite typical), *Rock* 1723 ! Circle of Ayuthia. Saraburi, Muak Lek at 2DD m., (a little doubtful), *Marcan* 1880! **ID h. Laos.** Tra-ninh province. Khuang, near the village of Ban-naPunh, *Poilane* 23B1 !

MALAYSIA, **lib. Tenasserim.** Tavoy district. Without precise locality, *Heifer* 5553! General in the district, *Gaitskdl* 14110 ! 21475! **11 d. Peninsular Siam.** Circle ofRachaburi. Kanburi at Sai Yok, *Put* 1804 !

PLATE 122. Dioscorea Hamiltonii, *Hooker fil.* |1) A branch with male flowers from C. B. Clarke's no. 3B17B, nat. size: |2) its flower dissected, X8: (3) capsules from R. K. Das' no. 34532, nat. size : |4) a capsule with immature seeds, nat. size : and (5) an immature seed from it, (B) the upper part of a tuber and the base of the stem from R. K. Das' no. 34510, nat. size.

113a. DIOSCDREAsp. Among the Dacharis and the Mikirs is found a Dioscorea which is regarded as a delicacy. The Cacharia call it " thakun " and the Mikirs " rui un," tha and rui being wards meaning yam in their respective languages : while obviously the second syllable in both names is of common origin. It is related to *D. alata* and to *D. Hamiltonii,* but in stem is unlike either. The leaves, which in shape are such aa characterize both these species, dry brownish and are quite glabrous.

INDIA, south of the Himalaya. **4 e. Sub-subregion of Rains from the Bay of Bengal.** [Brahmaputra valley.) Nowgong district. Lumding, in forest, *Burkill* 353D4 !

WESTERN INDD-CHINA. **ID a. Khasi-Naga hills.** North Daehar. In the low-lying forests close to the southern border of the Nowgong district, *Herb. R. E.* P. !

114. DIOSCOREA ALATA, Linnaeus, Spec, plant., 1753, p. 1D33, and ed. Df 1763, p. 14B2 : Burman, Flora Ind., 17 58, p. 214 : Forster, Flor. Ins. Austr. Prodr., 1786, no. 373 : Lamarck, Encycl. meth, 3, 1789, p. 230: Loureiro, Flora Cochinch., 1790, p. S25, and ed. Willdenow, 1793, p. 765 : Moon, Cat. Iniig. and Exot. plants Ceylon, 1824, p. 59 : Thunberg, Flora Jav., 1825, p. B, and Flora Ceil., 1825, p. 5 : Blume, Enum. plant. Jav., 1, 1827, p. 22 : Endlicher, Prodr. Flor. Norf., 1833, no. 776 : Blanco, Flora Filip., 1837, p. 799 : Buchanan-Hamilton ex Montgomery Martin, Eastern India, 3, 1838, p. 842 : Graham, Cat. plants Bombay, 1839, p. 218 : Wight, Icones, 3, 1843, part 1, p. 7, plates 810 and 812 : Blanco, Flora Filip., ed. 2, 1845, p. 553 : Masters in Journ. Agric.-Hort. Soc. Ind., 4, 1845, p. 232 : Voigt, Hort. Suburb. Dalcutt., 1845, p. 652 : Jardin, Essai Archipel. Marquises, 1858, p. 26 : Elliot, Flora Andhrica, 1859, pp. 55 and 134 : Long in Journ. Agric.-Hort. Sou. Ind. 10, 1859, p. 346 : Miquel, Flora Ind. Bat. Suppl., 18BD, pp. 50 and 27D : Mason, Burma and its people, 1860, pp. 465 and 813 : Thwaites, Enum. plant. Zeylan., 1864, p. 325, footnote : Nadeaud, Plant, usuelles des Tahitiens, 1864, p. 10 : Seemann, Flora Vitiensis, 1865, p. 308 : Stewart, Punjab plants, 1859, p. 229 : Nadeaud, Enum. plantes de Tahiti, 1873, p. 253 : Blanco, Flora Filip. ed Naves, 1879, p. 207 : F. v. Mueller, Select plants for extra-trop. cult., 188D, p. 99 : Atkinson, Gazetteer N.-W. Prov. and Oudh, 10,1882, pp. 13 and 21 : Lisboa, Useful plants Bombay Presidency, 1884, p. 178 : and in Bombay Gazetteer, 18, 1885, p. 55 : DymDck, Veg. Mat.-Med. of W. India, 1885, p. 842 : de Lanessan, Plant, utiles des Col. franc, 1885, pp. 785 and 868 : Trimen in Journ. Linn. Soc. Lond., Bot. 24, 1887, p. 151 : Watt, Diet. Econ. prod. India, 3, 1890, p. 125 - Warburg in Engl. Bot. Jahrb., 13, 1891, p. 274 : Tschirch, Ind. Heil-u. Nutz-pflanzen, 1892, p. 185, plate 110: Drake del Castillo, Flore Polynesia francaise, 1893, p. 225 : Dymock, Warden and Hooper, Pharmacolog. Ind., 3, 1893, p. 551 : Hemsley in Journ. Linn. Soc. Lond, Bot, 30, 1894, p. 158 : N. N. Banerjee, Rep. Agric. Cuttack, 1893 p. 114 : Matsumura, Shokubutsu Mei-i, 1895, p. 106 : Ridley and Curtis in Journ. Roy. As. Soc, Straits branch, 30, 1897, p. 279 : Dalgado, Flora Goa, 1898, p. 193 : Koorders in Mededeel.' s Lands Plantentuin, 19 1898 p 312 : Mollison, Text-book Ind. Agric, 3, 1901, p. 198 : Symonds, Vern. names plants Bombay, 1901, pp. 3, 25, 35 and 44 : Willis and Gardiner in Ann. Roy. Bot. Gard. Peradeniya, 1, 1901, p. 101 . Ridley ani Durtia ^ Journ Roy. As. Soc, Straits branch, 33, 1902, p. 65 : Woodrow, Gardening in India, 1903, p. 498 : Prain, Bengal plants, 2, 1903, pp. 1034 and 1067 : Gage in Reu. Bot. Survey Ind., 3, 1904, p. 133 : Haines, Working plans forests Singbhum, 1904, p. shV: Hosie, Rep. on PrDV. Ssuchuan, 1904, p. 12 : Firminger, Man. Gardening India, ed. 5, 1904, p. 140 : Merrill, Rev. spec described in Blanco's Flor. Filip., 1905, p. 86 : Usteri in Arbeit, d. Bot. Mus. Zurich, 19, 1905, p. 129 : Bin Quang Chien in Bull. Econ.

Indoch., 19D5, p. 1177 : Prain in Rec. Bot. Survey Ind., 3, 19D5, p. 298: Gammie in Bull. Dep. Agric. Bombay, 30, 1905, p. 77 : Matsumura, Index plant. Jap., 2, 19 D5, p. 223 : Macmillan in Circulars Bot. Gard. Ceylon, 3, 19D5, P- ID: Safford in Contrib. U. S. Nat. Herb., 9, 1905, p. 259 and pi. 48 : Hole, List trees, shrubs North. For. Circle, Centr. Prov., 19 DB, p. 69 : Heinig, List plants ChittagDng CDllectorate, 1907, p. 58 : Cooke, Flora Bombay Presidency, 2, 19D7, p. 759: Ridley, Mat. Flora Mai. Penins. Monocot. 2, 19D7, p.84 : Watt, Commerc prod. India, 19D8, p. 492 : Eberhardt and Bloch in Bull. Sci. Pharmacology 19D9, p. 5D9: Stuhlmann, Beitr. z. Kulturgeschielite Dst-Afrika, 19D9, p. 239 : Rechinger inDenksDhr. Math.-Naturw. Klasse Akad. Wein, 85, 191D, p. 72 : Haines, For. Flora Chota-Nagpur, 191D, p. 532 : Guillaumin in Ann. Mus. Col. Marseille, 19, 1911, p. 248 : Hoarders, Excursionsfl. Java, 1, 1911, p. 3D8 : Prain and Burkill in Journ. As. Soc. Bengal, N. S., 10, 1914, p. 39 : Burkill in Gard. Bull. S. S., 1, 1915, pp. 298, and 3DB : Wester in Philipp. Agric. Rev., 9, 191B, p. 195 : Witt, Descr. list trees herbs N. and Berar For. Circle, Centr. Prov., 191B, p. 221 : Burkill in Gard. Bull". S. S., 1, 1917, p. 371, with six plates : Crevost and Lemarié, Cat. prod, de 1'IndoDh., 1, 1917, p. 123 : Merrill, Interpret. Rumph. Herb. Amboin., 1917, p. 14B : Burkill in Gard. Bull. S. S., 2, 1918 pp. 3B, with a plate, and p. 42 : Juel, Plant. Thunbergianae, 1918, p. 85 : Hammerstein in Tropenpflanzer, Beih. 19 zum 22, 1919, p. 82 : Burkill in Gard. Bull. S. S., 2, 1919, pp. 129 and 158, with a plate : Schinz and Guillaumin in Sarasin and Roux, Nova Caledonia, 1, 1925, p. 128 : Duthie, Flora Upper Gangetic plain, 3, 192D, p. 25B : Hayata, ID. Plant. Formos., ID, 1921, p. 42, with a figure on p. 43 : K. Heyne, Nutt. plant. Ned. Indie, ed. of 1922,1, p. 493 : Merrill, Enum. Philipp. plants, 1, 1922, p. 215 : Burkill in Gard. Bull. S. S., 3, 1923, pp. 4 and 5, with two plates, and 3, 1924, pp. 121 — 244 : Setchell in Carnegie Instit. Washington, Dep. Mar. Biol., 20, 1924, pp. 1DB and 19B : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 2B5 : Backer, Handb. Flora van Java, 3, 1924, p. 114 : Haines, Bot. Behar and Drissa, 1925, p. 1122 : Burkill in Rec Bot. Survey India, 13, 1925, p. 389 : Setchell in Univ. Cal. Publ. in Bot., 12, 192B, p. 155: K. Heyne, Nutt. plant. Ned. Indie, ed. of 1927, p. 45B : Yamamoto, Suppl. ID. Plant. Formos., 3, 1927, p. 5 : Syun'iti Sasaki, List plants Formosa, 1928, p. 113: Fischer in Gamble, Flora Presidency Madras, 1928, p. 1512: Dchse, Vegetables Dutch E. Indies, 1931, p. 229 : Suuki in Ann. Rep. Taihoku Bot. Gard., 3, 1933, p. 126 : Prain and Burkill in LecDmte, Flare gen. de l'lndoch., B, 1934, p. 735 : Kanehira in Journ. Dep. Agric Kyushu Imp. Univ. Fukuoka, Japan, 4, 1935, p. 591 : Burkill, Diet. EcDn. Prod. Mai. Penins., 1935, p. 814 : Merrill in Trans. Amer. Phil. Soc, N.S. 24, parb 2, 1935, p. 112.

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Dioscorea atropurpurea, Roxburgh, Flora Ind., 3, 1832, p. 8DD : Voigt, Hort. Suburb. Cabutt., 1845, p. 652 : Kurz, Prelim. Rep. Veget. Pegu, 1875, p. xxii : Watt, Diet. Econ. Prod. India, 3, 189D, p. 127.

Dioscurea Batatas, presumedly, Reinecke in Engl. Bot. Jahrb., 25, 1898, p. 595 ; not of Decaisne.

Dioscorea bicantaia, Buchanan-Hamilton ex Wallich, Cat. lith., 1830, nD. 51D7 D.

Dioscorea bulbifera, Linnaeus in Stockman, Herb. Amboin., 1754, p. 22, and AmDen. Acad., 1754, p. 131 : Miller, Gard. Diet., ed 8, 1758, the second half of no. 4 (it had been the whole of no. 4 in the previous edition Df 1759, but not under a Linnean name); and as var. *sativa,* Gammie in Bull. Dep. Agric. Bombay, 3D, 19D8, p. 77.

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Dioscorea eburina, Loureiro, Flora Dochinch., 179D, p. B25 : de Lanessan, Plant, utiles des Dol. francaises, 1883, p. 785.

Dioscorea eburnea, Willdenow in Loureiro, Flora Dochinch. ed. Willdenow, 1793, p. 767 : Merrill, Diet, plant-names Philipp. islands, Philipp. Bur. Agric. Bull. 4, 1903, p. 144 : Crevost and Lemarié, Cat. prod. Indoch., 1, 1917, p. 122.

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Dioscorea Hamiltonii, Koorders, Excursionsfl. Java, 1, 1911, p. 339, and 4, 1923, p. 251 ; not of Hooker fil.

Dioscorea octangularis, Buchanan-Hamilton ex Wallich, Dat. lith., 1830, no. 51D9.

Dioscorea oppositifolia, Linnaeus in Stickman, Herb. Amboin., 1754 p. *22,* and Amoen. Aoad.,4,1754, p. 131 ; not of Sp. plant. 1753

Dioscorea oppositifolia, var. *b,* Burman, Flora Ind., 1793, p. 215.

Dioscorea ovata, Buchanan-Hamilton ex Wallich, Cat. lith., 183 D, no. 5108B.

Dioscorea purpurea, Roxburgh, Flora Ind., 3, 1832, p. 799 : Voigt, Hort. Suburb. Dalcutt., 1845, p. 652 : Elliot, Flora Andhrica, 1859, p. 45 : Thwaites, Enum. plant. Zeylan., 1854, p. 325 : F. v. Mueller, Select plants for extratrDp. Culture, 1880, p. 1D1 : Watt, Diet. Econ. Prod. India, 3, 1890, p. 133 : WoodrDW, Gardening in India, 1903, p. 498 : Drevost and Lemarie, Dat. Prod. Indoch., 1,1917, p. 124.

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Dioscorea saliva, Munro, Hort. Agrensis, 1844, p. 3D : Honigberger, Thirty-five years in the East, 1852, p. 271 : Stewart, Punjab plants, 1869, p. 229 : Wright, Agric. of Dawnpore, 1877 p. 64 : Grierson, Behar peasant life, 1885, p. 250 : Duthie and Fuller, Field-crops of the N.-W. Provinces 1893, p. 11, plate BD : Prain in Journ. Bombay Nat. Hist. Sec, 8,1893, P. 53 : Birdwood, Cat. Flora Matheran and Mahableshwar, ed. ofl897, p. 34 : MollisDn, Text-book Ind. Agric., 3, 19Dl, p. 198, applied to one raceonly SymDnds, Vernacular names plants Bombay, 19D1, pp. 25, 38 and 62 : ? Maiden in Rep. Australian ASSDC. Advance Sci., 19D1, pp. 263 and 269.

Dioscorea sp., DrevDst andLemarié, Cat. prod. Indoch., 1, 19D7, p. 127.

Pre-linnean references:—

1581. ? Inani, Caesar Frederick |a Venetian), translated in Hakluyt, Voyages, 2, p. 339.

1BD1. Inhame and ? Yearn, Clusius, Rar. Plant. Hist.. 4, p. lxxix.

1648. Inhame de S. Thome, brasilice Cara dicta, Piso and Marcgrav, Hist. Nat. Brasiliae, p. 93 |Piso's part) and p. 29 (Marcgrav's part).

1568. Cara, Francisci, Dst- und West-indische Lust- und Stats- garten, with a bad figure taken from Piso's.

1584. Arachidna alia indica, Grimm in Miscellanea curiosa, for 1684, tab. 28.

168B. Katsjil kelengu, Rheede, Hort. Malab., part 7, plate 38. Batatti sylvestria species ex Ceylona transmissa, Dommelin in Rheede, Hort. Malab., 7, p. 71 (Rheede's wild tubers).

1689. Ricophora indica s. Inhame alba caule alatD Scammonii foliis nervosia conjugatis, Hermann, Paradisi Batavi Prodromus, p. 37D.

1691. Ricophora indica Bryoniae nigrae similis ad foliorum ortus verrucDaa, Plukenet, PhytDgraphia, tab. 22 D, fig. 6.

1596 DD., Plukenet, Almagestum, p. 321.

Ricophora indica s. Inhame rubra, caule alat$_D$, Scammonii foliis nervosia oonjugatis, Plukenet, Almagestum, p. 321.

Ricophora Melonis folio parvo, radice Rapae nigricante, Plukenet, Almagestum, p. 321.

Ricophora s. Inhame sirinamensis folio auriculato, an Ricophora a Inhame javanica plantaginea rigido splendente folio, Herb. Plukenet.

1696. Volubilis nigra, radice alba aut purpurea, maxima, tuberosa, esculenta, farinacea, caule membranulis extantibus alato, folio cordato nervoao! Sloane, Cat. plants Jamaica, p. 45.

1698. Rizophora zeylanica, Scammonii folio singulari, radice rotunda Hermann, Paradisus Batavus, p. 217.

17DD. RhizDphora zeylanica, Ammann, Charact. plant, nat., p. 211.
RhizDphora indica, Ammann, op.cit. p. 431.

About 17DD. Ubi dagD, Herb. Kamel. |the name indicates origin in the Marianne islands).

17D2. Dorally calungo (i.e., kavalli kilangu) in Herb. Sherard., no. 1371. Daulo willy (for kavalli), Bulkley in Herb. Sherard.

17 D4. Rizophora a. Inhame sirinamensis folio auriculato, Ray, Hist, plant. Suppl., p. 132.

Rizophora s. Inhame javanica Plantaginis rigido splendente folio, Ray, IDC. cit.

Inhame malabarica caule alatD, Katsjil kelengu, in Herb. Petiver., and ex Ray, op. cit., append., p. 24B with the vernacular name omitted.

Battata silvestris Indica foliis Smilacis nervosis laevibua, caulinis alatis, flore vidua, pro fructu glandes tuberosas ex ortum foliorum emittens, Ray, Hist, plant., Suppl., 3, p. 134.

Volubilis nigra, radice alba aut purpurea, maxima, tuberosa, [etc. ex Sloane), Ray, Hist, plant., suppl. 3, p. 134 in confusion under Mu-kelengu.

17 D9. Volubilis nigra, radice alba aut purpurea, maxima, tuberosa, Sloane, Hist. Jamaica, 1, p. 139, excluding the reference to Plukenet.

1737. Rizophora indica s. Inhame rubra, caule alato, Scammonii foliis nervosis, conjugatis, Burman, Thesaurus zeylanicus, p. 2D5, excluding the reference to Rumpf's Ubium pomiferum.

1737. Dioscorea foh'is cordatis caule aculeatD bulbifero, Linnaeus, Hort. Dliffort., p. 459.

1739. Ricophora indica seu Inhame rubra, caule alata, Scammonii foliis nervDsis conjugatis, Miller, Gard. Diet., ed. 2, addenda.

1745. DioscDrea Indiae orientalis folio singulari caule crispo alata, Ammann, Herb. Ammann., in Mus. Imp. Petrop., 1, para. 2, p. 257.

1747. Dioscorea foliis cordatis, caule alato bulbifero, Linnaeus, Flora zeylanica, p. 171.

175 D. Ubium anguinum, Ubium anniversarium, Ubium digitatum, Ubium draconum, Ubium ovale and Ubium vulgare, Rumpf, Herb. Amboinense, lib. 9, caps. 7, 8, 9, 1D and 12.

1789. DioscDrea foliis cordatis, caule alato bulbifero, Patrick Browne, Civil and Nat. Hist. Jamaica, p. 359.

Tubers edible, of a great variety of shapes, sometimes long and thin, a little clavate and going deeply into the soil even to 1 -5 metres, sometimes globose, and of every possible intermediate shape, usually solitary, but in some races several together, sometimes branched but more usually unbranched, with all degrees of lobing which exhibit intermediate conditions between branched and unbranched, either circular in section or flattened in various degrees; usually descending into the soil vertically in response to gravity, but not always so ; and in several races, curving so that the apex after starting to grow downwards is ultimately directed upwards and even extrudes from the soil : flesh tender, white or creamy-white or with magenta sap under the brown skin and often throughout, oxidized when cut in varying measure to a rusty brown ; skin sometimes very thin, cracking and flaking, but in most races not so. The head of the tuber from which the descending soft parts grow is relatively

hard, and it is unusual for any neck to be developed between it and the descending parts ; it carries long feeding roots : short rootlets are produced lower down in decreasing numbers. As far as is known any part below ground is able to reproduce a new vegetative plant. *iStem* growing to a height of about 15 metres, in some races branching somewhat, in others branching little, invariably glabrous, always with ridges or wings, generally four, but at times six or even eight in the few basal centimetres, in some races in the same centimetres with weak and blunt prickles : when the wings are large above the base they are never more than four, and they are often frilled : a magenta sap similar in appearance to that in the tubers is often present in the stems which in consequence vary from leaf-green to purplish. In some races fleshly shoots are thrust upwards from the head of the tuber, which attain B cm. in height and store food like the descending tubers, and seem to be of the same nature but require further morphological study. *Bulbils* are produced in soine races in great numbers, in others sparingly : at times short rootlets arise on these bulbils while as yet they are growing on the vine ; and if, by accident, the vine comes to lie on the moist earth, these rootlets take anchor and the bulbil passes into a new plant without any resting : they may be globose, ovoid Dr obpyriform, or so much elongated that they attain 4 cm. in length or sometimes they are flattened : usually they are astringent. Possibly fruit-eating bats distribute them a little ; but precise observations are lacking : otherwise they aid in the dispersal of the parent by breaking free and being rolled along the ground through short distances. Three years are needed for the production Df a large plant from them. *Leaves* opposite or rarely alternate, sometimes the opposing leaves are unequal, herbaceous, subsagittate or subhastately ovate, rarely hastately deltoid, acuminate and mucronulate, the auricles divergent or in life taking an ascending position which causes them to meet and slightly overlap, a wide funnel resulting with its apex at the insertion of the petiole ; when this is the case they are scarcely angular but rounded : the uppermost leaves are sometimes ovate-cordate : leaves up to 15 cm. in length by 14 cm. in width as a rule, but it is recorded that in the West Indian race called " cap-le-eau" they reach 22 cm. by 12 cm. and in the race called" cut-and-throw-away" 22 cm. by 15 cm. |R.O. Williams), the auricles such that if the blade be measured obliquely from their tip to its mucro the leaf attains 22 cm., usually 5-nerved : the nerves of the first pair diverge from the midrib at about 35° and enclose an elongated Dbovate-elliptic area: the nerves of the second pair diverge from the midrib at about 80° and curve round to become submarginal in the distal third of the blade ; and from near the base they give off submarginal nerves in the auricles : the secondary nerves cross the interspaces with some elbows and are only a little more conspicuous than the network : the margin is not thickened : the upper surface glabrous, of a dark glossy green colour with the secondary nerves in life scarcely visible, but the primary plainly impressed : the lower surface glabrous, paler, the secondary nerves rather distinct, the primary prominent : petiole about as long as the blade, sometimes slightly frilled about the lower pulvinus, green or suffused with magenta sap.

Male flowers rarely produced : when produced they are found on special leafless branches which are usually not much longer than their subtending leaves, but sometimes much longer : axis of the spike 12—15 mm. long, zigzag, with ID—18 flowers sessile on the angles, glabrous, ridged, each ridge in turn ending in a bract and then gradually replaced by another above the flower : buds globose with a somewhat flattened base : bracts deltoid-ovate, nearly 1 mm. long, acuminate, scarious with a few dots, owing to the bending of the axis not strongly repressed against it by the base of the flower : bracteole similar but much smaller and relatively broader. */Sepals* elliptic-ovate, obtuse above, much curved, the uppermost, i.e., that opposite to the bract, sometimes gibbous at the base, but usually not, all equal otherwise, 1 mm. long and quite glabrous. *Petals* almost spathulate, nearly

equal to the sepals in length, rather thinner. *Stamens* 6, the filaments D -25 mm. long and the anthers of the same length, elliptic-oblong. *Gynoecium* a small cone.

Femah flowers in spikes which exceed the leaves, rarely produced: flowers to 20 in number in each : axis slightly angled : bracts ovate, acute, 2 mm. long, scarious : bracteole similar, smaller and relatively broader. *Sepals* broadly ovate, thick, shortly acuminate, 2 mm. long, 1 -5 mm. broad. *Petals* shorter, obovate, very thick. *Staminodes* rather small. *Stigmas* as three pairs of sickle-shaped hooks. *Capsules* directed forwards, 20 mm. long, the wings broader than semi-circular, 13 mm. broad at the middle, drawn out slightly at the base into the stipe which is 2 mm. long, the angle being about 70°, their length along the placenta about 20 mm., glabrous, reddish brown when dry, the apex slightly retuse *Seeds* winged all round with a slightly unequal reddish-brown wing which is conform to the loculus.

CULTIVATED within the tropics and in warm countries a little beyond the tropics, if water be plentiful and the temperature at the same time high over 7-10 months. Without irrigation the rainfall required seems to be about 154 cm. or 63 inches. The map on plate 147 gives the countries where it is found.

Th* affinity of *Diu«ma* ritf. to *D. persMs* and *D. Hamiltmii* ig 8D ^ &g ^ ^ ^ suggestion that, wide as the distribution of the species now is, its original home may have been somewhere to the north and east of the Bay of Bengal, between that Bay and the China Sea. Even before tha economic value of the .pecies had become fully appreciated its area seems to have spread until it became by degrees one of man's implant food-plants throughout southeastern Asia, Malaysia and the tropical islands of the Pacifl, To this enlarged area twasatnrsthm^dnorthandsouthby.limatestoocold. Eastward the expanse of ocean proved sufficiently wide to prevent it from reaching America direct. Towards the west its .tension by land was checked by conta too dry for it,, ftrf; its extension by sea was inhibited at first because tradLutes in use ended -^-^-«^y. J-hapst e fir;«<fa^ to the western side of the Indian Ocean was one of the consequences of the settlement, about 1000 A.D., of a Malaysian people in the island of Madagascar. At about the same period the Arab seamen whose early voyages eastward and westward were restricted in the western parts of the Indian Ocean to the more northern latitudes, following th t*W I. the Zanquebar c ough to make the cultivation of s we may not unreasonably maintain that this species obtained a hold on . When, four power rounded to West Africa became possible and the way was paved for its introduction thence to the West Indies and Brazil

alata from the Old World to the New, the species had, as the result of selection by man, undergone morphological changes and economic improvement that annear t. *h* * *A*

particular f another it seems desirable to indicate the range of variation in the species exhibited by these numerous forms

While most of the original features the different forms exhibit havp attr» nt^ ** „• i . .!_• A- M i. u I I J ! attracted attention and stimulated man to select, this activity has been less marked as regards the above ground than as regards the under-ground parts of the plant. Climatic conditions have induced the evolution of forms marked n W by precocity, now by delay in reaching maturity of growth. But it has not been because early oompletion of active growth and a prolonged resting period were of advantage to a particular form in a particular locality so much as because the tubers of these kinds enjoying a prolonged restmg period usually have a firmer skin and are believed to keep better when harvested that Man has used the character as a guide in selection Rut if Man has u been able to segregate forms whose aerial stems and therefors their underground tubers are earlier or later m reaching maturity there is littlu to indicate that he has tried, and less to suggest that he has manaeed tnslmrfa., n, • J * , 6 > "u OJIUI uen me period of growth.

There is no indication that Man has ever shown any interest in the appearance of the flowers and fruit in *D. data.* This may be because this species exhibits to an unusual degree the shyness of flowering noticeable in

the case of some of the other species of the genua. There ia, however, another reason why Man, when seeda are avaifeble, does not employ them for purpoasa of propagation. Though the tiny plant which resulta when a *Dioscorea* seed germinates, at Dnce begins to form a tuber, in the case of *D. alata* several seasons have to pass before that tuber approaches maturity, and many more—the number of which cannot be predicted__must elapse before the plant forms flowera and fruit. Aa a consequence, *D. alata,* like many other economic plants, shows little tendency to sexual reproduction, though in this case Man has not mads any conscious effort to inhibit the tendency. That tendency may however have been fostered unconsciously by Man's treatment of the underground portion of the plant. The removal year by year, or, at any rate, periodically, *of* part of the tuber to serve as human food, may have kept the rest of the plant in a condition sufficiently subnormal to inhibit the production of flowers and seed.

But if aexual reproduction has played no part in the economic evolution of *D. alata,* vegetative reproduction is characteristic of the species aa a whole. In some of the forms the production of bulbils is scanty, in other forma they are produced in considerable quantity, and sometimes these bulbils emit short rootlets, while still attached to the parent stem : by breaking free and rooting in the soil they aid in the dispersal of the particular forms that produce them. It may be aaid that the formation of bulbils indicates that the parent form ia increasing in vigour, rather than that the plant ia reaching maturity. But the bulbils, which vary considerably in size and ahape, have not been used largely for reproductive purposes by Man : they are usually astringent in taate, and in any case it takes three seasons to raise a large tuber from a bulbil. Nor has Man done much to influence bulbil-formation, though he has occasionally selected plants with bulbils less astringent than usual, and, in at leaat one instance in India, has selected a form, known as "phar alu" or "phal alu" |fruit yam) because of the abundance of its bulbils. But selection has usually been in the opposite direction owing to the exceaaivB formation of bulbils being apt to coincide with reducbion in the sizB of the tuber below ground. It is to this underground part of the plant that attention has been almost exclusively reatricted : to Man'a selective action we owe the various and striking differences of shape, colour, consistence and quality met with in the many forms of *D. alata.*

Easily recognizable as most of these forms are—Roxburgh and other competent authorities have even regarded some of them as distinct species—we are unable to treat them aa of varietal rank. They are all the outcome of deliberately controlled vegetative reproduction : each form ia, in a large measure if not wholly a number of subdivisions of a singls individual and is therefore in fact a clone. It ia probable that few of these forms are fixed : it is by no means certain that any of them would reproduce themselves from seed. But having regard to the recognition to which their economic position entitles them, we find it convenient to speak of them as distinct " races. "

Dn Plate 125 are given figures of uniform scale |rV nat. size) which afiori some idea of the variety in outline of these tubers : the vernacular names of the races will be found at page 342 below. The figures show :—

1. Elongated positively geotropic solitary tubera, thin above, whence the term " bottle-necked, " employed in the West Indies ; e. g., figs. 1—12 :
2. Similar tubers which are paired or multiplied in number ; e.g., figs. 13_14 :
3. Similar tubera, surrounded at the top by lobes : such tubera in the West Indies are termed "seal-topped, " e.g., figa. 24—25 :
4. Similar tubers associated with upward-growing negatively geotropic swollen shoots ; e.g., figs. 27—31 :
5. Short, rounded, positively geotropic tubers ; e.g., figs. IB_18 :
6. Elongated tubera, at first positively geotropic, then as the season progresses beooming negatively geotropic and possibly associated with secondary negatively geotropic tubers, e.g., figs. S8—72 :
7. Lobed and branched tubers ; e.g., fig. 4D :
8. Lobed and branched tubera, with the lobes and branches in the same plane, as if due to fasciation, e.g., figa. 51—54.

9. Similar tubers, with the geotropism changing as fasciation becomes manifest; e.g., figs. Bl—B3 :

ID. Similar tubers, but with the lobes always horizontal and behaving as do the rhizomes in species of *Dioscorsa* belonging to the section *Stsnophora* ; e.g., fig. 67.

These changes in shape of tuber are not necessarily accompanied by changes in colour, texture or quality • tenderness is associated with deep penetration of the tuber in the soil and mealiness is perhaps associated with early cessation of active growth. In colour the flesh of the tubers of different races may be ivory white or magenta : the ivory and the white may grade into each other ; the magenta depends on the presence of a distinct water-soluble pigment, found in the cell-sap, sometimes throughout the tuber but more often confined to a sharply defined superficial layer. The absence of this magenta pigment from the tubers of those species most nearly allied to *D. alata* renders it conceivable that its intensity in particular races of the latter may be one of the consequences of deliberate selection, though if this be so the motive can hardly have been utilitarian A magenta coloured yam when cooked, does not differ in flavour from one which is ivory or white ; when the pigment during cooking has become diffused and diluted the tuber may, when served up, present a less agreeable appearance-beinq grey.

The pulvini of many species of Diucoreo are not infrequently of a livid tinb : in those races of *D. alata* whose tubers have a magenta sap, the pulvini are also of a magenta tint. H. H. Bartlett has found in *D. bulbihra* var. *saliva* a chromogen which, when appropriately acidified, turns purple *Bull. 2U. U. 8 Dep. Aaric Bur. Plant-Industry,* 1912). The connection, if any, between this chromogen and the magenta sap'of particular races of *D. alata,* awaits establishment. The rusty-red tint which slowly appears on the cut surface of a yam just as it does in the case of an apple, has been shown by Bartlett to be due to another chromogen.

Man's observation has not been confined to the fact that the tubers of some races of *D. alata* are sweeter than those of other races, but has extended to the selection of races with tubers having distinctive flavours A race highly regarded near Bombay, and another race favoured in Deylon, have the mouse-like flavour characteristic of SDme rather esteemed forms of rice, while, according to Barrett *Philipp. Agric. Rev.,* 5 1912 p 71) Dnerac i the Philippine Islands has a raspberry odour.

Attempts have been made to obtain comparative percentages of the carbohydrates present in the tubers of *D. alata* and in thoSB of the species to which *D. alata* is most clearly allied. Messrs. Bloch and Eberhardt *IB II Ewn. Indoch.,* 12, 191D, p. 365) have recorded a higher percentage of carbohydrates in the "cu-mai"—*D. persimilis*—than in those of *D. alata.* The experience of Dr. D. Hooper *Journ. As. Soc. Bengal,* N^s T 1911, p. 59) has been similar : he found the percentage of carbohydrates in the tubers of *D. Hamiltoni* higher than in thos of *D. alata.* In the latter case we are indebted to Hooper for our knowledge of the dat on which his analyses were made and realize that the tubers of *D. Hamiltonii* examined by him may have reached a, somewhat later stage in their resting season. But this does not afford any clue to the dates at which an y of the tubers examined were dug, and as the tubers selected for comparative analysis should be grown under con ro and examined when quite mature, we realize that the figures at our disposal do not yet permit us to rea h d ff t conclusions : the differences in the figures are not incompatible with differences in date of harvest' rl r ni e ing an egree of maturity of the tubers.

It is not inconceivable that Man may have tried by selection to ensure that the food-value of his yams h 11 h greater, weight for weight, than that of the stock from which they were derived, but no more definite proof of this is as yet available than there is of his having succeeded in shortening the period of growth of the ul t s. Tvi usual practice, at least in Bengal, is to grow *D. alata* near the homestead by means of a quite small set which is placed in a well-dug pit filled with good earth. When, at the close of the season the plant dies down the lar ger tuber that has developed is left undisturbed. The still larger tuber formed during the following season is a gaun left alone, but at the end of the third season the tuber which may now be as thick as a man's thigh is harv t rl and eaten, all but a small set, saved from the top of the tuber, which is replanted. A plant thus t rl occasionally produces flowers in its third season, but more often does not. When *D. alata* is grown fi lrl crop a larger set is planted in the hope that maturity may be reached by the end of one season but s f flowering is concerned the result is the same. Plants of *D. alata* raised from bulbils, owing to the limited t W f food-material thess bulbils contain, behave very much as do the plants raised from the small sets 1 in homestead cultivation SD far as attaining maturity and SD far as bulbil-formation and flowering are fl In the caSB of *D. bulbifera* bulbil-formation takes place, at least sometimes, at the end of the first year f th of a seedling plant. It is not known whether bulbil-formation ever takes place SD early in the case f *D. alata* raised from seed : judging from the behaviour of plants raised naturally or under control bv v f reproduction it seems unlikely.

A West Indian experiment undertaken in St. Lucia and described in the *Annual EepoHfor thz year 1905 .06 of .4h^e Botanic Station* of that island |p.l2) is of interest in connection with the question of the time required by a tuber to reach maturity, by illustrating clearly the value of a good start in growth. The experiment showed that—

whole tubers weighing 1 Ib. yielded a return of	..	..	15-2 tons per acre ;
tops weighing fib. each yielded	..	..	9-2t$_D$ns;
bottoms Df the same weight yielded	..	..	7-8 tons,-and
tops weighing ilb. each yislded	..	..	7 • B tons per acre.

These figures show, incidentally, how far growth may be affected should the head of the tuber, the portion most exposed, be injured or destroyed by animal agency or by frost.

The tuber-shapes shown on plate 125 are SD arranged as tD indicate in the upper left-hand earner th$_D$ss that may be most primitive ; those most modified by selection are given lower down. But when Man selected short-tubered races because these are most easily harvested he soon appreciated the fact that short tubers do not develop the desirable tenderness which marks the tips $_D$f deeply rooting ones. A luxury-interest therefore prevented Man from abandoning the cultivation of the latter : the more easily harvested short tubers served to satisfy the immediate cravings of hunger : gastronomic taste rendered worthwhile the labour which the extraction of deeply burying tubers involved. To this diversity $_D$f interest may be due the circumstance that so complete a range of the races selected by man has been conserved.

Rumpf has described the method adopted in the island of Buton in Eastern Malaysia, whose inhabitants prided themselves on their skill in raising yams, to save themselves trouble in harvesting the tubers of racea normally deep-rDDting. A split bamboo, with the tip of the new tuber of a deeply growing race inserted at the end, was buried horizontally in the soil. The elongating tuber, having to grow through the bamboo at no great depth, could thus be harvested with little trouble. Rumpf has not remarked on the physiological effect on the tuber of compelling it to remain in the more freely aerated layers Df the soil, but the bumbou would itself interfere with the aeration.

The desire which led to the device adopted by the people of Buton has led elsewhere tD the selection of races with long recurving tubers that, unless earthed up at intervals, normally extrude from the soil. These races, known in various languages as "snake-yams", may more explicitly be spoken of as "curved snake yams". One yam of this type, brought as a curiosity tD the native governor of the Siamese district of Sriracha, has been seen and recorded by Mrs. D. J. Collins *Kew Bull.*, 1927, p. 24D) : it was 10 feet long and coiled in several tiers, the coiling perhaps largely due to its having been grown in a confined space. Dther curved snake yams arB represented in the lower figures of plate 125 : the yams figured as 7D—72 were grown in the Botanic Gardens at Singapore, and earthed up whenever the tip extruded. Halfway through the growing season, when the negative gBDtropism Df the tuber had become fully established, the yam figured as 71 produced a secondary tuber which proved negatively gBDtrppic from its inception.

Figures 27 to 33 on plate 125 show yams which remain positively geotropic throughout their growth, but eventually become associated with small negatively geDtropic tubers of later formation. The flattened tubers shown in figures 51—55. are of of interest because their lobes recall the production in series Df the multiple buds in the axils of leaves, characteristic of various species of *Dioszorta.*

The longest tubers of *D. alata* measured by one of us were those Df a "curved snake yam" which reached lBDcm. |B3 inches). The longest vertically descending tubers seen by us reached a depth of 95 cm. (37-4inchea) but we have been informed that the Assamese race of *D. alata* known as "fena alu" may at times go down six feet or 184 cm. ; and Seemann has written of tubers eight feet long. The heaviest *D. alata* yams recorded have weighed 82 kilos |136 lb. : in Florida, R. A. Young in *Dep. Bull. 1167, U. S. Dep. Agric,* 1923, p. 7), and BO kiba |132 lb.) in the Philippines |Barrett in *Philipp. Agric. Journ.,* 5, 1912, p. 1B9).

Man has influenced by selection the surface as well as the shape of the tuber in *D. alata* : in some races this is less abundantly furnished with rootlets than in others ; some races develop a corky protective layer : others have a skin so thin that it is easily scratched by a finger nail. The beliefs which underlie selection in terms of aurfacB arB that thB fewer thB rootlets thB better the yam ; the thinner thB skin the more satisfactory the

tuber when cooked. The yams with thicker skins are those regarded as most suitable for use during sea-voyages because they keep better when stored. There are however certain races with thin-skinned tubers whiuh show a tendency to develop a decided resting period : the tubers of such races also have the reputation of being "good keepers."

The horticulturists' belief that *D. alata* is a species which will not endure frost, though warranted so far as its cultivated races are concerned does not hold in the case of a form or forms met with in an uncultivated condition in the Eastern Himalaya and South-West China. The Himalayan plant in question is that known to the Lepchas of Sikkim aa "pirieh bok" or "piriyeh bok". The Lepchas, whose acquaintance with the forest products of their native country is extensive, believe that the "piriyeh bok" which is to be met with at elevations from about 3DDD ft. above sea-level and upwards extends in the valleys of the headwaters of the Rungit river to the forests immediately under the Singalela range at elevations of between BDDD and 9ODD ft. We have not been able to verify the presence of "piriyeh bok" at this altitude Dr to study the conditions that may enable this form of *D. alata* to thrive in a zone where oak-forests prevail and at least 2DDD ft. above the upper limit of tree-ferns. But we know that "piriyeh bok" does occur at elevations where it must be exposed to frost.

Above ground this uncultivated form of *D. alata* is indistinguishable from the cultivated race grown by the Lepchas as "pern bok". But when the tubers of the two are examined they are at once seen to be very different : "pern bok" as its name implies, has short, globose tubers ; those of "piriyeh bok" are long and thin, have a slightly magenta-tinted superficial layer and descend deeply into tliB soil. The tubers of "piriyeh bok", when boiled, have a somewhat unpleasant odour which the Lepchas say, reminds them of the tubers of the wild yam which is called "singul bok" |the name is applied to *D. belophylla*, *D. hpcharum* and sometimes to *D. bulbifera)* : they are on this account less pleasant to eat than those of the cultivated races of *D. alata*.

If it be impossible to say what environmental conditions aid in protecting the tubers of "piriyeh bok" against frost, it is known that in all the races of *D. alata* with deeply descending tubers, the lower parts of their tubers are more watery than the upper. The comparative absence Df moisture renders the upper portion of the tuber the part least susceptible to frost : the depth at which the lower portion is buried gives it the maximum of protection by the covering soil.

We know less regarding the high-level uncultivated Chinese form of *D. alata* than we do regarding the "piriyeh bok" of Sikkim. Dur material of this Chinese form is scanty : it has been collected twice in Yun-nan by Mr. G. Forrest, twice, also in Yun-nan, by the Abbé Maire, and once in Sze-chuan by Mr. F. T. Wang. All five gatherings belong tD female plants ; all consist of the ends of flowering branches : all are so alike as to justify the suggestion that they represent a single uncultivated race. But the specimens available and the field notes accompanying them afford no clue to the nature of the parts under-ground and no opinion can be expressed as to the relationship, if any, between the Chinese high-level uncultivated race and the "piriyeh bok" of Sikkim.

Fortunately the late Mr. Forrest was one of the most precise and careful of collectors in China, SD far as the localization of his specimens is concerned, and to him we are indebted for the knowledge that this high-level form of *D. alata* grows at elevations of 9,DDD—ID,ODD ft. in lat. 25° 4D' N. in Yun-nan : the specimens obtained by the Abbé Maire in the same province were collected at an elevation of 2,BDD m. i.e., about 8,5DD ft. We are thus induced to believe that the Lepchas may not exaggerate the elevation tD which "piriyeh bok" extends in the forests of Sikkim. But we have no clue to the nature of the localities in which the Chinese specimens werB collected and must leave to future students the tasks of settling the relationship of this Chinese high-level plant to the "piriyeh bok", and of explaining how it happens that forms of *D. alata* are able to exist at elevations so considerable.

When we turn from these uncultivated forms to the cultivated races of *D. alata* we again profit by tbB knowledge and experience of the Lepchas of Sikkim who grow yams extensively and are well aware where to plant and how to tend them. They cultivate up to elevations of 5DDD ft., various races in addition to their "pern bok". Thuswiththem cultivation extends well above the lower limit of the uncultivated "piriyeh b ok" and well within the zone in which there is a liability to frost. But, frost or no frost, the Lepchas find that, at 5,ODD ft., whatever be the race they use, the tubers never are properly formed : they give them, in fact, a special name meaning "high-level yam". But even at this elevation the careful cultivator is able to save his crop before there is much risk of its being damaged by frost.

North Df the equator, the cultivation of *D. alata* extends to lat. 3D" N. in the Liu-kiu islands where the climate is ameliorated by the warm oceanic KurD-ShiwD current, whereas on the coast of China, *D. alata* is not

grown beyond Amoy in lat. 24° 3D' N. The only known locality in Sze-chuan is in about lat. 28° 5D' N., whereas in India the shelter of the Himalaya enables *D. alata* to be grawn about Kangra in lat. 32° N. In North America, thanks to the effect of the Gulf Stream, *D. alata* can be grown at Charleston in lat. 32° 40' N., whereas in this Pacific only inferior conditions for its cultivation are afforded at lat. 21° 3D' N. in the Hawaiian islands.

South of the equator, *D. alata* was at Dne time grown in the North Island of New Zealand, in lat. 39° 39' S., but its cultivation had eventually to be given up. In South America the cultivation of *D. alata* ceases in lat. 3D° S. ; in Africa it is doubtful if the species be in cultivation anywhere beyond 22° S. It seems safe to assume that in all these outlying places where the cultivation of *D. alata* is tried, care has to be taken, as in Sikkim, to harvest early in order to avoid damage to the tubers owing to cold.

Though the water-requirements of *D. alata* have never been precisely determined, the .recorded rainfall of regions in which this crop thrives well suggests that an annual fall Df about 50 inches is a favourable amount if three-fourths of the total precipitation fall during the six months of vigorous growth. The necessary conditions obtain over considerably less than half the land-surface within the tropics, yet Man has been able by means of irrigation to extend the cultivation of *D. alata* well, and at times far, beyond the naturally suitable climatic limits. Thus *D. alata* is grown, though apparently on a very limited scale, at Multan in the Punjab, where the rainfall in inches, month by month from January to December, amounts to :—0-39, D-4D, 0-38, 02D, D-29, D-59.2-D4, 1-74, D-3B, D-Dl, D-OS, and D-25 |total 5-73, and for the months from April to September inclusive only 5-22 inches). *D. alata is also giown to a.* slight extent at Amritsar in the Punjab, where the rainfall in inches similarly set down, is :-l-24, 1-26, D-BB, D-55, DB7, 2-D5, 5-35, B-5B, 5-38, D-29, O-DB, andD-4B (total 25-75, and for the six months 21-55 inches). Similarly!), *alata* is grown at Poona in the Decc'an where the rainfall for each month throughout the year averages :—O-DB, D-D5, D-D4, D- BD, 1'18, 4-51, 7-43, 3-76, 4-71, 3-88, D-B2, D-19 |total 27-23, and for the six months May to Dctober 25-47). In all three cases the deficiency of rain is compensated for by irrigation.

In 19D7 Mr. G. A. Gammie was supplied with sets for experimental cultivation in the Ganeshkind Botanic Garden, Poona, and had to report |Ann. Rep. for 19D7-D8, p. 34) that the yield there, even with irrigation, was insufficient to justify cultivation and the experiment was transferred to Bassein on the coast north of Bombay where the average monthly rainfall is :^0-13, DD4, D-Dl, D-Dl, D-53, 1B-D9,2B-5D, 15-84, 11'BD.2'15, 0'13, D- DS |total 77-11, and forthe six months May to October 75-71). Yet even at Bassein where yam-cult.vation for the Bombay market is a staple industry it is usual to irrigate at intervals both at the beginning and at the end of growth. The position may be best appreciated if it be realized that without irrigation *D. alata* would yield no yam crop north of Bombay on the west coast of India, or west of Darbhanga in the Gangetic plain. Without attempting here to'contrast in detail the climatic requirements of *D. alata* with those of *D. bulbijzra* and *D pzntaphylUi-the* areas in India occupied by these two species are shown on plates 82 and 83-it may be stated here that *D. alata* requires much more water than either, and apart from those curious hill-plants spoken of earlier, a rather higher temperature than *D. bulbifsra* ; also that *D. alata* cannot be regarded as m a rëgion where it is native, when its growth is retarded by low temperatures or deficient moisture.

Though there are numerous localities in which *D. alata* is known or reported to propagate itself spontaneously it is not possible to point to a region in which it can be regarded as indigenous. The localities in which lt appears spontaneously are shown in a small map on plate 148. They lend themselves to arrangement in two groups : |.) places where spontaneous occurrence is clearly casual: and *b)* places where spontaneous occurrence is so nsual that the inhabitants dig up the tubers for use as food. The regions within which JJ. *alata* is cultivated similarly arrange themselves into four groups : |.) regions where Man must irrigate while the plant is in active growth, or must take steps to harvest the tubers before they become exposed to damage at the close of the growing season ; *b)* regions such as the Lower Gangetic Plains, in which plants established near a homestead can be left undisturbed from year to year ; |e) regions in which the plant occasionally reproduces itself spontaneously : and *i)* regions in which it is so freely spontaneous that its tubers provide Man with an additional source of f DDd in times of scarcity.

The nearest natural allies of *D. alata* being certainly natives of south-eastern Asia, it seems natural to look for the original home of the cultigen which *D. alata* has become, in some portion of south-eastern Asia in which it shows a tendency to become freely spontaneous : the period at which the conversion of i?. *alata*: or its ancestral form into a cultigen commenced, must be regarded as at least subsequent to the close ol the last Glacial, there being reason to believe that since then the climate of south-eastern Asia has remained fairly uniform.

It is certain that this cultigen is one of the plants within thB section *Enantiophyllum* belonging *to* what has been termed on page 2BB " the group of *D. alata* ", and that within this group it may atleast claim to

share a common ancestry with *D. persimilis* and *D. Hamiltonii*, which are as vigorous of growth as itself. In connection with this it may be noted that *D. alata* is intensely tropophytic, a feature which suggests its descent from an ancestor native in a region where the changes of season are pronounced, therefore one nearer the Tropic Df Dancer than one near to the Equator. Dn plate 148 maps showing the distribution of two members of the *D. alata* group of species are given along with that showing the distribution of spontaneous *D. alata*. ThesB show that the centre of distribution of *D. persimilis* is in Tonkin ; that of *D. Hamiltonii* is in Upper Burma though the latter speDies seems to have a subsidiary centre in Tavoy and an isolated one in Malabar. The differential characters shown by *D. pzrsimilis*, while suggesting the possibility that it may have diverged less than *D. alata* has from some common ancestor, are not incompatible with the alternative possibility that *D. persimilis* is a regressive form of *D. alata*. Unless genetical study should indicate that the latter is the more probable alternative, Tonkin might reasonably be suggested as the area within which *D. alata* began its career as a cultigen. Should it be proved that *D. persimilis* is no more than a retrogressive form *oiD. alata* the almost equally obvious affinity of the latter to *D. Hamiltonii* renders it reasonable to suggest that *D. alata* first became a cultigen in Upper Burma. In any case morphological and physiological considerations point to northern Indo-Dhina as a whole as being probably the original home of the ancestral form of the cultigen known as *D. alata*. If this conclusion be justified it would follow that in the case of this cultigen, the exploitation which usually precedes cultural attention, began in an upland forest-clad region, where the woods in which its ancestral form wag wild, were, as compared with the denser tropical vegetation of Malaysia to the south, sufficiently easily pens. trable by the primitive tribes who competed with wild animals in the search for edible tubers. This suggestion is in keeping with the generalization for which economic botany is indebted to Rumpf, when he remarked that the consumption Df yams is a feature in the life of those who do not have sufficient rice. Rice and yams agree in growing during the season of rains and in ripening together when the rains end. A diet mainly composed of rice is characteristic of people living in the plains ; one in which yams bulk largely is a diet for hill-tribes. The early inhabitants Df northern Indo-China were hill-dwellers : yams are most abundant in hilly tracts and hill-people are especially given to the collection and consumption of yams. But it does not follow that the *Bioscorm* whose tubers most attracted the attention of the tribes of northern Lido- China was the ancestral form of *D. alata*. The high level spontaneous race Df *D. alata* in Sikkim resembles the majority of the species which belong to the section *Enantiophyllum* in possessing tubers which escape exploitation by wild animals by descending vertically and deeply in the soil, and it is reasonable to assume that the ancestral form Df *D. alata* shared this peculiarity, and therefore was neglected not only by wild pigs but also by tribesmen whose implements of horn Dr wood were ill-adapted tD the purpose Df extracting such deep-going tubers. Dn the contrary it is reasonable to imagine that the northern Indo-Chinese hill-tribes who used wild yams must at first, as was the case, within living memory, with the aboriginal tribes of the Andamans, have been content with the shorter, less deeply descending and more easily accessible tubers Df species like *D. bulbifera* and *D. pentaphylla* and, like the Andamanese, have made little effort tD obtain the tubers of any species belonging to the section *Enantiophyllum*. It is true that the Andamanese ate tubers of *D. glabra* and *D. vzxans* which are species of the section *Enantiophyllum;* but taboos placed against the eating Df them during certain ceremonies, show that they were regarded as dainties. Yet it is not unreasonable to imagine that though the *Enantiophylla* were usually passed by, at some stage in the development of the practice of yam-exploitation an accident Df observation may have led some primitive tribesman to form the happy idea, sometimes acted upon by the Sakai of the Malay Peninsula, of replanting the portion of the tuber he does not care tD cook. From the replanting of part of the tuber to the choice of a place in which to plant it ; from the choice of a place suitable for planting to thB formation of a plot Df cultivated yams ; from the formation Df a yam-plot to the selection of sets for the thrift or the quality of the crop hoped for, are only distinct stepa in one logical sequence. It is equally reasonable tD believe that at least some of the steps had been taken before the primitive tribes of northern Indo-Dhina become acquainted with the merits Df ancestral *D. alata*, and to imagine that selective attention continued to be bestowed on those species whose tubers are relatively easily accessible after *D. alata* came into use.

An account Df the various cultivated races Df *D. bulbifera* is given at page 122. The mere existence of such races affords evidence of the extent tD which Man has been able by selection tD modify the tubers of this species. The degree Df modification the species has undergone is sufficient tD warrant the surmise that, notwithstanding the protective astringency characteristic Df the wild races, this species may at one time have been regarded by Man as the most important of his yams. The account given at page 138 of a cultivated form |var. *hortorum*, of *D. pentaphylla* is sufficient proof that efforts have been made to modify this species also by selection. But the attempt in this case must have been less sustained. It is a possibility that modification in the case of *D. pentaphylla* was not attempted till after successful results had been attained in the case *of D. bulbifera :* whether the more limited success with this species be a consequence of less ready response to Man's selective treatment Dn the part of the plant DrtD greater dislike by him for its tubers because Df a different degree of

prgtective astringency, must remain open questions : perhaps both reasons have played a part. But while it is possible that *D. bulbifzra* may originally have been the yam Df most importance to Man it seems certain that long before *D. alata* become entitled to its existing hegemony, the yam most esteemed by Man was *D. escuhnta*, an account of which is given at page 84. This assumption for a time by *D. escuhnta* of the leading place in popular esteem is not difficult tD understand. Its tubers are almost as close to the surface as those of *D. bulbifera*, or Df.D. *pentaphylla* and have the advantage, from Man's point of view, of being devoid of the protective astringency characteristic of those of both of the species mentioned. Instead of discouraging the attention of inquisitive animal enemies by chemical means, *D. escuhnta* protects its bland tubers from attack by wild pigs by a mechanical screen of firm surface roots with branchlets converted into spines, interposed between the tubers and the surface Df the soil. This defence, eff ective against animals, Man could SD turn that it proved no hindrance tD his exploitation. But in this case the results secured by Man during the cultivation which followed destructive exploitation and led to reasoned selection were more beneficial to Man than those secured in the case of *D. pentaphylla*, and quite as marked as in that of *D. bulbifera*. Even in the latter case now, the results appear so inferior tD those achieved with *D. escuhnta*, whether because *D. bulbifera* has been less amenable tD selection or merely because it has been found less agreeable as a food, its present condition may, like that of *D. pentaphylla*, be regarded as the dying end of a spent human effort. This, however, cannot be said of *D. escuhnta*, which still remains in some of its modifications, a crop of much economic consequence in certain regions, though it may be admitted that the extent to which, as compared with *D. alata*, the species has proved amenable tD selection may not unfairly be said to resemble the extent to which, as compared with *D. bulbifera*, it has reacted to the selective activity of Man, while it is not unreasonable to conclude that many of the modifications met with in *D. escuhnta* had already appeared before Man took an active and sustained interest in *D. alata*. The delay in the development of this interest is not difficult tD understand. Primitive tribes in northern Indo-China could, like the Andamanese, copy the example of the wild pig which unearthed the shallowly buried tubers of *D. bulbifera* and *D. pentaphylla*. There and elsewhere early Man could improve Dn the unsuccessful efforts Df the pig tD reach the shallowly buried but spine-protected tubers Df *D. escuhnta :* an armature which repelled the snout of an animal could easily be removed by the human hand employing a stick or other simple weapon. But the tubers of the ancestral *D. alata* owed their immunity, as did those of most of thB species of the section *Enantiophyllum*, to the simple, but effective, expedient of burying themselves so deeply as to be beyond not only the reach of animals but also of early Man.

Even when the primitive tribes in whose forests the ancestral form of *D. alata* was a native had, as a result of partial contact with peoples more advanced, come to possess implements of metal which made it possible for them tD dig up the tubers of this particular *Enantiophyllum*, the physical exertion entailed must have proved a deterrent to exploitation. To Dr. E. D. Merrill we DWB the information that he has seen on Mt. Mariveles in Luzon, holes five feet deep, from which Negrito yam-hunters had dug the tubers of the Philippine *D. divaricata*. One of us has had the opportunity Df examining holes four feet deep from which the Abor tribesmen in the Eastern Himalaya had dug the tubers of *D. glabra*. The late Dr. Maiden has recorded that the Australian aborigines dig down three feet for the tubers of *D. transvsrsa*.

The aversion Df primitive tribesmen to unnecessary labour may well explain why, even after thBy possessed implements adequate for the purpose, the early inhabitants Df northern Indo- China only extracted the tubers of ancestral *D. alata* when supplies of tubers Df the less deeply descending kinds ran short. The Lepchas of Sikkim now, under the same conditions, sometimes undertake thB arduous task of digging out the tubers of the spontaneous " piriyeh bok " which, above ground, closely resembles the cultivated " pern bok " with comparatively superficial globose tubers in place of elongated deeply descending ones. It is conceivable that during sums season of scarcity in northern Indo-China while the search for the tubers of the ancestral *D. alata* was imperative, some fortunate tribesman stumbled upon a plant with a. tuber formed near the surface of the soil and was led by this discovery to the idea of propagating from that less deeply buried tuber. The process of cultivation and selection were already conducted in the cases of *D. bulbifera* and perhaps *D. escuhnta :* their extension to a form of *D. alata* which promised to prove equally easily harvestable was only natural since even a primitive tribesman was able tD realize that if his experiment proved successful, the same amount of labour bestowed on a shallow-buried form of *D. alata* must ensure a heavier yield than could be expected from the smaller tubers of *D. bulbifera* and perhaps *D. escidenta*.

Whether the inception of this early empirical trial was due to such an accident as is here suggested or was induced by some other cause, the hope that inspired it was realized : experience shows that vegetative reproduction from any portion of an underground tuber of a particular race of *D. alata* usually results in the formation

of tubers with the characters of the parent one. This experiment, whatever may have inspired it, proved to be the initial step in the conversion of ancestral *D. alata* into the cultigen familiar to Man throughout the Tropics to-day; and the expectations that the raising of a form of this *Dioscorea* with tubers nearer the surface than the normal form, would prove an enterprise more economic than the cultivation of the species till then raised by Man, have been amply fulfilled.

While it is possible to think that this initial improvement of ancestral *D. alata* may have been effected in northern Indo-China, there is little to suggest that this deviation from the normal in an *Enantiophyllum* owed anything to hybridization: but subsequent hybridization might account for the introduction of a factor of resistance to climate and explain the existence of the high level forms to be met with in Sikkim and Yunnan: some of the forms met within Sikkim have ridges near the base of the stem strongly suggestive of *D. Hamiltonii*. This is equally true of the form from Goalpara in Assam differentiated by Buchanan-Hamilton as *D. octangularis*. There are in all our Yun-nan specimens certain features which render it possible that they belong to a distinct race of which at present too little is known to justify a definite decision. But the unwillingness to produce flowers so marked in the cultivated races, and the unanimity with which those who make use of their tubers have ignored the existence of seeds when these are produced, lead us to believe that hybridization can hardly have affected the creative evolution which has supplied us with the various races now in cultivation; and to feel that our suggestion (*Journ. As. Soc. Bengal*, N. S. [illegible], 1914, p. 39) as to the existence in the North-Western Himalaya of a hybrid between *D. alata* and *D. belophylla*, even if possible, must be deemed unproved.

Whatever the origin of the form of ancestral *D. alata* first cultivated in its native region may have been, the establishment of the form as a cultivated plant made possible its transfer to other areas inhabited by peoples sufficiently enlightened to welcome it: tribes so endowed were obviously competent to promote the improvement of the new cultigen. They enjoyed the advantage of the fact that such a plant when transferred to new localities at times thrives more vigorously in its new home and escapes blights and pests that assail it in its native region. Transfer to islands may in both respects prove especially favourable, as the production of the Otaheite and the Tanna races of the sugarcane in the Pacific shows. But if it be probable that the cultivation of *D. alata* began in a form whose tubers do not go deeply into the soil, it does not follow that cultivation, even in the original home of the plant, did not sooner or later extend to plants with deeply buried tubers. When in times of scarcity jungle kinds were extracted, the fact that the deeply burying kinds were the more tender could not escape notice: those in a position to order others to dig for deep-going tubers on their behalf would naturally see to it that some at least of the plants in their yam garden were deep-going ones.

There is some evidence that extension of the area invaded by *D. alata* as a source of food synchronized with its further modification, perhaps more especially in Malaysia, as a cultigen; also that some of the [illegible] forms thus evolved, spread backwards towards, though perhaps, without getting as far as, the ancestral home of the species. The races here termed the "curved snake yams" for example appear to be numerous in the Philippine Archipelago. It cannot be said with certainty whether a "curved snake yam" [illegible] derivative of some elongated deeply burying form resembling the spontaneous "piriyeh bok" of Sikkim, [illegible] from some form like the "pembok" of the Lepchas, with a short and shallowly burying tuber, or a regression; [illegible] factors in the Philippines that would account for the physiological change in the first instance or the morphological regression in the second. But the distributional [illegible] working hypothesis suggests that the type to which the "curved snake yams" now generally conform [illegible] in the Philippines whence in diminishing numbers and lessening importance [illegible] western Malaysia and Siam. The interesting reference by Rumpf to the practice of the [illegible] suggests (a) that the race with which they were familiar had deeply descending tubers, [illegible] in becoming acquainted with the existence of these Philippine "curved snake yams" they endeavoured to educate their own race with whose qualities they were satisfied, to behave like the more easily harvested [illegible]. Though these "curved snake yams" have spread eastward to Fiji, even now they have not extended [illegible] Indian Peninsula, though forms with similarly curved but fasciated tubers have reached [illegible] Brahmaputra [illegible] where another is known as "hatharpatia alu" (flat oar yam). It seems clear that these fasciated forms also came into existence somewhere to the south of the region in which ancestral *D. alata* was a native, and that they are now in process of extending their geographic range. As regards the origin of those races whose tubers have [illegible] such as are shown in figs. 24-33 on plate 125, which are [illegible] the judgment of Roxburgh may be accepted with some confidence. They have been widely cultivated in southern India for some centuries and have reached the New

World, where they have received the name of Seal-topped yams. When Roxburgh described, as a species, under the name *D. atropurpurza,* that race of this type which is represented at fig. 24 of the plate, Roxburgh regarded it as a plant *of* Malaysian origin.

The season in which *D. alata* is normally harvested in Asia coincides with the commencement of the autumnal calm weather during which sea-voyages are still most conveniently made and were once almost exclusively undertaken. It is therefore practically certain that tubers of *D. alata* formed part of the stores taken on board by Eastern mariners for consumption at sea ; and is therefore highly probable that the stocking of the islands of the Pacific with *D. alata* took place by means of surplus tubers carried from the Asiatic continent to the nearer archipelagos, and from one group to another, by mariners whose voyages have not been recorded and cannot be dated with precision.

The fact that the East African localities in which *D. alata* can be grown are somewhat definitely circumscribed, makes it easier to form conclusions as to when and how this species was carried westward across the Indian Ocean. The most northerly of these localities is south of the Equator ; the centre of the suitable area is about Zanzibar. Yet Miss Welsfard states *Notes on Agricultural Exhibits in the. Zanzibar Museum),* that, though grown by certain tribes, *D. alata* is not in general cultivation; it is grown by the Wahadiwa in the Chuaka district on the east coast of the island and is used by the inhabitants of Fundu, an island under the west side of Pemba, instead of the cassava favoured by others. But while the quantity grown is usually small, Miss Welsford mentions four different kinds,—" moiringo," " kinana," " madole " and " mwendachi " ; while Lyne |Shamba, 19D3, p. B) mentions the last three and adds three others,—" panga-panga," " karaj " and " denga." *D. alata* has been collected in Zanzibar (Greenway no. 1196 in Herb. Kew.) cultivated under the Ki-swahili name " viazi vikuu," in holes and pockets in coral rock filled with red earth, near villages on the east coast such as Pwani Mchangani. Lyne also employs the name cited by Greenway, but uses it as a term including all his six races. The possibility of recognizing as many as six races, entitles *D. alata* to be regarded as well established in Zanzibar. Miss Welsford describes two of her four kinds as with turnip-like tubers ; in the other two the tubers are fingered.

As a result of replies by natives tD his enquiries Mr. P. J. Greenway states that in Tanganyika Territory *D. alata* is grown generally near the coast, chiefly by the Wa-swahili and the Arabs, as well as by the Wa-segua tribe in the low country opposite Zanzibar. But he reports further that yams are grown on raised beds and trained on supports by the Wa-chagga who dwell on the southern slopss of Kilimanjaro ; by the Wa-pare on the Pare range which extends south-east from Kilimanjaro : by the Wa-shambare who live between the Pare range and the coast; also by the tribes who inhabit the Uluguru mountains. Reference to the map given by Engler and Drude |Vegetation der Erde, 9, part 1, 1910) shows that the inland tribes mentioned live in thB vicinity of rain-forest, just where the cultivation of *D. alata* is calculated to succeed best: though we have no definite assurance that the yam they grow is *D. alata,* it is most likely so. The rainfall maps given by Knox (Climate of the Continent of Africa, 1911) suggest that, provided the disadvantage of dry weather in February can be overcome there are a few favoured spots in this part of Africa which enjoy a climate suitable for yam-cultivation from November to May. But the suitable area is extremely limited : it all lies between lat. 3° S. and lat. 8° S. and does not, even in the most favoured parts, extend further inland than 300 miles. The country south, west and north of this area, though in some parts suitable for cassava, is too dry for *D. alata.* We learn from Dr. W. Small, Director of Agriculture, Nyasaland, that the cultivation of *D. alata* has been attempted near Zomba, but has been given up.

The cultivation of *D. alata* proved more attractive and at one time was very much more attractive, to the inhabitants of Madagascar than to the tribes of continental Eaat Africa. According to Perrier de la Bathie |Rev. Bot. Appl. et d'Agric. trop., 11, 1932, pp. 727, 833) this species was formerly grown as a field crop by almost all the Malagasy tribes, but is now only grown in gardens, having been reduced to a subordinate position owing to the extended cultivation of *Ipomosa Batatas.* In Mauritius, Reunion and the other islands of the Mascarene group where *D. alata* is grown, its importance as a food-plant is a mere shadow of what it used to be.

The question as to how and when *D. alata* reached the Mascarene islands and the area in East Africa where its cultivation is possible involves a cursory review of the history Df navigation in the Indian Ocean. That ancient Egypt by way ofthe Red Sea and ancient Mesopotamia by way of the Persian Gulf maintained a mari-' bime intercourse with East Africa and India we can realize ; but there is little to indicate that this intercourse extended beyond the mouth of the Juba on the coast of Africa and the mouth of the Indus on the west coast of India or, at the extreme, Broach, and nothing to suggest that either established or encouraged direct

intercourse between India and Africa. Even if they encouraged traffic by a route within sight of land between Habshi and Hind this could not have led to the transfer to Africa of *D. alata* for the trade routes thus linked did not go so far south as to reach an Indian port where yams were likely to be purchased as ships' stores or BO °uth along the African coast as to reach the area in which *D. data* can be cultivated. It was other groups **far so** of traders who voyaged to the east of the track upon which they sailed : and thBy had different resources. Ws feel assured that the vessels of these most eastern traders putting to sea from any port on the coast of **may** ' the Malay Archipelago between Surat and Tonkin had taken tubers of *D. alata* on board as part of **Asia or in** tli t es for the voyages; but we have no ground for suggesting that their destinations ever were any Mascarene **es or** island or any place Dn the east coast of Africa between 3° S, and 8° S. Even if, during the first few centuries of our third group the Chinese, adventurous interlopers Dn the tracks of Indian shipping, did, as Schoff suggests **era, a** fTh P riplus 1912, p. 83) but as Laufer doubts |Sino-Iranica, 1919, p. 541), adventure yet further, transgress thB **bounds be** tween the Indian trade organization and the other, and sail as far as the Persian Gulf, it has never **been su** eeested that they tried to reach the African coast. The first chord voyage across the Arabian Sea, the record of which brought renown to the Greek sea-captain Hippabs, was made in A. D. 45. Thia voyage *t* \, **mus. ave ena** bled that seaman to reach Indian ports where IIB could have revictualledhis vessel with yams, but **it has no** t been claimed that on his return j ourney he could have put any of the tubers ashore on the East African **coast anyw** here to the south of ths Equator. The same remark applies to a similar voyage or voyages across **the Sea o** fI5 sal made during the reign of Hadrian in the second century of our Era. It can hardly be doubted **that ra an** A li d Indian sailors had made on occasions similar unrecorded voyages beforB the first and after thB **secon cen ur** *A* t ie3A D but it is reasonable to believe that the western limits of such voyages were Red Sea Dr Persian Gulf ports and never the ports on thB coast of Zanquebar. These voyages, wherever begun, ended in **regions wi** 'th drv climate which did not afford conditions suitable for thB cultivation of *D. alata*. We know **that some vo** vaee Df this kind, very early in or just before our Era, resulted in the establishment of *Coloaasia* cultivation in Jigyp nDn uf them can bB said to have rssulted in the introduction of thB morB exacting *D. alata* tD East Africa.

In tli**e seven**th century A. D. the foundation of a new faith between the Red Sea and the Persian Gulf lei **to th tra** ffi hich began and ended in the sea-ports on its coasts being put to other than commercial usea. Tli **e eastern** route to Malabar was that followed by thB Zoroastrian and Christian refugees from Persia and **S**yria w **sou**eht in western India an asylum where they might indulge undisturbed in the faith of their **f th** Baatern route waa ftlso that USBd by zealous disciples of the new faith.bent on imposing it, if i. *t* n the DBDUles of India and the countries beyond the Bengal Sea. About a century later the necessary by lorce, on mo *a r* J - - . I I

by Arab and Persian non-conforming sectaries DI the newtaith who sought asymnnrom b the orthodox in already established seaports on the East coast of Africa, like Makhdashu in persB **c tion y** u founding new settlements on the littoral of the land of the Zanj to the south of the Juba, or on **So**ma **liland or by** b yond the Rovuma. The only portion of the littoral wherB the climatic conditions aiB such that D **the** i o n Df *D_ data* feasible is that known as Zanquebar, from Melindi southward to Kilwa, as prev **th**er **is no in**dication that any of these ports established direct intercourse with Indian or Malaysian an as ere **til** somBwhat later, we can only conclude that if *D. data* did at that time reach the Zanquebar b ora **at** mugthaVB been the result of intercoursB with Madagascar. There is reason to think t **h t th** a isi **ay** possible when the Persian element in the population Df the East African littoral first reac **hd th** **Z nq** Anthropological study has proved that there is a Malaysian element in the population o element is the result of two distinct incursions of which Haddon *\Thi Raws of an* **pagan** Malaysianato considers that the first cannot be dated with precision. But we know that theforcib e conve the new faith founded in the seventh century was being actively pursued before heterodox Persians was undertaken, and we have reason tu believe that Malaysia possesse **d** nav g M rBBonrBbful as those of Arabian birth. There is therefore no reason to imagine that the incursion ot Ma ay Madagascar was more than a repetition in the eighth and ninth centuries of the reaction to an aggressi **ve** Q{ & pars and & Nestorian element into In **may** asaurei ftt whatBVer date this first Malaysian incursion into Madagascar took place **tul** cDnsiderablB pDrti[)n of tnBStores shippei for uae during the voyage, and ec-ua **h d M** pDrtiDns of these tubers were available for planting at the conclusion of the voyage. Having **Wh** daeascar , *D. alata* was ready for introduction to Zanquebar as soon as its value was appreciated there, **d** SBttlements from Makhdashu to Sofala bscame welded into the once pawerful Zanquebar Conle mtercouraB between them and Indian sea ports set in, so that the introduction of *D. data* from a **of the** bom MaliagaScar was a possibility : its introduction to any onB settlement assured its extention to aU tnose Melindi southwards at least to Kilwa, where its cultivation was feasible.

When the Portuguese rounded the Cape in 1498, that Confederacy had become BO weak that the newcomers were able to engage at Melindi an Indian pilot who took them direct to Calicut in Malabar before they undertook the task of destroying the Confederacy. But these European invaders of the Indian Ocean have not told us whether they found *D. alata* in cultivation on the Zanquebar coast. We know, however, that *D. alata* cannot have reached Mauritius when that island was discovered by the Portuguese in 15D5, or have reached Réunion when they discovered it in 1513, because neither of these islands was then inhabited. During this period of Portuguese activity the second Malaysian incursion into Madagascar took place and led to the establishment of the Hova kingdom which eventually became dominant throughout the island. If *D. alata* was not already present in Madagascar as a result of the earlier invasion it certainly became established as a result of this later one.

When, early in the eighteenth century, bath Mauritius and Reunion were colonized by France, some of the new settlers married wives from Madagascar. The Creole speech used in both islands, which contains many words borrowed from the languages of Madagascar, shows that the tubers of *D. alata* accompanied their Malagasy spouses.

By the close of the eighteenth century Indian petty traders, under the name of Banyans, were beginning to settle in the island of Zanzibar and were thus able to introduce there both Indian words and a wish for vegetables familiar in the Indian bazaars. If *D. alata* had not already been introduced from Madagascar or direct from India, in their settling there was a further opportunity for its introduction: and even if already present in Zanzibar gardens, the demand for its tubers must have encouraged extension of its cultivation. In Mauritius the employment of indentured Indian labourers began in 1834 and in Réunion this practice prevailed from 1BBD till 1882. Linguistic evidence shows that pBrhaps more kinds Df yam than one were present in both islands before Indian labourers were employed there, though the presence of these Indian workmen may have brought into use Indian names for some of these yams.

The Hova names applied to the yams of Madagascar usually begin with the two syllables "ovi", the linguistic equivalent of the Malay "ubi." This is only one of the numeruus plant-names in use in Madagascar which seem attributable to one or other of the two Malaysian incursions into the island. M. Perrier de la Bathie has given a list of these names \(*Mim. Soc. Linn. Normand.*, N. S. Bot., 1, 1928) supplemented by a few morB \(*Rev. Bot. Appliq.*, 11, 1931, p. 834). Those which belong to *D. alata* include "oviharine" or "oviharc." with dark charcoal nr violet tubers ; "ovi buoy" with globose tubers ; "ovi lava " with elongated tubers ; "ovi fantaka" or post-yam, because the stems are trained on supports : "ovi mena" with red tubers ; "ovimboay" or crocodile yam ; and perhaps "ovisorokomby", a term the meaning of which is not explained. Some at least of these terms are pure Malay, being the exact equivalents of the Malay "ubi buah" Dr round yam, "ubi merah" or red yam, "ubi buaya" Dr crocodile yam. It has been suggested by some authors that the Malaysian settlers in Madagascar must have touched at Ceylon ports to refit and revictual their vessels before resuming their voyage, and that some of the forms of yams met with in Madagascar may consequently have come from Ceylon. But this assumption seems unnecessary even as regards the earlier incursion : the Malays were good sailors, and quite capable of embarking stores sufficient for a long voyage. As regards the second incursion, it may be set aside as improbable, because soon after A. D. 1500, the Arab navigators who traded between thB Red Sea or Persian Gulf ports and Malay ones, abandoned their early practice of calling at Ceylon in order to avoid the interference to which they were subjected at the hands of the Portuguese when they did. Pagan Malays prepared to leave their homes owing to their dislike for the conditions created in Malaysia by the growing power of Muhammadan Arabs, doubtless shared the aversion of the latter for the Christian Portuguese, and objected to baptism as much as to circumcision.

The Mauritius name for all the yams grown in Mauritius was, in the Creole patois of the island, the word "cambare." From Bojer \(*Hort. Maurit.*, 1837, pp. 351-352) we learn that he knew five distinct kinds. By thB time that Bojer dealt with this question *D. alata*, had long been the most important and widely distributed of the cultivated DioscDreas : it had deprived *D. esculenta* of its hegemony, just as *D. esculenta* had, at an earlier age become more important than *D. bulbifera*. Besides "cambare" proper, Bojer recognized "cambari à piquans", "cambare a tige ailee," "cambare violette" and "oambare marron". NDW of these forms it is clear that it is "cambare a, tige ailee" which was *D. alata* because, following Linnaeus and Roxburgh, he named it *D. alata*, and because, like these authors, he identified it with the yam figured by Rheede \(*Hort. Malab.*, 7, t. 38) as "katsil kBlengu," which is, as Roxburgh has pointed out, the "kham alu" or post-yam of Bengal and may, as we now realize, have been the "ovi fantaka" or post yam Df Madagascar. It is equally clear that "cambare marron", must, as Bojer thought, be *D. bulbifera*. Whether the "cambare violettG[1]" of Mauritius, as Bojer knew it, was *D. purpurea* as understood by Roxburgh, or if, as seems possible, it was Roxburgh's *D. rubella*, and therefore

only in either case a form of *D. alata,* ia not clear. WB are, howevRr, especially concerned with tl, V. ^ , the cultivated yam termed in Mauritius "cambaré" tout court and, on tnls a c c o u n T m ! l l ^ h T the first one to bB introduce to that island. ^ J ^ ^ , & m u m a n o n v ^ ^ ^ ^ ^ was, aa Bojer believed, the yam figured by Rheede |Hort. Malab., 8, t. 51) as "mu-kelenKu ' ,whi h T ft»C. *Phnt.*, ed. 1, p. 1033) had included in *D. sativa.* The "cambare a luans" of M f ^ fied with the figure given by Rheede *Horl. Malab.*, 7, t. 37) as "kattu-kelengu " whi 1 LnT n " " ^ included in *D. a.uUata.* In doing this Bojer ignored the warning of Roxburgh I ^ H* ^ *} ^ figure to be quoted." That warning was certainly warranted, for Rheede's figure is a chim Z uT ' pricklystem of "m,ke,ngu" with the axillary bulbils of D. ^ ^ ^ " ^ 7 ^ Bojer overlooked something more : whatever the *D. azuhata* of Linnaeus may have included th n ! Roxburgh was a homogenous species whiuh was the "mou alu" of Bengal and thpr-f ' r TM*Ulmta ot* "mu-kelengu" of Malabar : it was, moreover, one of the forms of the C ^ ^Z ZT T^ ^Z Z T T ^ p. 357, t. 125). That "cambare a pi,uans" was merely aform of cambare proper is clea wi 5, to which both forms belonged is that named *D. wzulmta* does not admit of dispute in apite of the regards "cambare" tout court as the igname of the French and the " cambare a piquan "th ^ ^ English, when thEse two names bore the same relationship to each other that the Malabar " " ^ * ^ Bengali "mou"". But the association with one of these forms of the name "cambaré " unnu lifi K *" ^ minative term, suggests that in the caae of Mauritius the introduction of *D. ueuUmta* ma h * ^STM~ introduction of *D. data* and have occurred before the latter had become, all over south Asia, important crop of the two. That thia was not impossible the history of the island showa TlT t ^ ^^ its discovery only used it aa a port of call and the Dutch annexed it in A.D. 1598 but rf after colonize it till A. D.1338, from which date onwards they formed small settlemehta Tt ^ ^ °. ^ ^ ^ to Dutch were then in influential positions on the coast of Malabar, in Ceylon and in Malaysia^th The island may well have carried with them yams from any of these three regions. But the colony rfl in the theisland was abandoned by the Netherlands in A.D. 1710. It lay delict for five yearstil], A ^ France took possession, but it was not till A.D. 1721 thatitwaa definitely colonized by French 1 ^^ Malagasy wives. But there is nothing to suggest that the introduction of *D. esoulenta* to Maurit' settlers with in 1721 from Madagascar, for in that island the name for *D. escuknta* is "mavondro" and^'d" ^^ ^^ bear any name resembling the word "cambare"." But the derelict condition of the island bet "^ not there 1715 does not imply that none of the settlementa eatablished by the Dutch after 1538 1710 and inhabitants : otherwise the place-name Pieter Botte must have failed to survive. If a place-na persist after those who invented it had gone, so might one of the plant-names for a staple crop pBrsiat^te ^ introduced it had left : the name "cambaré"" may be aa authentic a relic of the early Dutc^ "^ ^^ Mauritius as the name Picter Botte, still borne by the principal mountain, seems to be occupation of

M. Perrier de la Bathie has, however, made *Re,v. Bat. Appliq.*, 12, 1931, p. §34) a different regards the source Df the word "cambar§." He is of opinion that this name originated in Mauritius, as for *D. alata,* by the combination in one word Df the Bengali and Hindi term "kham" used for presumedly species with the Malagasy term "hare" employed to distinguish another form of that species ^ T h T V * ^ ^ in a particular language or dialect of a technical term combining elements borrowed from two distinct tongues, though it may be unusual, is not unknown. What to an English traveller in Scotland may be described as a curling "match" between opposing teams ia termed by the Scottish players of the game a "bonspiel". In thia case the combination in one word Df an adJBctive which is French with a Flemish substantive affords one of the proofs that the game itself was borrowed by Scotland from apart of Flanders where the educated element in the population was in practice more Dr less bilingual. But while it is possible that one element in the population of Mauritius after its colonization by France was sufficiently bilingual to employ Malagasy as well as French terms for its cultivated plants, there is no indication that Bengali or Hindi names were in rn. further difficulty in connection withM. Perrier de la Bathie's interesting hypothesis : thathypothesis implies that the inventors of the name "cambarfi" were unable to discriminate between two distinct races of D

thB "khamalu" of India, at least aa regards its ijualifymgname, accorded with the "ovifantaka" of Madagascar so far as its mode of cultivation was concerned, whereas the "ove hare" of Madagascar must as regards its colour have borne some reaemblance to the Malaysian race which Roxburgh named *D. atropurpurea* but which, though already known in Bengal when Roxburgh and Bojer lived, had not yet received a distinctive Bengali name. The fact that the name "cambare," if the explanation given by M. Perrier de la Bathie be correct consists of two Qualifying words the aubatantives associated with which have disappeared, though noticeable, does not invalidate hissuggestion because the word '"kham," used alone, is often employed in India withoutthe term "alu" to signify the race of *D. alata* which is trained Dn supports, just as in Europe the word "savoy" is used for a particular race of cabbage and the word "picotee" is employed in connection with a particular race of carnation. But the

most serious objection to M. Perrier de la Bathie's theory is the fact that it connects the name "cambaré" with *D. alata*, whereas it is evident from what Bojer has recorded that "cambaré", as an unqualified term, must have originally indicated *D. ssculenta*. This consideration suggests that the name "cambaré" may be no more than a modification of the Malay name "kombili," which signifies *D. esculenta* and renders it almost certain that this species was introduced to Mauritius during the Dutch occupation of that island : also, that though it may have been brought from Malabar, from Deylon or from Malaysia, the probability is that it was brought from one or other Df the Dutch settlements in the Malay Archipelago.

The presence of *D. alata* in Mauritius may also be due to the Dutch from 1B38 onwards to 1710 : other races may well have been brought from Madagascar by the French settlers with Malagasy wives who reached the island after 1715 ; or may have been supplied from India by the French East India Company after the foundation bv that corporation of a purely French settlement in 1721 ; still other races may have been introduced by the Indian labourers whose arrivalf allowed the annexation of the island by the British in 1811). But the modification Df the old Dutch-Malay name "kDmbili"f or .D.escwJeniaintD "cambaŕe" and the extension of the name "cambarS" to the various races of *D. alata,* can only have taken place as the result of the settlement of French colonists with Malagasy wives in or soon after A.D. 1715.

Within the somewhat limited region of continental East Africa where climatic conditions permit the cultivation of *D. alata,* its tubers are known in the singular as "kiazi-kukuu," in the plural as "viazi-vikuu" to those who use Wa-swahili speech. These people grow the crop, as do the Arabs and the Wa-digo : we learn from Dr Stuhlmann *[Bsitr. z. Kultur-geschichte. Ost-Afr.,* 1, p. 240) that the name these people USE means "the potato, or potatoes, of the old style," the potato of the new style being *Ipamoea Batatas,* and thereby learn incidentally that some natives of Africa are as ignorant Df the original incidence of the name potato as the average English allotment holder. But this misunderstanding is not widespread in East Africa for neighbours of the peoples mentioned so close as the Wa-rua and the Wa-kuasu respectively know *D. alata* as "kilungu" and "kilunga," while in Usambara the plant is termed "kilunga mazi." The recurrence in this region of a namB essentially identical with the general term for edible yams throughout southern India and northern Ceylon suggests the possibility that the word may have accompanied yams brought tD Zanzibar by or rai behalf of the trading banyans from India who settled in the islands towards the close of the eighteenth century. Dr. Stuhlmann also mentions |1DC. cit., p. 242) the existence in Zanzibar of the term "pome" in the expression "pomayakwichi" applied to a yam which he identifies as *D. alata,* and adds that one race of *D. alata* was found by Warburg grown as "viazi ya shambalani." But it seems clear that the establishment of *D. alata* in East Africa has been too difficult to admit of any suggestion that this species was ever carried westward overland to the Atlantic sea board, and appears equally clear that its introduction to any part of West Africa must have been round the Cape and was most probably effected by the Portuguese.

The Portuguese deserve much credit for their courage and energy as explorers. Dn the west coast Df Africa they reached Bojador by A.D. 1434, Dape Verde in 1455, the Bight of Benin in 1471, the mouth of the Congo in 1484 and the Dape of Good HopB in 1485. Establishing fortified posts as they advanced they had by 1482 developed mines on the Gold Coast, founded slave-trading stations near the mouths of the Dalabar and the Bonny rivers, and had planted colonies in the islands of the Bight. They must therefore have already become familiar with *D. rotundata* and *D. caymensis,* yams not less important as food-plants then than now. But the Portuguese were not good record-keepers and it is to the Spanish, Dutch and German authors that we are mainly indebted for what scanty knowledge we possess regarding the conditions under which the Portuguese travelled and in which they lived. In 1497 Vasco da Gama passed the Dape in February 1498 ; he reached Melindi in March, and with the help of an Indian pilot made a landing at Dalicut in August. Whether his crew made their first acquaintance with *D. alata* at Melindi or not, they could not fail to become acquainted with its tubers at Dalicut, and however slight their knowledge Df the yams of Guinea may havE been, they could hardly have failed to recognize their affinity with this new Indian tuber.

Linschoten, who is our most reliable guide as to the mode of life of Portuguese navigators during their early years in the Indian Seas, tells us what rations each man received on board during the voyage ; explains that during their sojourn in Goa the sailors, except for a few imported luxuries, lived like the native Indians on the produce of the country ; and adds that on the return voyage, while still within the Indian Ocean, their food was the same as that supplied at Goa but that, when beyond the Dape, where fresh provisions were available, they received rations like those issued on the outward voyage. Though the Portuguese have left no record of the fact, we may feel assured that, while in the Indian Ocean, Portuguese sailors used yams as Indian sailors did.

It should however be remembered that the first bulky edible tropical tuber with which the Portuguese became acquainted was not a *Dioscorea*. At or shortly before the commencement of our Era *Colocasia antiquorum* had reached Egypt : followers of the new faith founded in the seventh century carried its tubers along the southern shores of the Mediterranean and thence to the southern provinces of the Iberian peninsula where though climatic conditions did not enable it to flower, it throve readily if planted where water Was available' The Moors of Spain knew it under its Egyptian name "kolkas," written "alkolkaz" by the Spanish who drove out the Moors, the first syllable which they prefixed being the Arabic definite particle. But in southern Portugal it did not retain the same name as in Spain.

The absence of records, so characteristic of the Portuguese, makes it impossible to elucidate in full the history of the adoption of *Colocasia* in cultivation in southern Portugal. But the constant conflict with the Moors and with the Spanish occupied the available man-power of rural Portugal : Portuguese intercour with Africa led tu the introduction of many negro slaves who grew *Colocasia* near river-courses as food for the^T selves. From these slaves the Portuguese learned to speak of *Colocasia* tubers as "inhame," which still rema[1] the name used for a *Colocasia* tuber in Madeira, though in other regions, such as Brazil "inhame" is extended tD the tubers of any *Dioscorea* as well. The Spaniards carried the same word in the form "name" or "nyame" to the West Indies where, in Cuba for example, it is still used but is restricted to *Dioscorea* tubers. Among names picked up by Kaempfer at the beginning of the eighteenth century there is one designating *D. hispida* which suggests that the Spaniards carried the word "name" to the Philippines as well as to the Antilles. "Name" or "nyame" seems the linguistic equivalent of the Portuguese "inhame" : but the measure in which "inhame" was a word in the original speech of negro slaves imported to southern Portugal or a Portuguese d" such a word cannot be definitely stated. That the Portuguese form of the word has under gone considerable distortion by other peoples is evident from the variety of forms it has assumed. These forms are inani, ignane, miamu, lniamo, iniamia, igname, myame., injamc, nyame, name : in French imame, inhame, English jamme, yearn and yam. The majority of the forms include the letter "m-" the "h" is not always sounded.

A prolonged search in dictionaries and grammars of African languages shows that words resembling "inhame" are widespread in the Semi-Bantu languages of Guinea and have travelled as loan-words into the languages of Sudanic tribes which have forced themselves into Guinea. Of the words which have been found is written as "inhame"; but "enyame", the nearest, a Temne word, is of the same. The Temne live in the Colony of Sierra Leone and in French Gambia to the north; they are an agricultural people of considerable ability, but were unable to resist the more organized Mandingo tribes when they pressed on them from the east. The Mandingo, Jolof and V ai, speak Semi-Bantu languages classified as of the Mandingo group, first appeared among the tribes that speak Semi-Bantu languages of the Atlantic group (Temne being one), as traders carrying coast products such as salt inland, and inland products including gold coastward ; then they assumed the rôle of settlers and conquerors, enslaving the Temne and kindred tribes, but themselves n during slavery. In 1442, Portugese explorers captured certain Moors at the Rio de Oro and these Moors were ransomed by the substitution of negro slaves. In 1448, the Portuguese having advanced further south, assembled two hundred negro slaves at Arguin Bay. These they brought to Lisbon for sale : and we may assume that their nationals whether left at the trading post in Arguin Bay or at other trading stations so soon afterwards established on the Gambia and beyond, kept slaves in their households. The appetite for slaving grew with great rapidity until a Dutch observer somewhat vulgarly wrote—Portugal was full to belching with slaves. At the very outset of Portuguese trading the Arabic language of the Moors was the means of communication ; but beyond doubt Mandingo must have been substituted soon, and in time other languages would come into service. When the Portuguese bought food, as they undoubtedly did, the Mandingo would sell yams to them under their name "nyamba": but at the same time they were selling negro slaves, and the negro slaves, employed in the households in cooking, if Temne, would serve these yams to their masters as "enyame". And Temne slaves domiciled in Portugal would there call the only starchy tuber which was available, that of *Colocasia*, by the same term. It is suggested that the Portuguese took it from Temne and wrote it as "inhame"[1]. It occurs as "niame" in accounts of Columbus' first voyage across the Atlantic ; and it occurs again in the accounts of the voyages of Amerigo Vespucci and Pedro Alvarez Cabral. The Florentine Vespucci sailed in 1437 from Cadiz in a Spanish ship apparently with a locally recruited crew ; after touching at the Canaries the vessel reached what appears to have been the Surinam coast. The Portuguese Cabral who set out for the Cape, by mistake sailed too far west and, as a result discovered Brazil. Whatever the inhame of Vespucci may have been, the inhame of Cabral was Manihot.

Perhaps in possession of knowledge that words such as " enyame " denoted the tubers of several plants, though the "inhame" of th& early Negro slaves in Portugal was *Colocasia,* the. extension ?)f the latter name by Dubral so as to include *Manilwt* did not strike sixteenth century European scholars as unnatural. Indeed in 15 B7 the younger Scaliger *Exot. e:rercliat. lib. xv,* p. 246) employed the name "inhame" as raio including all tropical tubers like those of *Ijiomoea Batatas,* of *Xanthorrhiza, oi Pachyrrhizus* and of *Dioscorea* mentioned by earlier authors. Scaligir evidently believed that this was the usage in the island of San Thome though we know from other sources that the "igname of San Thome " was a particular *Diosrorta.* In 1580 Dalechnmps *{Hint. omn. Plant, peregrin.,* lib. xviii. p. 1007) repeated and endorsed the statement madr by Scaliger. But authorities like OviedD, Garcia da Orta, Piso and Marcgruf, who had spent some time in the tropics, wire more exactly informed and displayed a tendency torestrictthe term " igname ", " inhame " Dr " name" to a particular plant. Dviedo was the Spanish hidalgo appointed in 1514 to the po.st of Director Df the Gold and Silver minis in Hispaniola, at first exploited by the use of forced West Indian labour, but from 1502 onwards worked by means of imported Negro slaves WIID revolted in 1522. In 1535 Dvicdo gave an account (Hist. gen. y nat. delas Indias) Df the economic plants of the New World and there explained (oil. of 1S55, lib. 7, cap. 1!), p. 25fi) that " name " was a tuberous root brought to Hispaniola with the Negro slaves, which was Df such value tD them as a food that the fugitives subsisted on it. Garcia da Drta was a physician who was born about 1400 at Elvas in Portugal near the Spanish frontier, was educated in Sjiain, and left Portugal on 12 March, 1534, as a member of the staff of Martin AffonsD de SDUSEI with whom he landed at Goa in September of that year. He practised his profession at Goa till he died about 1570. In 1533 he published at Goa his famous *Coloquios,* the third European book to be printed in India and, perhaps on this account, full of typographical errors, as well as being from the outset very difficult to obtain. Clusius, while family tutor tD the Fuggers of Augsburg, had charge of the sons during their Iberian tour, and apparently was able to secure a copy and prepare a Latin version Df Garcia's work, for the, publication of which he was able to arrange on his return to Antwerp in August 1533. This Latin version, which wasissuedin 15D7, andreprinted in 1574 and in 15!)3, and was translated into Italian by Briganti in 1582 and into French by Colin in 1 BID, is usually relied on as the source of the facts learned and the opinions formed by Garcia. But this version, though as valuable as anything Clusius over published, is not a translation Df Garcia's work : it is a resume or epitome rather than a translation, it might in parts not unjustly be described as a paraphrase of what Garcia wrote. The only reference in the original to any *Dioscorea* is an incidental one in the eighteenth colloquy, where Drta represents himself as discussing with his friind RuanD the subject of Tincal and passing from this to the subject of Turmeric. While SD engaged their discourse is interrupted by Drta's servant with the announcement that "the Durcas have come from Cochin " and the question as to how her master desired these to be dished. Not unnaturally Euano enquires " What sort of things are these Curcas Df Malabar?" Garcia thereupon explains that they are white earth-tubers which in Malabar are termed " chiviqivilenghas," a word which means small yams : adding that he himself had met with them both in Surat and in Dambay, and that Cojc Cofar, an Italian renegade of his acquaintance, had assured him that they arc common in Cairo where they are known as Curcas. But as these tubers are not medicinal he will say nothing more, about them but will return to the question Df Turmeric. Clusius in his epitome of Garcia's work |p. 239 of ed. of 1557 ; p. 215 of ed. of 1574 : p. 2)15 of ed. Df 1593) gives the Malabar name " chiuiquilenga," not " chiviquilenghas," and says the Latin equivalent is exiguum inhame. Whether Clusius had reason to suppose that the compositor had erred in using the letter " v "in the Malabar name there is nothing to show : it is however, quite evident that the compositor did blunder, The letter in Garcia's manuscript must have been " r ," and not " v ; " f Dr " cheru kelongu " |little tuber) is the expression which fits exactly the, race Df *D. escuhnta* known in northern India as the " susni " Dr " sutni alu," which Roxburgh differentiated from the " mou alu " or " mu kelengu " as aspecies—*D. fasciculata.*

Even more interesting than the Malabar name for the tubers which the Portuguese in India knew as Curcas is the evidence than an Italian who had turned Muhammadan and was familiar with Cairo should have, regarded these tubers as identical with the " kolkas " of Egypt, the " alkolkaz " af Spain. That the term " Curcas " and " kolkas " are linguistically as identical as are the Portuguese " praza " and the Spanish " plaza " is evident. This fact lends support to the suggestion that the term "inhame " which the Portuguese applied to more than Dnc esculent root was introduced to Portugal by NegrD slaves and applied by them to the, tubers of *Colocasia.*

The Dutch, as subjects of the Emperor Charles V, who was born at Ghent in 1500, became King Df Spain and was elected Emperor in 151D, took an active part in the slave trade. They long enjoyed a contract which pledged them to supply 4,800 Negroes every year to Spanish America and permitted thi-m tD offer any surplus for sale in Virginia. In 1593 ships detailed to embark at Lisbon slaves brought to the Tagus from the coast of Guinea had to anchor off Walcheren. Two citizens of Middleburg obtained from the vessels samples of the tubers stored as food for the slaves during their transit to the new AVorld. Two of these tubers were sent

to Dlusius, then Professor of Botany at Leiden and Keeper of the Botanic Garden recently established there. Ulusius could not growth i\si' tubers : he didnothave a grt'Dn-house till four y pars latpr : but he was able to describe and figure them |Rar. Plant. Hist., 1B01, lib. iv., p. lxxix). One of the tubers had sprouted, the figur^ shows that the stem was angled and proves that it was *D. alata.* Though, when Dvic do wrote in 1535, the tubers embarked to feed the Negro captives who survived the Middh; Passage may have bEen only those yams indigenous to Guinea, it is clear that by 150R, tubers of *D. alata* were in use on the more northerly Atlantic route, the source of the food-supply being the island of San Thom6, since Dlusius, like the younger Scaliger, called his tuberthe " igname de San Thomé."

Linschoten's eastern voyage was, like the, Dutch slave-trade, a result of the connection of the Netherlands with Spain. As a native of Haarlem, anxious to see the world, he had access to the court at Madrid where, Spain having annexed Portugalin 1581, he was granted permission to visit Goa. He sailed from Lisbon in 15B3 and on reaching India lived mainly at Goa but partly at Cochin for five years. Delays due to war prevented his reaching home till 151)2 when, with the assistance of Bernard Paludanus, he set to work on an account of his travels. This appeared in Dutch, in 159G, Latin and German translations were issued in 1303, followed by a French translation in 1 BIO. From the last mentioned (Hist, de la Navigation de Jean Hugues de Linscot) we learn |p. 148) that yams were eaten in India and |p. 253, where they are termed iniamos), learn further that they were an important food of the Negroes of the Gabun ; also that they served as the food issued by the Portuguese to the slaves they kidnapped on the coast of Guinea.

Paludanus had himself travelled in Muhammadan countries though not in regions where yams can be grown. Yet even he was able to add to the knowledge of *D. alata :* he appears to have seen the tubers examined by Dlusius in 15DB, for he tolls us that they had " the flesh white and the surface mouse-coloured."

Whim the Dutch were satisfied that they had deprived the Portuguese of their maritime supremacy in the Indian Dcean, the Netherlands East India Company made it a settled policy to ascertain and to publish whatever CDiild be learned concerning the economic products of the regions it exploited or occupied. Thus in 1327 Jan PietersZDDn Coen took with him to Batavia as physician on his staff Jakob de Bondt |Bontius), a achDlar eager tD prepare a compendious treatise on tropical medicine. DD Bondt died in 1331 leaving his manuscript unfinished. In 1352 Georg Everhardt Rumpf, a native of Hanover, sailed for the Dutch East Indies and in 1B53 settled in Amboina where his life was devoted tD the preparation of his *Htrbarium Amboinense.* Rheede tot den Drakenstein, who entered the Dutch service in 1B57 and became Governor of Ceylon in 1BB7, organized in his provinces the preparation Df the *Horlus Malabaricus.* Johann Moritz of Nassau-Siegen, when appointed Governor of the Dutch Settlements in Brazil, took with him Dn his staff two physicians, Willem PiSD and Georir Marcgraf, whose separate writings were published together as a *Historia Naturalis Brazilian* in 1548 By that date Marcgraf had died, but Piso, to whom the unfinished manuscript left by de Bondt had been bequeathed, published in 1B58, as *De, Indiae utriusque re naturali,* an abridgement of the earlier work on Brazil accompanied by what de Bondt had written regarding Malaysia. The value of these great undertakings lies in the wide range of the tropical zone with which they deal.

De Bondt, alone of these various naturalists, fails to mention *Diuscorea alata,* a, circumstance fully accounted for by the fact that *D. alata* was of no great importance in Java when de Bondt served there. *Colocasia* was thtn of more consequence than *D. alata* in western Malaysia and de Bondt's attention was confined to the mer crop. What PisD and Marcgraf have to say is, however, of exceptional interest. Piso's account of *D. alata* *Hist. Nut. Bras.,* pars. 1, p. 93) and Marcgraf's account |1DC. cit., pars. 2, p. 29) are illustrated by amewoodcutwhichissDmewhatdefectivebecause the engraver has substituted lines of hairs for the wings f th t«' But that the figure represents *D. alata* is none the less beyond dispute. Both authors term the It" Df the Brazilians " and "inhamc of San Thome: " the name " cara " does not call for discus- ^ thewDrdisaTupi one which connotes any *Dioscorea* that produces tubers andis applied to some Amaryl. lids with bulbous bases as well. The name "inhame of San Thome " we have seen, was regarded by the Scaliger in 15B7 as one connoting any tropical edible tuber ; as employed both by PisD and Marcgraf years later it is restricted to *D. alata* and seems to suggest some intimate connection between ics and that West African island. In the work of 1358 dealing with both Indies, Piso used the us spi- i 1SBg *i*Ost·und *West-Ivdisch Lust- u. Stats-Garims)* borrowed Piso and Marcgraf's same plate, jfrancifan in iu \ o figure, but made it still more inaccurate by scattering further the hairs that represent the wings.

Though Rhecde's assistants described and figured a spontaneous form of *D. alata* *Hort. Malabar.,* 7, t, 38) d'd not deal with any of its cultivated races or mention the name "inhame." Rumpf, who owned a of PUD'S work, arrived *Hvb. Amboin.,* 5, p. 355) at the singular conclusion that the "inhame of San

Thome " was his own *Vbium porniferum* which is clearly *D. bulbifera,* but failed to observe that his own `*Ubium vulgare,* which equally clearly is *D. alata,* had already reached both coasts Df the Atlantic. He knew that roots bearing the name " inhame," which name, like Scaliger and Dalechamps, he believed to be common to all edible roots, were used as food |1DC. cit., p. 315) in the West Indies, and added that *Ubium vulgare* tubers were used in the same way. But hB does not appear to have realized that *Ubium vulgare* was already one Df the food-plants SD named and so used in Brazil. Jan Burman, who edited the *Herbarium Amboinense,* did realize both facts, as we know from an observation made by him |op. cit., p. 349) : but that observation cannot have been written until after 17315, the year in which Burman received sanction to edit Rumpf's manuscript.

The conclusion to which this literary survey leads is that the Portuguese carried *D. alata* on their vessels from the Indian Dccan to the, Atlantic, and that they established its cultivation in West Africa, more especially in the, island of San Thome which had been chosen by them for intensive colonization. To this island, as Linschoten informs us, they introduced such Indian crops as ginger and sugarcane as well as " other necessities of life." Among these necessities they included yams : indeed, as we learn from Dalechamps *Hist. omn. Plant, peregrin,* lib. xviii, p. 1D97), before 1585 instructions as tD planting yams were included in Portuguese sailing directions.

The object of raising tropical products in San Thome was partly their shipment to Portugal, partly their use in revictualling Portuguese vessels. For the latter purpose one of the products required was a yam that possessed good keeping qualities. Experience showed that the tubers Df *D. alata* were those that keep best when stored; the needs of the sea-faring community therefore dictated the cultivation Df *D. alata.* That its tubers are better "keepers " than those Df either *D. ratundata or D. cayenensis* is known to modern growers of yams . Speaking of *D. alata* Mr. R. D. Williams tells us *Bull. Dep. Agric. Trinidad and Tobago,* 2D, 192B, p. 4) that all races under cultivation in those islands keep well if stored under proper conditions, and yams reaped in January and February will keep for twelve months with a IDSS Df weight. But this the Portuguese evidently found out for themselves early in the sixteenth century.

So long as the island of San Thome was the only source of this desirable yam Dn the Atlantic coast the nime " inhame of S. Thome " was appropriate and intelligible, but when it began tD be grown and became readily available west of the Atlantic this local name gradually fell into disuse among those who cultivated the plant. We still find it employed by authors who deal with Brazilian plants, but that it is now a name of the study and the library rather than Df the farm and the garden is evident from its application. Thus Peckolt *[Hist, plant, med.* B *uteis Brazil.,* 1898, page 154) modifying the name into " cara de S. Thome ", identifies it with *D. bulbifsra* and adds that the Dutch had brought it from San Thome and that it had run wild but that its original home was the East Indies. In this case the author has failed tD distinguish between *D. alata* , the East Indian plant which reached Brazil *via* San Thome, and *D.-bulbifera* var. *anthropophagorum,* an African plant with which he was acquainted but which he, thought identical with *D. bulbifera* var. *sativa.* Granato *Bol. Agric. Sao Paulo,* ser. 15, page 7D5) adds tD the confusion by employing the name *D. aculeata* and treating this as the inhame of S. Thome. M. P. Correa *[Diet, plant, utzis Bras.,* 2, 1931, p. ID) definitely assigns this name to *D. bulbifera* so that " inhame de S. Thome " which crossed the Atlantic as the name Dfths most valuable of the species of *Diuscona* nDW lingers in vague association with a less important one. There is nD indication that thi3 name was ever used on the shores of the regions in which the various races of *D. alata* originated, and if *D. alata* ever was termed " inhamé de S. Thome " by those who grew it in that island it is not given that name in San Thome now. There, according tD A. F. Moller *Tropenpflanzer,* 3, 1899, page 387) it is known as " inhame gudu ", a term which doe3 not appear to have ever crossed the Atlantic.

What the Portuguese knew regarding the keeping qualities of yams must have been learned by the younger Scaliger who mentions, in this connection, ".igname cicorero " which would keep for a year, and three others all of the them " impatient of time ". These were |a) the igname Df Benin, with an excellent flavour ; |&) the igname of Manicongo at the mouth Df the Gabun river, with a less agreeable flavour ; and |c) an inferior yellow-fleshedkind. The " igname cicorero " may have been *D. alata* ;that of Benin and that of ManicongD may perhaps have been forms Df *D. rotundata,* the yellow-fleshed kind being *Ipomoea Batatas.* But save as regards " igname cicerero ", there is no definite evidence available and even in that case the meaning Df the term is obscure : at any rate it does not seem to have persisted. In connection with this feature a remark by Tussac *[Flare dss Antilles,* 4, 1927, page 82), made a quarter of a millenium after Scaliger wrote, is worthy Df repetition. " It was in Nantes ", says Tussac, " that I first tasted a yam. The captain Df the ship had obtained it in Africa, carried it ta San Domingo and brought it back to France : so that possibly it had been a year out Df the ground. It was still sound, of a pleasant taste of chestnuts, and more floury for the keeping than such yams are when freshly dug ".

That tubers of *D. alata* must have repeatedly crossed the Atlantic as ships' stores in both directions is certain. Clusius, who is our authority for the fact that tubers from San Thome were on board the slave ships that in 158> visited Walcheren on their way to Lisbon, is also our authority *{E.rotioarvm libri dr.cem,* 2, pages 237) for the fact that by 1151)5 yams like those he examined nearly twenty years earlier were now grown and eaten in the West Indies. An obvious proof of this is the existence in the West Indies of the name Lisbon Yam ; though it is not easy to decide whether this name was given to *D. alata,* because its tubers reached the West Indies in the first instance *via* Lisbon, or was given because its tubers were raised in the West Indies for despatch to Lisbon where the great slave mart existed, in order to serve as stores for the slavs ships that were to bring over a new supply of Negroes. Other West Indian names that must have originated in the Old World are " Half-a-yam" and " Pooka ". These names are corruptions uf two Twi (Gold Coast) words, Afa-sew and Apuka, which denote races of *D. alata.* Moreover the term Connie yam is derived from the Twi word " kani".

In the 17.17—39 edition of his Gardener's Dictionary Philip Miller records growing *D. alata*. This plant died, but in the 17B8 edition he points out there was no difficulty in securing it again as it was often brought in ships. But the first plant of *D. alata* in cultivation in Europe was one sent by Rheede in 1B8B to the Medical Garden at Amsterdam. It was still there when Ray was completing his *Historia plantarum* in 17D4 : Ray states (op. cit., 3, page 134) that it throve there under the care of Dommelin. There is an unrealized leaf, dated 17D9 in the Herbarium of the Duchess of Beaufort which probably did not come from a plant in her own collection but may well have been sent to her by Commelin. If Dommelin's plant had been received from Malabar it should have belonged to the spontaneous bulbilliferous form depicted in the *Hortus Malabaricus,* but as it is said to have been sent from Ceylon as a curiosity it probably belonged to one of the cultivated race's, examples of many of which must, unrecorded, have from time to time, from the close of the fifteenth century onwards, been brought by ship from yam ports in the Indian Ocean to sea-ports on the Atlantic coast.

While, as regards the important matters of growth and of outturn, the tubers of the two African yams, *D. rotundata* and *D. cayenensis* are fairly comparable with those of the Asiatic *D. alata,* as articles of diet, the African Negroes pound the tubers of their indigenous species into a pulp suitable for cooking as porridge but eat *D. alata* boiled as it does not lend itself so readily to being pounded. In the East *D. alata* is sometimes "pounded and made into cakes ; more often it is boiled or made into curry. This difference is associated with the keeping quality and the maturing capacity of *D. alata:* its keeping quality explains its selection as suitable for ships' stores but it DWBS that quality to the fact that, when dug, it is not ready to make new growth, and to the circumstance that while in store it matures slowly, becoming more mealy in the process. It is owing to this peculiarity that connoiseurs among yam-eaters sometimes recommended that the tubers of *D. alata* be kept for a time before they are used.

A study of the actual specimens which Linnaeus was able to examine before he differentiated the species defined by him *{Flora Zr.ylan.,* no. 3BD) in 1747 as *Dioscurea foliis cordvtis cauh ala'to bulbifero* shows that this was *D. alata*. His own Herbarium contains another example of the species which probably reached him from Dsbeck in 1752, and may, as a letter of that year from Dsbeck to Linnaeus suggests, have come from St. Helena. But in the original edition of the *Speries Plantarum* of 1753, where Linnaeus first used the trivial epithet " alata" to designate this species, he referred Francisci's figure and description of the " cara of S. Thome " ... *D. alata* to the species he designated *D. aculeata.* It is certainly true that Francisci's figure is a very indifferent one but it is, after all, borrowed from the figure given by Piso in 1B48 which Linnaeus identified correctly in 1747 and by implication included in *D. alata* in 1752. In 1754, when dealing with the forms figured in the *Herbarium Amboinmse oi* Rumpf, Linnaeus referred the first four forms to *D. alata,* there dealt with, to the species which in 1753 he had designated *D. oppositifolia* and placed the sixth of the forms described by Rumpf in the species which in 1753 he had designated *D. bulbifera.* The critical botanist notes, however that the treatment accorded by Linnaeus to the three species recognized by him in 1753 with simply ... leaves that are cordate at the base and are furnished with axillary bulbils there is no indication as to whether the leaves be alternate or opposite and it may be that in 1754 this character seemed to him of more consequence than it did a year earlier. Loureiro, Buchanan and Roxburgh, all three being observers with a wide field experience of cultivated yams, showed a tendency to treat as distinct species some of the recognizable forms of *D. alata* that we prefer to regard as merely distinct races : of these authors, Roxburgh went furthest, far he distinguished as species *D. alata, D. atropurpurea, D. ghbosa, D. purpurea* and *D. rubella,* relying mainly on the shape and the colour of the tubers and to a less extent on the character of the angles and wings of the stem and the outline of the leaf. But we would caution the Academic Student against the temptation to exclude that Roxburgh's attitude was due either to limited experience or to immature judgment. Those who remember the remark of Huxley that what, in Academic circles is still far too often disparagingly termed " Applied Science", is only Pure Science applied to particular purposes, and who will take the trouble to read what Roxburgh has said *{Flora 1ml,* oil. 2, 3, page 801), will appreciate that in laying stress on " the shape and

colour Df the root " and in deciding to disregard " the Linn can rule which forbids placing confidence in colour " "he was less concerned, to " gratify the Botanist " than to assist " those who are not Botanists ". He frankly admits that the Botanist WIID feels it essential to abide by the Linn can rules as to colour must consider the majority of the species recognized by him as " varieties of the same species ", and if this be found a mare convenient PDurse than that adopted by himself, this course has his "hearty consent". Perhaps, had it been su^f ested while he lived, Roxburgh might have approved the treatment Df the forms in question as races rather than as " varieties ".

Lastly, it seems a duty *to* those who follow us that we should mention that Tussac's figure of *D. alata* does not, as it should, represent a West Indian race, but was borrowed from Rumpf, and that Correa has borrowed a figure Df a race grown in Florida to illustrate his account Df the species in Brazil.

The amount of material which we have seen is so great, that to quote specimens as we have done for other Dios D ore as would be tedious without being correspondingly useful : we propose therefore to give an account of the way in which the plant occurs in our sub-subregions, seriatim, with sparing references to collectors. In the course Df doing this, we shall have an opportunity of suggesting how Malaysia has sent out ennobled races, and of indicating the types which are grown where conditions for cultivation are less ideal.

INDIA. **4 a. Malabaria.** The cultivation of *D. alata* begins at Nadiah, lat. 23^{D} N., in the K a i r a district, and increases in importance southwards in the tract between the Western Ghats and the Indian Dcean. The race grown furthest north is one with white, rather firm and somewhat coarse flesh which turns rusty red when cut by the oxidation of a chromogen. When it is necessary to distinguish it from other forms this race is termed " bhusara " : it may be regarded as a rather hardy but somewhat inferior race suited to the climats and conditions where it is grown, these being hardly ideal for the species. The considerable demand for yams in Bombay City is provided for by garden-cultivation, with irrigation, in the T h a n a district, the tubers being planted at the base of posts, up which the stems are trained to a height of about 5 metres, the plants affording sufficient shade to keep the soil moist till the next application of water. In addition to"bhusara" a second race known as "talabadi", also with white flesh, is grown, as well as a third which is termed " kamodia" because the flesh, when cooked, has the mouse-like odour of " kainod " rice, so much esteemed by the natives of India. The tubers weigh approximately 8 lbs. (3 - B kilos) each. An account Df the method of cultivation is given by Mollison *[Text-booh of Indian Agriculture,* 3, 1901, p. 199).

From Bombay southwards, the Ghats are nearer the coast; the area under rice is more limited and yams become more important. Additional races of *D. alata* are now met with and one with fasciated tubers is known, near Goa, as " chaina " : this name is met with elsewhere without being strictly applied to so flat a tuber. Yams Df the " bottle-necked " and " seal-topped " types (plate 125, figs. 9, 24 and 25) are met with from Goa southwards to southern Ceylon and multilobulats forms appear. This greater diversity in form suggests that in these more southerly and moister districts *D. alata* is more at home than in the drier districts further north, though there is Dne indication that the forms with flattened tubers may have been introduced, perhaps from Malaysia, rather than have originated in Malabaria : one of these forms is known in Ceylon as " rata kondol", i.e., foreign yam. A more convincing indication that the climatic condition in south-western India is congenial to *D. alata* is the fact that the species there runs wild. It is stated in the *Hortus Malabaricus* that the abundant axillary bulbils of these spontaneous plants were used to fatten pigs and as Rhccde does not cite any localities he must have regarded the occurrence as general. But as many of Rheede's specimens came from near Calicut and Cochin and as specimens collected by Bourdillon prove that *D. alata* occurs in Travancore in an uncultivated state we can regard Rhec-de's assertion as accurate. But the statement by Graham *[Cat plants Bombay,* 1B39, p. 218) that *D. alata* is wild in the Concan, has not been confirmed and is regarded by Cooke *[Flora Bombay Presidency, 2,* 1907, p. 759) as probably erroneous. It may bo that Graham believed that, since Rheedc had

indicated that it occurs spontaneously in Malabar, it must do so in the Cancan as well* Dne rather precocious race in Ceylon is known there as " bindhar alia", i.e., September yam : other races everywhere reach maturity in November.

The evidence that, prior to the entrance of European sailors into the Indian Ocean, direct intercourse had been established between at least one sea-port on the Zanzibar littoral and at least one sea-port on the Malabar coast, also that Indian sailors were accustomed to this sea route, suggests that races of *D. alata* familiar to Malabar would naturally be among those to reach East Africa earliest. The use in East Africa of a form of the Malabar term for a yam strengthens this belief. But *D. alata* may, as has been shown, have been imported earlier still to East Africa by vessels calling at Arab settlements in Madagascar, in which case the races may have been of Malaysian origin established in that island by earlier settlers from Malaysia. On the other hand, since Malaysian navigators would sail direct to Madagascar from the Malay Archipelago, there was nothing to prevent Arab navigators from sailing direct from East Africa to the Malay Archipelago and bringing Malaysian races of *D. alata* back with them as ships' stores. The much later settlement of permanent Indian petty traders in the island of Zanzibar may haveledtothe introduction of races of *D. alata* cultivated elsewhere—anywhere on the west coast of India from Bombay southwards. But no one has yet undertaken a comparative study of the races of *D. alata* grown in East Africa sufficiently careful to warrant the expression of a definite opinion as to the provenance of particular races.

If it be certain that *D. alata* did not find its way overland from East to West Africa, it is equally certain that its presence in the islands in the Bight of Benin and on the shores of the Gulf of Guinea is one of the results of Portuguese enterprise, though in this case it would be premature to hazard a suggestion as to whether the earliest introduction consisted Df races from Goa, or further south on the west coast of India, from Ceylon, or even from Malaysia.

4 b. CommandBlia. In this sub-subregion the cultivation of *D. alata* is general but the crop ia of less importance than it is in Malabaria, because in many districts it can only be grown with the aid of irrigation. The seasons observable resemble those in western India except in the most northerly districts where both planting and harvest may be a month earlier, or where it is found desirable to plant as late as July and harvest the crop in the month of March following. Jaffna in northern Ceylon, a district which falls within the sub-subregion, enjoys the reputation of producing good yarns: one—a race called " rasa valli kelengu " or " japana alia " is esteemed for puddings (see Molegode, *Handb. Veg. Cult.*, Ceylon, 191B, p. B8): one of the races grown has the mouse-like "kamodia " odour; it developes low prickles at the base of the stem: another race, known as " athi kavali" (plats 125, fig. 7) shows this latter feature. Races with flat yams occur, and there are several forms in which the stem at the very base has more than four ridges.

4 c. Deccan. Large tracts in this sub-subregion are too dry to admit Df the cultivation of yams with the amount of irrigation water available : no race of *D. alata* has been met with either in the Dominions of the Nizam or in the State of Mysore, But in the districts of K u r n o o l and C u d d a p a h, in the part of the Presidency of Madras which is above the Eastern Ghats, a few racss are grown; indeed the taluks of Gandikola and Jammalmadugu enjoy a local reputation on account of their yams. In parts of the Bombay Presidency above the Western Ghats, yams are sometimes grown near the larger towns ; near Poona especially, where the local demand is sufficiently great to render the labour entailed in producing them worth while to the growers, three or four races are cultivated in gardens and in the corners of fields along with turmeric.

4 d. Hindustan. The demands Df the numerous considerable cities in this sub-subregion involve the raising Df quantities of yams as far to the west as Multan where the average annual rainfall is under seven inches (180 mm.) and precipitation is sufficient to meet the needs *of D. alata* in only two months Df the yam-season, during the remainder of which irrigation ia required. At Multan apparently the only race grown, with rather indifferent results, is one with moderately short straight tubers. At Amritsar conditions are slightly more favourable though irrigation is essential during the early half Df the yam-season. At Delhi, Agra, Muttra and Aligarh the conditions are similar tD those at Amritsar, but at Delhi in particular the demand for yams to be used chiefly to stuff the cakes known as "samosa", is SD great that considerable quantities of two or possibly of three races are raised. At Saharanpur, which benefits by the hot-weather Himalayan thunderstorms, two or three races are raised with the help of irrigation. The considerable demand for yama at Lucknow is mainly met by supplies from the H a r d D i district where the villagers of Bilgram, Mallanwan and Sandluh, who specialize in yam-raising, cultivate five races Df *D. alata.* Yams are rather sparingly raised in all the districts of the Upper Rangetic plain eastward as far as Benares, in or near which city the *Susruta Samhita* was written somewhere about BCD A.D. (for this date see Reinhold F. G. Mueller in *Journ. Roy As. Sac,* 1932, p. 789). In this work mention is made Df four yama, "hastyaluka," "kastaluka," "raktaluka " and " sankaluka," all of them presumedly races of *D. alata, \Burkill in Gard. Bull. Straits Settlements,* 3, 1924, p. 143). The first of these races was 'large,' the second was 'hard', the third was ' red '; and it is not impossible that all of them are still tD be found in gardens in the Gangetic plain. At present the most common race in the Plain is that known as "kham alu," i.e., post yam : next in importance ia a race with subglobose tubers. Whether the curious curved tuber figured by Duthie and Fuller *[Field Drops of the North-west Provinces,* 1893, plate 8D) be normal and the curvature which they illustrate, be characteristic Df a rare race which we have never seen or whether it be abnormal and the curvature only the result Df growth in a confined space, we do not know : we desire to call attention to it in Drder that those who have the opportunity should seek to ascertain if there be a race with curved tubers in the sub-subregion which we recognize as Hindustan.

4 e. Sub-subregion of rain from the Bay of Bengal. In this sub-subregion *D. alata* is cultivated except Dn the waterlogged brackish soil of the Sundribans, in the south-east and in the western districts Df the Central Provinces, towards Central India and Bombay, where deficient rainfall renders climatic conditions toD dry tD be suitable. The amount of cultivation increases progressively eastward in response to the increased precipitation, more especially in areas with sandy soil. The wide sandy sill under the Himalaya in Northern Bengal affords tracts particularly suitable ; of this area the district of P u r n e a is typical and its reputation as a yam-growing district is still what it was when Buchanan surveyed it more than a century ago. It is from villages some distance away in the direction of the Himalaya that the city of Patna derives its supplies of yams. But the sandy soil of the Damodar valley in the districts o f B a n k u r a and B a r d w a n, the sandy soils of the M u r s h e d a b a d district, and the similar soils of Drissa and the Dircars are all regarded as favourable for yam-cultivation. The most prevalent race in Lower Bengal ia the "kham alu " (post yam) which extends from the neighbourhood of Calcutta far up the Granges valley: about Calcutta, though much less frequently as we pass up the Granges valley, the "kham alu " is accompanied by the race with globose tubers known as the " chubri alu " or " chupri alu " (plate 125. fig. 17), which is considered particularly good tD eat: along with these occur two others, both with magenta colouring matter in the sap and one of them a yam with tubers of the "seal-top " type with shoots rising around the base of the stem ; this last is ths "rakta garaniya alu" distinguished by Roxburgh as *D. atropurpurea* and suggested by

him as being Df Malaysian type. The distribution in India of yams Df the "seal-top" type —they are all found near DDasts that are and have been in maritime intercourse with Malaysia,—suggests that they may have come from Malaysia. When Drissa is reached we find in gardens yet other types ; notably same with multiple tubers, bearing names like "sat bhaya alu " (seven brothers yam)," panch mukhi alu " (five snouted yam), "sahasra mukhi alu " (thousand snouted yam). These races extend southwards into the Circars where according *to* Elliot *Flora Andhrica,* 1859, p. 43) red races are commoner than white. In this same part of India a conspicuously fingered race is met with. Turning eastwards from Drissa in the level districts tD the east of Calcutta there occurs a race termed "binna jhar alu " Dr several tubers yam, which shares the character of having several tubers with "sat bhaya alu " and the other similar races mentioned already. Then in East Bengal races with flattened tubers and peculiar names becomes frequent and extend along the valleys of the Brahmaputra and the Surma. Some Df the Assam races have very long tubers as figured in the *Gardens'" Bulletin of the Straits Settlements* (I, 1917, opposite p. 378) and in that province races with multiple tubers are not uncommon. Both in the Brahmaputra and in the Surma valleys immediately under the hills, *D. alata* is sometimes tD be met with in a spontaneous condition.

HIMALAYA. **5 b. North-western Himalaya.** The most westerly district in which *D. alata* occurs appears to be K a n g r a where the narrow valleys afford adequate moisture and shelter up tD about 1,DDD meters above sea-level (long. 73° 2D' E. : kt. 32° ID' N.) Dnly DUB race is grown. There is nD record of *D. alata hum* the S i m 1 a H i 11-s t a t e s, but somewhat further east towards Dehra Dun it is cultivated, and still further east, in the N a i n i T al district it is so much at home that at times it occurs spontaneously. **5 C. Nepal Himalaya.** *D. alata* is probably cultivated in the sheltered valleys of this central part of the Himalaya, becoming progressively more plentiful eastwards towards Sikkim. Near Khatmandu, at about l.DBD metres |3,5DD ft.) elevation, one of us in 1907 saw considerable quantities of a race with tubers devoid of magenta colouring matter, straight and shaped so like the "kham alu" of Bengal that it may be identified with that bwer level race. **5 d. Eastern Himalaya.** In Sikkim, as has already been indicated, the cultivation Df *D. alata* by the Lepcha mountaineers is carried on up to l,85Dmetres |5,DD0ft.) but the plants at this elevation lack vigor and receive a distinctive name "lek ghar torul" (high level domestic yam). The Lepchas report that towards Sandakphu a race Df *D. alata* with very long deeply burying tubers which have a somewhat disagreeable odour when cooked, may be found at any elevation up to 2,775 metres (9,DDDft.) in a spontaneous state. This we have already explained may well be correct. Their name for this race, "piriychbok" or "pirieh bok," the Lepchas also give tD the spontaneous plants with similar tubers which occur at lower elevations near the sites of abandonrd homesteads and are supposed by them tD be relics of former cultivation ; these may be racially identical with the spontaneous plants that are found in virgin forest. But the Lepchas know intimately various other races, all of which they term "bok" and it is of interest to note that while most Df these are races of *D. alata* they regard *D. Hamiltonii* as a "bok." One of the Lepcha races, referred to already as "pern bok" (round yam), was grown experimentally at Singapore, where it was kept alive for three years but became weaker year by year as if unable to endure a climate SD unlike that of its native region. This suggests that though the tuber Df "pern bok" is indistinguishable from that Df the "chupri alu," and the two names are identical in meaning, the "pern bok" Df Sikkim may be racially distinct from the Bengal race which Koxburgh named *D. globosa.* On the other hand, it may be that the Lepchas apply the name "pern bok" tD more races than Dne. Dne race of *D. alata,* which the Lspchas term "bok dung" but which their neighbours, Nepalese immigrants into Sikkim,

term " kanasi torul," is flat-topped like the " rakta garaniya alu " of Bengal (the *D. atropurpurea* of Roxburgh) and has small upward-growing lobes. Bengal in the Gangetic Plain and Sikkim in the Himalayan Range appear to be the most western limit of th^ forms with flat-topped tubers. It has further to be remarked that, in some Df the Sikkim races of *D. alata,* the stem, though distinctly quadrangular, is certainly not four-winged. The Abors at the eastern end of the Himalayan Range, though they grow *D. alata,* appear to possess only one race (Burkill in *Rec. Bot. Survey India,* ID, 1925, p. 389). The name they use for it is an Assamese loan-word, which may imply recent acquisition of the plant. It has, however, tD be borne in mind that as yet little is known regarding the plants cultivated by this tribe and still less is known regarding the plant? grown by their neighbours. It would be strange, were it really the case, if the Lepchas in Sikkim should possess so many more races of *D. alata,* than the tribes further east.

JAPAN. 5 **j. Liu-hill islands.** In the Limschoten group of this elongated Archipelago, *D. alata* reaches its northern limit |lat. 30° N.). The explanation, it has already been suggested, is afforded by the existence of the Huro-Shiwo sea-current.

CATHAY. **7 d. Mid-China.** Amoy |lat. 24[3] N.) in the province of F u - k i e n appears to be the place furthest north on the coast of China where *D. alata* is cultivated.

Debeaux when he recorded it as at Dhe-fu in lat. 37° N. *Floruh dz Tche-fov,* in Acta Soc. Linn. Bordeaux), had mistaken *D. opposita.*

SOUTH-WESTERN CHINA. **B a. Province of Sze-chuan.** The only specimen of *D. alata* hitherto reported from Sze-chuan |F. T. Wang no. 23321) was obtained in the end of August in the Ma-pien hsien, under the name "shin-chu-pao." Hosie *Rep. on Prov. Ssu-chuan,* 19D4, p. 12) mentions two yams, neither of which bear this name and at least one of which may be *D. opposita.* Nothing is yet known as to the extent of cultivation of *D. alata* or if it occurs spontaneously in the sub-subregion. **B b. Province of Ylin-nan.** Reference has already been made to the specimens of *D. alata* as seen by us that come from this province |p. 312). They are from the Eastern flank Df the Ta-li range in lat. 25° 4D' N. with female flowers, *Forrest* 6885 ! and also from open places in scrub, as weakly scandent plants 3 — 9 ft. high, with female flowers, at altitudes between 9,ODD and ID,ÒDD ft., *Forrest* 72D2 ! from the Kin-tchong chan, with female flowers at 2,BOD m., *Maire* 217 ! and from an unrecorded locality, *Maire* 1147 ! All these specimens, like some Df those from Sikkim, have stems which are quadrangular rather than four-winged : all have leaves with angular auricles. In both these features they agree with the material of the "shih-chu-pao " collectedby Mr. Wang in Sze-chuan, which leads us to believe that they and it all tD belong to Dne race. The altitudes above the sea, at which this race is found in Yun-nan, are remarkable, but comparable as has been said with those of the " piriyeh bok " Df Sikkim, with which the race further agrees in occurring spontaneously.

EASTERN INDD-DHINA. **9 a. Formosa.** The cultivation of *D. alata* takes place in the southern parts of Formosa; the most northerly known locality being Banchoryo |lat. *22°* 45' N.) where it has been collected by Mori |5523 !). Suuki has claimed that it occurs wild in Formosa, and indicates two localities : but we do not know that it can maintain itself where he obtained it. **9 b. the Kwangs.** From Amoy in Fu-kien, already mentioned as the most northerly point reached by *I), alata* in China, the cultivation Df the species extends southwards all along the coast of Kwang-tung. Dsbeck, who visited Canton in 1751, mentions *A voyage to China,* English ed. of 1771, 1, p. 311) having seen *D. alata* in that port but not SD precisely as one would wish. Loureiro, who reached Danton in 1779 and stayed there for three years, refers to the species in his *Flora Cochinchinensis.* In 1836 Gaudichaud collected *D. alata* near the port Df Macao, and Dr. E. D. Merrill has informed us that he observed, in the markets of Canton, abundant supplies Df the clavate tubers of Dne race, raised CIDSB to the city. It seems

probable that the cultivation of *D. alata* in this sub-subregion is of long standing, in spite of the fact that there is no clear reference to its tubers by any early Chinese author : but they, as natives of northern China, were unlikely to be familiar with a product so distinctly southern. The only passage which may possibly refer to *D. alata,* with which we have met, is one in which T'ao Hung-king alludes to a very large and excellent yam obtainable, not in Kwang-tung *or* Kwang-si, but in the south of the adjacent province of Kiang-si, **9 C. Tonkin.** In this sub-subregion several races occur. Some of these grow spontaneously in hedges ; others are cultivated with care. An account of certain cultivated races is given by Eberhardt and Bbch *[Bull. Econ. Indoch.,* 12, 1910, p. 355) who treat them as species: Crevost and Lemarie *[Cat. Prod. Indoch.,* 1917, p. 120) add to the information at their command figures under vernacular Tonkinese names ; though it is not definitely indicated that the plants figured grow in Tonkin, these names suggest that they do. The figures convey the impression that the races which prevail there have elongated ellipsoid or ovoid tubers usually of moderate length, which descend into the soil and recall the yams of the Gangetic Plain. Our figures on plate 125, nos. 8, 15, 22 and 37 are reproductions of some given by Crevost and Lemarie. **9 d. Anam.** Regarding the yams of this sub-subregion our information is incomplete : what is known suggests that they resemble those Df Tonkin. Loureiro, who resided many years on the northern frontier of Anam, shows by his comments on the Dioscoreas enumerated in his *Flora Cochinchinmsis,* his intimate knowledge of the subject.

WESTERN INDD-CHINA. **ID a. Khasi-Naga Hills.** In this sub-subregion *D. alata* is especially plentiful. The Khasis have more then a dozen distinct races ; the GarDS have at least three, and two are known to be grown by the Nagas, who may have others. All the tribes living tD the south and east of those mentioned on the Burmese side of the watershed between the Brahmaputra and the Irrawaddy catchment areas, seem to possess some cultivated races, while throughout the hills in which they live the species is so freely spontaneous that in times Df scarcity the forest supplies of its tubers are freely exploited. The planting of tubers of the cultivated races takes place in April and May : the harvest occurs in January, February and March of the following year. The race which the Khasis term "phan suri " [wolf's yam) has tubers which go very deep and seem to beregarded as the most pleasant to eat. Tubers of this race, received from Cherrapunji in the Khasia Hills and from Lumding in the Nowgong district of Assam, proved of indifferent value for cultivation at Singapore. Some of the races from this sub-subregion grown at Calcutta had tubers with flesh that while raw irritated the mucous membrane of the mouth ; other races from the same area had not this quality ; indicating that the Khasis possess not only races that differ in the shape of the tubers but races very unequal as regards food-value. One of theirraces "phan tangkara" is a flatyam which ia perhaps identical with the "botharpatiya alu " of the Brahmaputra valley. **IDb. Northern Burma.** In this sub-subregion *D. alata* is not only cultivated in every district, but occurs so plentifully in a spontaneous condition as to be exploited for food : large holes throughout the forest bear witness to this activity. The planting of the races cultivated is here deferred until May, the crop being ripe for lifting in February and March of the following year. The race most commonly grown, known as " myouk pyu" (white yam) among the Burmese, is hardly distinguishable from the "kham alu" (pQst yam) Df Bengal. **ID C. Chlttagong-Arakan.** The district of Chittagong, though politically part of Bengal, is, as regards the part played by *D. alata* in the lives of the inhabitants, more like Burma than Bengal, and in Arakan the agreement with Burmese conditions is still more complete. The races grown, of which there are several, tend to be those with thin-skinned tubers like the " rakta garaniya alu " of Lower Bengal; though races with clavate tubers and

corky skin are not by any measure absent. **ID d. Dry Central Burma.** There is some cultivation of *D. data,* in all the districts Df the sub-subregion, though in the drier ones only with the aid of irrigation : but, not being available in quantity, the tubers rarely come to market. Dn the extinct volcano of Popa, the species occurs spontaneously, as it also does, rather abundantly, in the district of Thayetmyo. Dne of the races grown in the district of Kyaukse, resembles one of those grown in northern Ceylon in having low prickles Dn the stem. **ID e. Lower Burma.** The markets of the city of Rangoon attract considerable supplies Df tubers of *D. alata.* These belong mainly to two races, both with magenta-coloured tubers, one coloured throughout the flesh, the other Dnly under the surface. Both are of high quality ; in neither does the flesh turn rusty-brown when cut. Both appear to be generally distributed throughout this sub-subregion : of Dne the tuber is more evenly shaped than of the other, and has a firmer skin SD that it. has perhaps better keeping qualities. The other is indistinguishable from the " rakta garaniya alu " of Bengal. In addition to these two races there is a third'which immigrant Chinese cultivators are given to raising, the flesh Df whose tubers quickly turns red-brown when cut. Yet another race, known as " myouk nwa-gyD, " has curved tubers, usually three together and up tD 45 cm. long : this is the race known as the " Dx-liDrn yam " throughout much of IndD-China. **IDf. Shan Plateau.** Everywhere throughout this sub-subregion *D. alata* is commonly cultivated and occurs spontaneously as well: it occurs plentifully in the forests about Hsi-paw, male flowered plants being abundant but plants with female flowers difficult to find. In the Shan Hills more than a dozen races are grown. The race which the Shans term " man kliDW-WD " JDX-horn yam) is identical with the " myouk nwa-gyo " of Lower Burma both as regards the configuration of the tubers and the connotation of the name. Another Shan Hill race is indistinguishable from the " rakta garaniya alu " of Bengal. When the Shans dig for tubers of *D. alata* growing spontaneously in the forest, they leave about one-third of the deeply descending tuber behind in the soil, as being scarcely worth the labour of extracting. **1D g. Siam, excluding the Peninsula.** In this sub-subregion *D. alata* is again very generally cultivated and persists spontaneously after shifting cultivation in the moister parts of the country, such as the tracts immediately south of the Shan Hills, and those nearest the Gulf Df Siam : an account of the conditions has been given elsewhere *[Kew Bull,* 1927, page 239). There are several distinct cultivated races, often with somewhat fanciful names suggested by the shapes of the tubers. The most irregular of these races may be expected tD carry the magenta colour, at least superficially, in the tubers. **1D h. Laos Country.** In this sub-subregion *D. alata* appears tD be grown and tD Dccur much as it does among the Shans and the Burmese.

MALAYSIA. **11 a. Warm moist French IndD-China.** Information regarding the yams of this sub-subregion is less ample than we would wish. The remark already made regarding the yams of Tonkin as figured by Drevost and Lcmarié, that in general, they appear tD be elongated, ellipsoid Dr ovoid, has to be modified as regards Lower Cochin-China owing to the appearance there Df races with more irregular tubers. TWD of these have been figured in the *Gardens' Bulhtin, Straits Settlements* |1, 1917, plate 47, and 2, 1918, plate 3). In cultivation at Singapore it was found that the cuarser races gave the heavier outturn. From Pierre |no. 7DD3) we learn that *D. alata* occurs spontaneously at Tlm-doc in the province of Thu-dau-mot. **lib. Tenasserim.** In this sub-subregion *D. (data* is a common garden crop in all the districts. One Df the races which is grown is termed " twin-ZDuk myDuk " from the circumstance that its tubers descend very deeply into the dDil. **11 C. Andaman Islands.** The aboriginal inhabitants of the Andamans, now on the verge of extinction, did not cultivate *D. alata* ; nor does the species occur anywhere in these islands in a spontaneous state. That Dne tribe in particular, which is understood to

have at times raided Car Nicobar, may have met with its tubers is possible, if the incident mentioned by Caesar Frederick (see p. 322) shows that the species was cultivated in the Nicobars when Portugal was still powerful in the Indian Ocean. But even if the raiding Jarawa were aware of the existence of *D. ahta* they did not bring the plant to the Andamans: and if, as was probably the case, some race or races of the species became introduced to South Andaman when the Honourable East India Company attempted to establish a settlement there in 1789, and also to North Andaman when the original Indian Settlement was transferred there in 1792, none of these races had survived near the sites abandoned in 1792 and in 1795 respectively when the existing settlement, on the site of the one given up in 1792, was established by the Government of India in 1858. In that modern settlement *D. alata* is now cultivated, though not on an extensive scale. **11 d. Peninsular Siam.** In this sub-subregion, the conditions as regards *D. ahta* resemble those of Siam, proper. **11 B. Malaya.** Though the Malay Peninsula has a climate too moist to render it an i'deal yam-country, *D. alata* is grown sparingly everywhere in Malay gardens and occasionally in small patches by Chinese settlers. Only in the northern parts of the sub-eubregion, and very rarely there, does the species occur in a spontaneous state. The cultivated races regarded as the best for eating are those with the most elongated tubers. One of these races is practically identical with that known to the Burmese as " myouk pyu " [white yam): another agrees with the Burmese " myouk ni " (red yam). A third race with a subclavate descending tuber which late in the season produces in addition numerous upright plump tubers (plate 125, figure 27), is also found in Java : the Malay Peninsula appears to be the western limit of this character. A fourth race (plate 125, fig. 3D and 31) has less pronounced upward-growing tubers. Curved snake yams |ubi ular) also occur, but are very rare. In Krian a race very suggestive of Rumpf's *ubium draconum* has been observed. Kaces with short tubers, sometimes circular, sometimes flattened in section, and with lobes in a line, are grown. A race, " ubi sekok " (plate 125, fig. 20), with numerous plump elongated lobes in all planes is met with, and races occur with several short tubers in a bunch. In the *Gardens' Bulletin, Straits BMemmts,* figures additional to those given in this work will be found in volume 1, nos. 11-12, on plate 3, and in volume 3, nos. 1-3, on the plate opposite page 7. **11 f. Sumatra.** That *D. alata* is cultivated throughout this sub-subregion is highly probable. It is certain that the Bataks prize yams highly, since according to Warneck *[Toba-Bataksh-Deutsch Wwierbuch)* in their speech the verb meaning " to eat yams " is used as meaning " to eat ". **11 g. North Borneo anil Palawan.** Towards Kinabalu, in this sub-subregion, *D. alata* is found at elevations of 3,DDL> ft. above the sea, but to what extent is not known. Little is known regarding the races which occur. That one race with flattened tubers is grown will be seen from the *Gardens' Bulhtin, Straits Stitfommts* (3, plate opposite p. 7). Another race with curious small tubers we figure on plate 125 (figures 42 and 43). **11 h. Southern Borneo.** In this sub-subregion it is known that *D. alata* is among its cultivated plants ; and that it is probably grown rather generally ; but nothing is on record regarding the races which are used. **11 j. Java.** De Bondt, who spent the last four years of his life (1627-1B31), in Batavia, made no reference to *D.* ^faasafoodplant.thoughhementioned the cultivation of *Cohcasia* [PisD, De *Indian utriusque Rs naturali,* page 144). Rumpf has recorded that in his day (1G53-1592) the cultivation of *D. alata* as a food-plant was beginning, and its tubers were being raised in the neighbourhood of Batavia chiefly by immigrants to Java from further east. In his day yam-growing was more important to the east of Java : it was of consequence in Celebes and its importance increased through the Moluccas, Amboina, Banda and all the eastern Malaysian islands, extending from thence throughout New Guinea. Blume, so recently as 1827, reported that *D. alata* took a less important place as a source of food in Java than in the Moluccas. Now

conditions have altered considerably and many races are grown in Javanese gardens, while the species has come to occur spontaneously in open teak forests towards the eastern portion of Mid-Java and along the northern side of the island, ascending tD 8DD metres]2,6DD ft.) above sea-level. Dchse {*Vegetables of the Dutch East Indies,* 1931, page 223) gives an extremely interesting account Df the races to be met with in Java and takes the view that *D. data* is indigenous in the island ; the form with elongated descending tubers to be found in the teak-forests he regards as representing the wild type. Acceptance of this conclusion, however tempting to the student Df the local plant-association, presents certain difficulties to the student Df general plant-distribution, who is aware that *D. alata* occurs spontaneously in many other sub-subregions in which it is raised as a cultigen and that in not a few of these sub-subregions there is unequivocal evidence that the spontaneous occurrence Df the species may be attributed tD the exigencies of a system of shifting cultivation. The natural historian has further tD bear in mind that taxomomic considerations suggest that *D. alata* as a cultigen must have been evolved somewhere in northern I_n d_D-China, that as its use as an economic plant spread south-eastward from its centre of origin it underwent further cultural modification. Historical considerations seems further tD indicate that the cultigen reached Java from Eastern Malaysia and that its introduction to Java as an economic plant may have preceded its appearance as a spontaneous constituent of the vegetation in the Dpen teak forests of that island, these being under forest management and not in a natural condition. The evidence supplied by Mr. Ochse seems tD indicate that this is not only possible but probable. The elongated descending tubers tD be found in Javanese teak-forests, which he regards as representing fch risinal type of " wild " *D. alata,* appear tD be tDD irregular and too liable to curvature tD justify that conclusion. A figure Df what he terms " ubi tapak gajah " (elephant's foot-print yam) is reproduced (plate 125, fig. 5D). This shows a tuber which is fasciated, a feature we cannot regard as primitive ; also the positive geotropism tD be expected in a tuber Df a truly wild form seems to have undergone disturbances. Assuming that such a f_or m as this may be original, Mr. Dchse compares with it certain similar forms found in gardens and regards the latter as this "wild" condition in an early stage Df cultivation and proceeds tD discuss the cultivated races of greater value, giving figures some Df which we have reproduced in plate 125 : one of these (fig. 29) represents the Singapore race with finger-like up-growing shoots, which appears to be known in Java as " huwi tihang" which is not quite a race name. This, however, does not affect the possibility that the " wild " condition which Mr. Dchse regards as the origin of similar forms found in gardens may in reality be one Df these cultivated forms in a state of degeneration. **11 h. Philippine Islands.** Throughout this sub-subregion *D. alata* is generally cultivated as a garden-crop, though we learn from Dr. E. D. Merrill that in the island of Masbate it is also grown in fields. There are numerous distinct races and, though our experience of these is limited, it is sufficient tD show that they are as diverse as in any sub-subregion in which the species occurs. Figures of the tubers of some of these races may be found in the *Straits Settlements Gardens Bulletin* and in the *Philippine Agriculturist and Forester :* some of these figures have been selected for republication here. Dlemente *Philipp. Agriculturist and Forester,* 6, 1918, page 23D) has given an account Df their USDS as vegetables and has dealt with the colour, the texture, the oxidation phenomena on exposure, flavour, etc., Df the flesh of their tubers. 11 I. Delebes. That *D. alata* is cultivated in this sub-subregion is known : it is also evident that this was the case when Rumpf lived, since he recorded that the Celebes tubers seen by him were larger than those raised in Amboina. 11 m. Lesser **Sunda Islands.** Apparently *D. alata* is cultivated in most, if not in all, of the islands of the chain which constitutes this sub-subregion. We have seen specimens collected in Fbres *Rensch* no. 1366), and in Sambawa *Rensch* no. 872). **11 n. AmboineSe Moluccas.** The account

given by Rumpf *[Herb. Amboin.,* 5, p. 345) is still Df valuB. The tubers grown in Amboina during his residence there (1B52—1702) were the length of ths human hand, the largest only a span long (p. 347), though the Butonsse prided themselves Dn having larger yams : as already remarked, Rumpf |p. 348) describes the device adopted in ButDn tD cause the longer tubers to grow near the surface of the ground. Rumpf, after dealing with the common race of *D. alata* which he terms *Vbium vulgar*e, describes in turn the flattBned hand-shaped yams of *TJbium iigitatum*; the tubers Df curved snake yams, *Vbium anguinum* and *Vbium draconum* ; finally of the latter growing spontaneously *Vbium anniversarium.* Regarding *Vbium vulgare* he explains |p. 345) that the tuber assumes various shapes, but it is usually like a pouch widest below, a palm bng and four or five fingsrs wide, though SDmBtimes it is of various fanciful shapes. Though Rumpf does not figure the usual shape, we may conclude from what he says that it was a race with slightly lobed tubers or that his name covered all races with tubers that had short lobes, the races with tubers more distinctly fingered being included in his *Vbium digitatum.* Befors leaving the subject of the yams of Amboina, one further remark may be made : it is this :—that Rumpf's name *Vbium draconum* refers to a race such as ths Malays call " ubi buaya " or crocodile yam, and this name has been found to be repressntsd as far away as Madagascar (see p. 317 above).

PAPUASIA. **12 a. Ternate Moluccas.** In this sub-subregion *D. alata* is in cultivation, and presumedly in abundance ; but we have very little knowledge regarding the races. One of them is called in local Malay " ubi dasaswala " and has red tubers. **12 b. Dutch New Guinea.** In this sub-subregion the cultivation Df *D. alata* is general. Miklouho Maclay *{List of Plants in use by the natives of the Maclay coast of New Guinea)* states that many varieties of yams are raised and eaten between August and January. Kinman *{Bull. Porto Rico Agric. Exper. Station* 27,1921, p. 20) describes two races received from New Guinea : one with long, slender, easily broken tubers, not very sweet; the other with bng tubers, growing horizontally, being a more or less curved snake yam. The former has multiple tubers and resembles that shown in figure 14 of our plate 125 : the latter resembles that shown in figure 6D of the same plate. **12 C. Eastern New Guinea.** Warburg mentions twice *\Pflame,nkhid u. Nutzpfianzen Neu Guineas,* 1899, p. 55 ; and in *Engl Bot. Jahrb.* 13, 1891, p. 274) the cultivation of *D. alata* at Finschafen. Lauterbach *\Tropenpflanzer,* 1, 1897, p. 125) explains that yams occupy an important seasonal place as for use before the tarD crop is in . **12 B. Solomon Islands.** In this group *D. alata* is generally cultivated, though Guppy *{Solomon Islands,* 1887, p. 84) states that the raising of yams is more practised in the eastsm than in the western islands of the group.

AUSTRALIA. **13 a. Northern Australia.** In this sub-subregion *D. alata* is cultivated at Port Darwin in lat. 12° S. **13 b. Eastern Australia.** In this sub-subregion *D. alata* is grown in northern Queensland, and has been collected by Ladbrooke as far south as the Johnstone river in lat. 17D S. The furthest south to which it can be grown is really unknown to us.

NEW ZEALAND. In 1774 Captain Cook found that yams wersbsing grown by the Maoris in the North Island of NBW Zealand at Tolega Bay, Mercury Bay and Cape Kidnappers, three localities near Hawke Bay, the most southerly being in 39° 39' S. How far the yams referred to may have bsBn *D. alata* it is not possible tD say : it is, however, known that at a somewhat later date *D. alata* was grown by the Maoris near the Bay of Islands in lat. 35° S. in order to supply provisions for whaling ships. In a letter to the writersMr. CheesBinanhasstatBdthat whenbstweBnthsysarsl820 and 1845, great numbers of whaling ships, both English and American, visited the South Pacific, many frequented

the'Bay of Islands for the purpose Df obtaining provisions, mainly pigs, potatos and kumaras [tubers Df *Ipomoea Batatas),* etc. At that time there were few European farmers and most of the supplies were obtained from Maoris, who enlarged their cultivations to meet the increased demand. At first the chief vegetables were the ordinary potato and thekumara: but yams were introduced from the Pacific islands and were grown to some extent, the Maoris applying the name " uwhikaho " to them. Hooker mentions *D. alata* as cultivated by the aborigines at the time of his visit tD the Bay Df Islands, which was during the Ross Expedition." This shows that *D. alata* was being grown by the Maoris in 1841. The cultivation of *D. alata* in New Zealand proved, however, to be temporary Dnly and ceased SD long ago that Mr. Kirk, whose personal experience went back to 1854, never saw it, and Mr. Cheeseman adds that though he had visited hundreds of Maori cultivations from 1854 onwards he had never seen this yam being grown. Its disappearance was due to the extension of European settlements and the consequent increase in the supply of European vegetables, which displaced both yams and kumaras. The cultivation of *D. alata* so far south must have been difficult; this may account for its abandonment. Best *[Bull. N. Z. Dominion Museum,* 1925, p. 12D) has discussed very fully the evidence available regarding this phenomenon. The Maoris always had *Colocasia* to fall back upon ; besides, *Colooasia* can be grown further south than *D. alata* so that, in any case, it was for the Maoris a more important crop. As they had obtained the kumara *[Ipomoea Batatas)* they had an additional source Df food, in seasons when *D. alata* failed them, which had the advantage of coming earlier tD maturity, though it had the disadvantage of not keeping so well when stored. It may be noted in this connection that the name " New Zealand yam " is sometimes used to designate the tuber of *D. bulbifera* var. *sativa.* This renders it possible that the Maoris may have introduced this species as well as *D. alata* from the Pacific Islands and that though *D. alata* was the Dnly yam met with in the Maori cultivations by Hooker in 1841, the yams met with by Cook in 1774 may have been the produce both of *D. alata* and of *D. bulbifera* var. *sativa.*

PACIFIC. **14 a. New Caledonia.** In this sub-subregion *D. alata* is cultivated in many races. Ruillaumih (in *Ann. Mus..Col. Marseille,* ser. *2,* 8, 1911, p. 271) gives a list of these, which includes IID fewer than sixty names. Earlier in the same volume (p. 248) he quotes localities. The specimens from New Caledonia examined by us are characterized by narrow wings Dn the stems *Balansa,* no. 2781 from Tomambere at the base ofMt. Mou : *Vieilhrd,* no. 1375 and 1375, from Balade). We have also seen specimens from the Isle of Pines *Mme le Rat,* no. 97). It is in common use in the Loyalty Islands. **14 b. West Pacific.** There is hardly an island in this sub-subregion where *D. alata* is not cultivated. Safford *Contrib, U. S. Nat. Herb.,* 9, 19D5, p. 259) states that in Guam the inhabitants grow a number of races which differ as to the shape, size, colour and time of maturity of their tubers. Th? same appears to be true of the Caroline Islands; and Christian *[The, Caroline Islands,* 1899, pp. 333 and 349) has supplied a number of vernacular names which may prove useful for future investigators of the races grown there. Dne globose-tubered race has been figured *{Gardens' Bulletin, Straits Settlements,* 1, 1917, plate 2) ; a race with elongated tubers is, perhaps, the commonest. **14 C. Mid-Pacific.** In this sub-subregion the Fijians depend very largely Dn their yam-crop and grow numerous races of *D. alata.* Seemann, who spent the year 18BD in Fiji, states in his work *Viti,* 1862, p. 298) that ship-loads of yams were annually exported tD New South Wales and New Zealand for use by the whale-fishers who provisioned their ships in those colonies : other vessels engaged in whale-fishing called at the Fijian islands themselves for the same purpose. Apparently at the time mentioned, there was nowhere in the Pacific where yams were more plentiful than in Fiji. In 19D3 Mr. Hughes of the Queensland Sugar Refining Company very kindly sent to Calcutta no fewer than forty-six

named Fijian races of *D. alata* ; though the accompanying labels had unfortunately perished during the voyage, the yams themselves were sound and could be photographed and grown. Most of the races had tubers that were clavate in various degrees, sometimes rather bottle-necked above, in other cases not : one race had the tuber quite globose ; another had a flattened and curved tuber, the figure of which is given as no. BB on plate 12 . The much fingered races of Malaysia were not represented. This we regard as a most interesting fact ; for if they have nDt been carried Dut into the Pacific, then it seems likely that the Pacific islanders got their first supplies of *D. alata,* not by filtration through Melanesia, but straight from the IndD-China coast. Incidentally the use Df the name [11] kawai " in Fiji for *D. esculenta* suggests this, since kawai has a remarkable similarity in sound to the wide-flung Indo-Chinese word " khoai " with the meaning of " tuber " Ax C. Smith has found *D. alata* in Fiji growing in an uncultivated state. In Samoa its cultivation appears to be general: Rechinger has found it there alsD beyond the limits of cultivation. Setchell notes the existence of the species in Tutuila T In the Friendly Islands Cook and other voyagers were able to obtain supplies of yams West *[Ten years in South-Central Polynesia,* 1865, p. 137) records that " the T Dl ut are remarkably nice in rejecting inferior yams.. The best are dry and mealy whe/prT QV\ CDDked. Single yams vary greatly in weight, ranging from seven to eighty pounds YamI from sixty to eighty pounds weight are by no means uncommon." **14 j. Eastern Pa "fi S** Though in this sub-subregion the races of *D. alata* grown appear to be f ew in number than in the case of Fiji, the crop is of importance. In TahitT according to Nadeaud *Planles usuelles des Tahitims* lHfid „ im r> T ' is one Df its principal food-plants Df the dry season : the abundance of its tubers led him to think it could not be an imported vegetable. He remarks further on the abundance Df the bulbils, "as long as a finger," produced Dn the vines in the humid vail eys. Thanks to the kindness of Professor Harrison Smith we were supplied with tubers from Tahiti: these were figured *[Gardens' Bulletin, Straits Settlements,* 3, 1923, *n. 4-* one of these, named " ufi paparatia " was very bng and deeply burying. TWD others " ufi taho-taho " and " ufi opura " were bng bulky tubers Df considerable size ; a fourth, " ufi-mene-mene " was globose. The yams of Tahiti have often been alluded to bv voyagers. *D. alata* has been collected in Gaea *[Savatier* nD. 973); it has also been in the Marquesas Islands by Jardine and in Pitcairn Island by Miss Young. We believe that the " *D. sativa* " recorded by Maiden in his account of the vegetation of th" last mentioned island *Rep. Australian Assoc. Adv. Svi,* 19D1, pp. 2B3 and 2B9) mavh have been *D. alata.* Beechey, writing of the Pitcairn islanders *Narrat. of a voyage to the Pacific,* 1831, 1, p. 87) remarked that " yams constitute the principal food: these are boiled or made into pillihey |cakes), by being mixed with cDCDanuts, or bruised and formed into a SDup." Yams are alsD grown in Easter Island: Captain Cook saw them there, but the sterile soil seems little suited to this cultivation. **14 e. Northern Pacific.** In this sub-subregion the Hawaiian Islands resemble New Zealand in being somewhat too cold for *D. alata:* but the cultivation of the species, instead of having been abandoned, as in New Zealand, still persists in Hawaii and one of us has examined tubers of *D. alata* grown locally, and sold in the markets ofHonolulu. These tubers are small, those seen weighing about a kilogramme. This perhaps explains why theHawaiians, before the potato reached the Archipelago, were driven to use *D. bulbifera* tD a greater extent than the inhabitants of Pacific Islands situated in warmer zones. It may, however, be that the race oriein ally grown by the Hawaiians had more bulky tubers : it is known that the races now grown are, at least in some cases, recent introductons from the archipelagos further south

DUTSIDE ASIA AND THE PACIFIC. A letter from Osbeck to Linnaeus written in 1752, indicates that he saw *D. alata* in St. Helena in that year. This island was hId

by the Dutch during 1B45—155D. A year after its abandonment by the Dutch it wa3 occupied by the English East India Company. Whether *D. alata* was introduced by the Portuguese DI- Dutch before 1B50 or a recent introduction by the English when Osbeck noticed its presence, is not clear. St. Helena is situated in long. 5° 42' W. and lat. 15° 55' S., a latitude considerably further south than any known locality of the west coast Df Africa, but not as far south as localities known near the east coast of South America : this the relative dryness of the two coasts determines. Whether *D. a lat a* still persists in St. Helena is not known. The question as to the races which were introduced to Madagascar and East Africa has already been discussed (p. 319), all that need be said here is that the evidence is clear that many of the races grown in Madagascar must have originally come from Malaysia, though others may perhaps have come from Ceylon. It is equally clear that most of the races taken by the Arabs or Indians to East Africa must have come from India, though some may have come from Malaysia either direct or *via* Madagascar. Again there seems no reason to doubt that the " igname of San Thomé " taken by the Portuguese to West Africa and also to Brazil, most probably came from western India where the races grown have mainly ellipsoid, ovate DT clavate tubers. It is noteworthy that Rumpf, who was the first botanist to examine at all critically the tubers of the various races of *D. alata* in a region where these tubers show an almost protean diversity of form, did not recognize in any of the cultivated Malaysian forms of" ubi " that belong to this species the inhame of the Portuguese, but on the contrary suggested that the San Thome plant might perhaps be his *Vbium pomifwum* or Ahua, known to him both in a spontaneous and a cultivated condition, which does not belong to *D. alata.* Having regard to the known effects of human selection Dn the races met with in cultivation in south-eastern Asia, more especially in eastern Malaysia and some of the islands of the Pacific, it is difficult tD discard the possibility that selection may have led to the segregation of distinct races in tropical America and possibly even in Africa. As tD this, however, judgment must be suspended until much further information is available. Difficulty in reaching definite conclusions is enhanced owing to the activity shown, especially during recent years, in the introduction to the New World of races long established in other regions. The West Indian " seal-top yam " resembles the " rakta garaniya alu " of Bengal, which Roxburgh regarded as possibly of Malaysian origin, in being a yam which grows above and benefits if it be earthed up. Races with palmate, with digitate and with flat-fasciated tubers have been introduced to the West Indies ; so too have races approaching the curved snake yams—the " Bugle horn yam " is an example : but " curved snake yams " do not appear to have reached the West Indies. Another difficulty with which students of the races Df *D. alata* already in cultivation in the West Indies have to contend, lies in the fact that the names in use there differ in their application from island to island. One particular West Indian race deserves notice. This is known as " Cut-and-throw-away " because it includes a considerable amount of hard tissue which has to be discarded: Mr. R. 0. Williams describes it as more than half useless. Other authorities give it the alternative name Df " Devil yam," though it has been suggested that this term is not applied consistently. Hart *[Trinidad Bull., 2,* p. 207) describes its tubers as large, coarse and warty : adding that they are fed to pigs. Kinman *{Bull. 27, Porto Rico Agric. Expzr. Station,* 1921, p. 19) has described a race grown in Porto Rico which is of inferior quality though not quite SD undesirable as the " Cut-and-thrDW-away yam"; it fetches a low price and is without flavour when cooked. The distribution of *D. alata* in Africa, so far as this is known to us, is shown in the map Dn plate 147: from this distribution Niam-niam Land is excluded, although in various publications that region is mentioned as one in which *D. alata* is grown. These statements depend on the identification of a specimen *\3chwzinfurth* no. 3712) collected in Niam-niam Land, as referable to *D. alata* i

but the specimen does not belong to that species. Young *[Bull. 1167, U. S. Dep. Agric,* 1923,) gives Charleston in South Carolina |lat. 32° 30' N.) and Galveston in Texas (lat. 29° 20' N.) as the limits of the cultivation of *D. data* along the southern coastal parts of the United States.

PLATE 123. Dioscorea alata, *LinnL* |1) Two branches, one with female flowers and one with bulbils—they seem never to be associated together upon one branch—from a drawing belonging to the Royal Botanic Gardens, Peradeniya: |2) and (3) flowers much enlarged, from above and in section.

PLATE 124. *Variation in tht leaf*:—(1) The broad leaves of a race from Darjeeling : |2) a node of the race " gur alu " from Murshedabad, with two leaves: (3) the hastate leaf of a race called " man tin hpew " in the Northern Shan States : |4) the elongated leaf of a plant raised in the Royal Botanic Gardens, Calcutta, of the race " myouk-u-ni " from the Hanthawaddy district, Burma : (5) the broad leaf of a plant like the Bengal race [11] chuprialu" from the Darjeeling district: 16) the short leaves of a race called[1]' mach alu " in the Sontal Pergunnahs : |7) the stem and leaf of a race called " athi kavali " in Madras : (8) the leaves of a well-known race of Gujarat called " bhusara," showing the large auricles!

Variation in the stem :—11) The six-angled stem of a race from Darjeeling (5) the eight-angled stem of a race from Darjeeling cultivated in the Royal Botanic Gardens, Calcutta : |9) a typically four-angled stem of " myouk-u-ni " from Hanthawaddy in Burma : (10) the base of the stem of a Fijian race with low prickles upon ridges : (11) the base of the stem of the race called " mach alu" in the Sontal Pergunnah showing numerous wart-like prickles scattered over the surface: (12) a stem with small sharp prickles directed towards the tuber.

Variation in the bulbils:—113) a Fijian race with bulbils which produced plentiful rootlets, these not dying as is usually the case : |14) bulbils of the race " phal alu," obtained fromMayurbhanj.

Fertile parts:—[15) a branch with male flowers of the race " goradu " from Poona, \ nat.si.se: (15) an infructescence, \ nat. size: (17) a capsule in section from the same.

PLATE 125. Tubers of D. alata, *LinnL* Series A., of cylindrical deep-going tubers, with bottle necks, nos. (1), (2) and |3) tubers raised in Singapore, of a race from the Khasia hills called "phan shriew", which has white flesh and is reported to be eaten, curried, and if raw to irritate the tongue : |4) a tuber raised in Singapore of a race obtained at Lumding in the Nowgong district, Assam, its fleah white, its surface with short lobss : |5), |S) and (7) tubers of Fijian races, raised in Singapore, the second of the three has a little magenta sap under the surface. Series B., of clavate tubers more or less bottle-necked : (8) after Crevost and Lemarié who call this Tonkin race "cu cai" : [9) from Roxburgh's drawing of *his_D. rubella,* which has white flesh under a thin magenta layer ; Roxburgh's drawing of his *D.jpur_Ewrea* has the same outline : (10) a shapely torpedo-like tuber from Tahiti, sent to the authors by Professor Harrison Smith under the name "ufi-taho-taho", the flesh white: |11) a similarly shaped tuber from Fiji, sent to the authors by Mr. Hughes : (12) a long-DVoid tuber of a Philippine race, raised in Singapore ; it is also white fleshed. Series C, of races with bunched tubers : |13) and (14) the bunched tubers of a Philippine race, raised in Singapore : [15) after Crevost and Lemarié who call this Tonkin race "cuDaimo". Series D., of globose tubers: (16) from Fiji, sent by Mr. Hughes : (17) from Roxburgh^ figure of his £>. *gbbosa,* a Bengal race^which^he^ described as a species characterized by six wings upon the stem and by the shapeTof It7 tuber,Twhite-fleshed: [18) one of the tubers figured by Dchse as "ubi kelapa" or coconut yam. Series E.,

ellipsoid tubers : |19) from Dlusius' figure Df the yam used on slave ships, the relative size calculated from the diameter of the stem. Series F., of short-lobed tubers : |2D) a tuber raised in Singapore of a race called "ubi sekok" in Pahang ; it is without magenta sap and is equally fingered in all directions : |21) tuber of a race called in Fiji "uvi kaboa," raised in Singapore ; it has a little magenta colour under the skin. Series G., of seal-topped tubers : (22) after Crevost and Lemarié, who call this Tonkin race " cu coc guan". |23) a tuber sent from Fiji by Mr. Hughes : |24) from Roxburgh's figure of his *D. atropurpurea,* which he called a Malayan type and described as irregular, but roundish, purple throughout growing SD near the surface Df the soil as to raise it : |25) from a drawing in the Royal Botanic Gardens, Peradeniya, of a race called "kahata alia," in colour yellowish and without any magenta sap : |2B) of another Ceylon race called "hingurella", with whits flesh under a magenta superficial layer of tissue. Series H., of yams with up-growing shoots from the top of the tubers : |27) and |28) tubers, grown in Singapore, Df a local race with ivory coloured flesh, and pDDr keeping qualities :—129) after Dchse, a race which he calls " huwi tihang" and which is obviously the same as that figured as 27 and 28 :— |3D) and |31) tubers of the Singapore "ubi merah," raised from material bought in the local markets : |32) after Dchse, who calls this a form Df "huwi tihang" and defines "huwi tihang" as a race either wild or, if cultivated, Df gigantic size : this particular tuber, here figured, is intermediate between nDS. 29 and 50 ; it seems to be CDarse : |33) a tuber raised in Singapore, Df the same race as 3D and 31. Series J., tubers somewhat ellipsoid, becoming flattened: |34) a yam slightly flattened bebw, from Mr. Kinman, produced in Florida: |35) a somewhat more divided yam raised in Singapore from a Philippine parent : |3B) a yam figured by Ochse as "ubi kelapa" along with no. 18 and it may be assumed that when not growing with much vigour the tuber is as no. 18, but vigour produces no. 36. Series K., flattened and curved, but not lobed : (37) a tuber after Drevost and Lemarié who call it" cu giong." Series L., Df fingered but scarcely flattened tubers :—(38) from Rumpf, being his first figure Df *Ubium vulgare* described as rather protean in shape, SD that it is clear he placed more than one race under this name : (39) a long-fingered tuber raised in Singapore Df a race received from SaigDn as "khoai tiem" : (40) an elongated fingered tuber raised in Singapore, from a tuber of Philippine Drigin called "tugui," which name however is not distinctive : |41) another tuber Df "khoai tiem :" (42) and |43) tubers of a race from Sarawak with the peculiarity of growing from the side a small horizontal lobe :— |44) Rumpf's second figure of *Ubium vulgare,* which shows a much more bbed tuber than no. 38: |45) a third tuber of the race "khoai tiem", raised in Singapore; this figure on the plate is erroneously numbered 45, being the upper of the two SD numbered :— |4S), |47) and |48) small-lobed tubers raised in Singapore Df a race received from Saigon aa "khoai siam" Dr Siamese yam. Series M., Df tubers ill-defined in shape, lobed and also curving : |49) and |5D) both after Dchse, who obtained them in Java ; the first called "ubi menjangan" and the second "ubi tapak gajah" Dr elephant footprint yam; such yams were thought by him tD be the wild ancestral type, but that this should be the case is scarcely possible on account of the curving and the tendency to have uprising shoots which are modifications added to the plant by man's selection. Series N., Df tubers which are lobed in one plane, more Dr less symmetrically, the axis vertical : (51) Rumpf'a *ubium digitatum* or "ubi tangan," described as red within, flattish, with one side concave:— |52) a tuber raised in Singapore from a race Df Philippine origin, with beautifully white flesh and a thin smooth skin : |53) after Dchse, a race which he calls "ubi merah" or red yam : (54) also after Dchse, who figures this Javanese yam as "ubi tawar" he described it as attaining a very large size, white fleshed under a magenta skin : |55) another figure Df "ubi tawar :—(55) a curious tuber raised in Singapore Df a race met with at Klang in Selangor ; the skin contains much magenta sap : |57) a tuber raised at the same time

but from Brunei, the skin magenta. Series D., (58) a curious very rooty tuber figured by Dchse, unlike anything else which we have seen, described as " ubi bangkulit". Series P., of flattened tubers which during growth bse their positive geotropism and curve in one plane:—159) after Dchse who calls it "ubi gedangan" or vigorous yam and figured a second tuber at the back which we take to be the parent in the process of exhaustion and have consequently omitted, but he describes " ubi gedangan " as having paired tubera : (BD), |SI), |B2) and 133) tubers raised in Singapore of a Philippine race received as "tumuktok" fram the College of Agriculture, Los Banos ; it has white flesh but magenta sap in the skin : JB4) after Dchse, who calls it "ubi ular" or snake yam, an extreme in the way of curving early, after which the tuber seems to continue its growth horizontally. Series Q., tubers losing their positive geotropism and curving as if following circumnutation : |B5) the Ox-horn yam, a tuber raised in Singapore, of uncertain origin, but almost assuredly Philippine : |BB) Rumpf's *Ubium draconum,* the scale on which it has been represented may be too large. Series R., |B7) after Ochse, a very curious yam with horizontal branches. Series 5., intermediate between series P and series T : 158) a yam sent from Fiji by Mr. Hughes. Series T., of cylindrical tubera which become negatively geotropic during growth, and require earthing up in cultivation, perhaps originating where the yams for the household were encouraged by planting in the midden by the homestead along with which they grew : |B9) after Dchse who calledif'uwi puteh" or white yam, a by-nD-meana distinctive name : |7D) and (71) tubers raised in Singapore of a race from the Philippine islands received as "tamis ubi", and |72) a tuber also from the Philippine islands received as "yam of Sinawang island", all with magenta under the akin and sometimes with up-grDwing lobes from the head.

Group of D. opaca (species **115).** A aperies of New **Quinsa, inadequately known, characterized by rough** stems, large flowers and leaves with a very bng acumination.

115. DIDSCDREA OPADA, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 283.

Underground parts unknown. *Stem* with characteristic minute prickles and low ridges un the bweat internodes, where it is up to 4 mm. in diameter, above losing ita prickles and on becoming smooth. *Bulbils* not seen. *Leaves* upon the lower part of the stem opposite or subopposite, coriaceous, broadly ovate and long-acuminate, up to 14 cm. long, the acumen making as much as 3 -5 cm. of this, in width to 8 cm., 5-nerved : the nerves of the first pair diverge from the midrib at about 30° and enclose an obovate area, becoming submarginal in the distal quarter of the length of the broad part of the blade : i.e., somewhat below the acumen : the nerves Df the second pair diverge from the midrib at BD° and end in the margin also in the distal quarter of the length of the blade : the margin of the blade is conspicuously strengthened : the secondary nerves are relatively straight and cross the interspaces between the primary nerves, and are a little more distinct than thB nervules of the network : upper surface glabrous, with the nerves and nervules just prominent: bwer surface glabrous, with the primary nerves very prominent and the others just prominent: petiole up to 8 cm. long, glabrous.

Male flowers on long leafless branches or on the leafless terminations of leafy branches, entirely glabrous : axes Df the spikes up to 5 cm. long, bearing at intervals of 2 - 3 mm! flowers up *to* the number of 3D, not zigzag, ridged. *Buds* subovoid, usually inclined forward. *Brads* deltoid-ovate, acuminate, curved round the base of the bud : bracteole

suodeltoid, smaller. *Sepals* broadly ovate, very obtuse, rather thick, 2 mm. long by 1 -25 mm. in width. *Petals* shorter, obovate, very thick, 1 -25 mm. long. *Stamens* 6, slender, not more than D -75 mm. long. *Gynoecium* a small point.

Female plant unknown.

NEW GUINEA.

Thia imperfectly known speciea ia af Dbacure relationahip. It was found in flower in October, apparently in secondary forest.

PAPUASTA. 12 c. Eastern New Guinea. Etappenburg near the Kaiserin-Augusta river, in denss but scarcely high forest, at 850 m., *Ledermann* 9139 !

PLATE 126, left side. Dioscorea opaca, *R. Knuth.* |1) Two haves from close to the base of the stem, \ nat. size : |2) male flowers and a leaf associated with them, \ nat. size : |3) the tip of the stem with male flowers, \ nat. size : |4) part of a male spike, X 5 : |5) a sepal, X 5 : jB) a petal from within showing the thickened part, x 5 : |7) a stamen, X 5.

Group of D. lamprucaula Ispeciea 116). A apeciea of Sumatra and Malaya, not yet adequately known.

116. DIDSDDREA LAMPRDDAULA, Prain and Burkill in Kew BuU., 1932, p. 245.

Underground parts unknown. *Stems* tough, prickly in their lower parts, pale straw-coloured, up to 7 mm. in diameter, the prickles being 3—4 mm. long. *Bulbils* are sometimes formed of unusually large size, being about 8 cm. long, pyriform or digitate, with a hard rugged rich brown skin. *Leaves* alternate, those towards the base Df the stem very broadly ovate Dr almost orbicular, coriaceous : those among the flowers narrower, to narrowly Dvate, more Dr less coriaceous, 5—7-nerved : the largest leaves up to 17 cm. long by 13 cm. in width: the first pair of nerves diverge from the midrib at an angle of about 30° tD enclose an elhptic-obovate area ; the second pair of nerves running close within the margin tD end only a little short of the acumen; the third pair of nerves weak and submarginal in the lower half Df the leaf-blade : the leaves associated with the flowers about 11 cm. long by 4 -5—6 cm. in width, with the first pair of nerves diverging from the midrib, as in the larger leaves, at about 35°, to enclose an Dblanceolate-ob ovate area ; the second pair of nerves submarginal and evanescent in the upper half of the leaf-blade : upper surface glabrous, with the network slightly raised and quite distinct; the lower surface glabrous, with the primary nerves prominent and the network not only distinct, but raised : petiole 3—5 cm. long, the pulvini SD conspicuous that the two together make almost one half Df its length.

Mah flowers in spikes grouped in large leafless inflorescences, which may have short branches in the lower part, thereby acquiring a slightly pyramidal shape : spikes with axes 12—4D mm. in length, glabrous, very slightly ridged : bracts Dvate from a broad base, rather mucronate, scarcely repressed by the flower-buds which are directed slightly forward : bracteole deltoid, only half as long as the bract. *Buds* inclined to be pyriform. *Sepals* just over 1 mm. in length, obDvate, rounded above and strongly incurved at the tip, nearly 1 mm. in width in the upper part, quite opaque, glabrous on both sides. *Petals* less than

1 mm. long, orbicularly obovate and rounded above where they are, like the sepals, strondv incurved, D -75 mm. wide, not quite opaque, glabrous on both sides. *Stamens* 5 white, abŏŭt D -5 mm. long, the anthers rather longer than the filaments. *Gynvezium* a low c'one.

Female plant unknown.

MALAYA and SUMATRA, apparently where the rainfall is well distributed, both in the hills and in the lowlands.

This species was collected first in the Taiping Hills of Perak and then in the hills ,n *th* the Straits of Malacca at the eastern edge of the central plateau of Sumatra Sub near the Pahang river and later near the 'Sed* r.ver, bothers of thee^t ^ of Zl ^ 7 ^ material is unfortunately sterile ; and the Sumatran material carries male flowers only

In swampy forest where Corner obtained it, near the bank of the Sedili river it very wiry prickly stems unusually larger pyriform or digitate bulbils. In the Taiping in February in which it was obtained did not carry such bulbils - but nf seasons.

The remark in Ridley's Flora that *D.laurifolia* may have a nricklv st™ been referred to that species.

MALAYSIA. **11 B. Malaya.** State of P B r a k. Taiping hills, G 125Bm., *Mohamed Hanijfand Mohamed Nur* 2454 ! State of P a h near the limestone caves, *Henderson* ! State D f J o r i n r T», r i v e r , D . n . r , 11..Sumatra. R - ^ - y of th E s t D Nature reserve " of the Botanic Garden, at 5DDm., *Lorzina* Sibolangit, JfcAtmiBi ^r 7375 !

PLATE 12B, right side. D. lamprocaula, *Prain and Burkill* with the inflorescences, \ nat. size : |4) a leaf from the lower part of the stem |5) the bwer part of the stem, \ nat. size : |G) a sepal: |7) a petal: |8) and from either side, all these X 5. All from Lbrzing's specimen. |1D) A bulbil from a photograph by E. T. H. Corner, reduced to rather less than \ nat. size

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Gmup DF **D.** stBmonnidBS |sp$_B$cies **117).** A speciea of Siam, with distinctive organs in the position of stipule Sometimes its capsules are not evenly rounded. Its tubers are several, and Dn that account V the group of *D. glabra* : but it differs from that species, though not from *D. aryzetorum* in havin'/n^rick on the stem, and in the distribution of the flower-spikes among the leaves. *D. oryzdnriin,* with the rest of the group *of D. glabra.*

117. DIDSDOREA STEMDNDIDES, Prain and Burkill in Kew Bull., 1927 pi. 244, and in Lecomte, FIDIB gén. de l'Indoch., B, 1934, p. 737.

Tubers several, produced below a WDDdy knot in a bunch, at present though imperfectly collected, known to be long-stalked, with such parts Df the stalk as have been collected attaining a diameter of 5 mm. and doubtless each ending in a terminal swelling ty glabrous, slender, 2 mm. in diameter at the base, wiry, with faint lines. *Bulbils* moderately acuminate, up to 5 -5 cm. long by 3 -5 cm. in width, 7-nerved : the of the first pair diverging from the midrib at about 35° enclose a lanceolate area : the

of the second pair diverge from the midrib at about 90° to curve round into the margin at about the mid-length of the blade : the nerves of the third pair, diverge from the midrib at about 115° to curve into the lobes and tD give off a strong branch which runs marginally towards the end of the lobe : the secondary nerves are not easily distinguishable in the network : upper surface glabrous, with the primary nerves distinct and the others obscure : the lower surface glabrous, with the primary nerves prominent and the others just distinct: petiole up tD 5 -5 cm. in length ; at its base laterally and on its back are a group of blunt polished processes usually conoidal, but at the base of the larger leaves elongated and curved.

Male flowers arranged in spikes which are grouped in the leaf-axils, Dr are in the axils of bracts if ao close to the branch-ends as to be beyond the last functional leaves : spikes up tD 2 cm. long with upwards Df 35 flowers placed close enough to touch each other : the axis not winged but angled : bracts deltoid-acuminate, pressed by the base of the flower against the axis and curving round this base tD a length of D -5 mm. *Sepals* from a broad base with nearly parallel sides and a very obtuse apex, 1 -25 mm. bng. *Petals* thick, spathulate, nearly 1 mm. long. *Stamens* B, D -75 mm. bng.

Female flowers Dn short axillary few-flowered spikes, and only a few Df them, perhaps three, producing capsules, the glabrous axis of the spike about 6 — 8 cm. long, one spike in each leaf-axil ; bracts Dvate-lanceolate, up tD 1 mm. long. *Capsules* smooth, greyish fawn in colour, the stipe 5 mm. long, expanding to a diameter Df 3 mm. where the winga arise : these spring Dut rather squarely and at the apex unite retusely, being as broad as long and even broader, to 17 mm. in length by 18 mm. in width. *Seeds* with a brown wing all round which is more or less conform to the loculus.

East central SIAM.

This species grows upon limestone rocks and has the appearance of having responded by a reduction in size- to the dry nature of the substratum. That its affinity is with *D. oryzdorum* is suggBsted by its multiple tubers, and by its male flower-spikes being distributed among ita leaves ; but it differs in several characters. By growing in the crevices between rocks, its tubers, though doubtless edible, must escape disturbance by foraging animals auch as wild pigs.

From the group of *D. glabra* it differs not only in its lesser dimensions and lack of special leafleaa inflorea- cences, but in possessing no prickles at the base of the stem. These stems are very wiry, lik ethos B Df the calcicole *D.paradoxa ;* and it produces few capsules Dn a spike, in this resembling the equally calcicole and nearly related *D. calcicola* and *D. gracilipes.*

WESTERN INDD-CHINA. **ID g. Siam, excluding the Peninsula.** Circle of Rachasima. Korat, Dhan-tum, KaD-Sisiat-a, at about 4DD m., climbing among lime- stone rocks, *Kerr* 9098 ! Circle Df Ayuthia. Saraburi, at Hin-lap, *Put* 2408 ! 2436 ! 3D84 ! Saraburi, at Muak-lek, 3DD m., in crevices of limestone rocks, *Kerr* 9D98 a !

PLATE 129, leftside. DioscDreastemonDides, *Prain and Burkill.* |1) Male flowering spikes from Put's no. 3D84, \ nat. size : |2) a spike, X 5 : |3) a sepal, |4) a petal, and 15) a stamen, all X 5 : |B) a branch with capsules from Herr's no. 9D9S, \ nat. size : |7) a seed, slightly immature : |8) a node with the bases of twD petioles, and two inflorescences, below the petioles the characteristic processes, nat. size : |9) a leaf from Put's no. 3D84 A, nat. size : (10) the base Df the stem and the upper parts of the tubers from Kerr's no. 91)98 a, considerably reduced.

Group of D. glabra (species 117—135). This large and natural group of species, whose members extend from the Punjab in Upper India tD Tahiti in the Pacific DDean, includes a number of forms that appear to merge into each other and seem to represent thB result of modifications adapting them to varying environmental uDnditiDns. Thus *D. belophylla* suggests specialization adapting it to a short rainy season ; *D. pyrifolia* to suit precipitation during most of the year; *D. oryzetorum* to existence in a water-logged soil; while *D. cahkola* and *D. qrarilipes* seem adapted to suit limestone formations. It is probable that all are capable of hybridization in regions where they grow side by side. In regarding *D. glabra* (species 12D) as the member of the group most nearly representative of the ancestral form, whence it and the other species associatsd with it have been derived, we admit that, if WB could be guided by morphological considerations alone, the group might with equal propriety be termed the group of *D. nummularia* |species 125). Though, as has been shown in the key tD S Enanticphyllum, and as will appear more clearly in our treatment *oi* the individual species, it is possible to distinguish *D. glabra* from *D. nummularia* both in the living state and from herbarium material, these two species ai'e so closely allied that we may regard them as representatives, each of the Dther, in their respective geographic areas. Yet, though *D. glabra* extends from the Himalaya and India to the China Sea and the Malay Peninsula, while *D. nummularia* extends from Borneo in Malaysia eastward through the Pacific these two areas nowhere overlap, and if we could be guided by geographic considerations alone, the group might with hardly less propriety be termed the group of *D. pyrifolia* |specips 13B) which is characteristic of the region intervening between the areas occupied by *D. glabra* and by *D. nummularia* respectively, and shares with *D. glabra* the distinction of having been identified by a competent authority with *D. nummularia.* But *D. pyrifolia* is, as we show elsewhere, an outstanding species in the group to which it belongs as being, owing to its pubescence, more easily distinguished from both *D. glabra* and *D. nummularia* than these two can be from each other. Moreover, the area occupied by *D. pyrifolia* overlaps that occupied by *D. glabra.* If with some confidence we *ma*y *ie*ga,Ti *D. nummularia a,ni D. glabra as desaBniants of a, common mcestTnl* form it seems permissible to believe that *D. glabra* is, of the two, that more nearly representative of the ancestral form from which as the result of adaptation to different environmental conditions all the other members of the group have originated.

Outstanding characteristics 3f the group as a whole are the formation by its members of multiple tubers and a certain inability to reproduce themselves vegetatively by means of bulbils. Another marked feature shared by *D. glabra, D. nummularia* and *D. pyrifolia* is the presence of abundant prickles on the lowest few centimetres of the stem. This feature is equally marked in the cases of *D. divaricata, D. Kingii, D. Loheri,* and *D Merrillii.* But prickles do not occur Dn the stems of *D. belophylla, D. hpcharum* and *D. uryzttorum,* and this is perhaps also the case with *D. vexans.* The concentration of the attentiDn of field-botanists Dn the flowering portion of the stems unfortunately leaves us ignorant as to this character in ths cases Df *D. cakicola, B Foxworthyi, D. gzdensis, D. gracilipes, D. grata, D. NizuwEnhuisii, D. salidfolia, D. Sitamimna* and *D. Wilkesii.* What can be said definitely is that the feature of being unarmed at the base is characteristic of two hill species, *D. belophylla* and *D.lepcharum* in India and of one swamp-species, *D. oryzrtorum,* in Siam. The prickles may serve to protect the tubers against animals such as rooting hogs, though probably indirectly by causing the animal to break the ripe and then brittle vine and in so doing to lose the connection between plant and tuber rather than directly deterring the animal from rooting. It is possible to state with confidence that bulbils are'not produced on the stems of *D. glabra, D. Kingii* or *D. pyrifolia* : it is known that bulbils are produced abundantly on the stems of *D. belophylla,* and *D. lepcharum* : aa regards the remaining fifteen species of the group, we are yet without sufficient evidence on the point.

Save for the occasional presence of a ring of very minute more or less persistent hairs on the innovations and even on the base of the lateral branches—a condition met with in the type specimen of the species—the stem of *D. glabra* is quite glabrous. This absence of pubescence is characteristic of every other species of this group except *D. pyrifolia,* which is almost invariably more or less pubescent, always with some hairs, and is thus an outstanding member of its group.

The considerable and very general variability of the foliage met with in the genus *Diosama* renders comparison between the leaves of species belonging to the same sections Dr even to the same group a matter for caution. If it is desired to contrast two species, the contrast does not hold unless the leaves belong to the same part of the stem. In most species of *Enantiophyllum* the lobes on either side of the petiole of the leaves at the base of the stem are at their largest size and are especially large in the leaves on new shoots uf vigorous plants the stems of which have been arrested in growth as the result of a timber-fall while their leaves have been increased in size owine to the enjoyment of a greater amount of sunlight. Higher up the stem, for a considerable length, come what may be regarded as standard leaves, those which may best b_B compared. As the flowering region of the stem is reached, the basal lobes usually present on the standard leaves tend to disappear. These leaves,

if less reliable for comparison than the standard leaves, are often the only onea available for the purpose because they are more abundant in herbaria than standard leaves. Dn the more distal portions Df the inflorescences thB leaves may SD lose their features as to be Df comparatively little value in distinguishing species. In the group now under discussion the standard leaf-blade Df *D. glabra* is exactly long-cordate while the sub-standard leaf-blades at the base of the inflorescence become cordate |plate 131). The outline Df the standard leaf is reproduced in *D. nummularia, D. pyrifolia* and *D. vexnns,* also, but somewhat inconsistently, in *D. oryzetorum.* In *D. belophylla* the outline ia conspicuously more angular and approaches a hastate condition : this is also the case in *D. divaricata, D. Foxworthyi* and *D. Loheri,* three Philippine species. In *D. Kingii* thB leaf-blade is much more elongated : the leaf-blades are elongated and narrow in *D. calcicola, D. gracilipes, D. grata, D. salicifolia* and *D. Wilkisii,* as they are also in *D. oryzetorum* var. *angustifolia.*

In texture the leaves of *D. pyrifolia* and *D. Merrillii* are subcoriaceDus and in this respect differ from all the other members of the group. The leaves of *D. belophylla* are parchment-like and those of *D. calcicola* arB also rather firm. The first of these four species occupies the most humid portion of the area to which the group is confined ; the second has SD far only been found in the Philippine islands Df MindorD and Mindanao, in both cases on the mountains ; the third affBcts the wetter parts of rather dry regions ; the fourth is a limestone area plant. In *D. glabra* and in all the remaining species Df the group, the foliage is herbaceous.

The leaves of *D. glabra* contain a chemical substance which turns liver-coloured on drying. There is very little of this substance in the leaves of *D. oryzdorum.* The leaves of *D. pyrifolia* always turn red-brown : those of *D. Kingii* approach the former in colour.

The male inflorescences Df *D. glabra* are often very amply developed and include many spikelets |SBB plate 131). But *D. calcicola, D. glabra* and less consistently *D. oryzdorum* have small male inflorescences. In *D. gracilipes* the male spikes are in the axils Df leaves ; in *D. hpcharum* the spikes are disposed loosely in the inflorescence.

In six of the species belonging tD this group the capsules have not yet been recorded. In the remaining fourteen the capsules are known and in some cases their dimensions afford characters that assist identification. These dimensions and other particulars are supplied by the subjoined table.

Name.	Length along placenta.	Greatest width.	Shape of apex.	General character.
118. *belophylla* ..	15—22 mm.	13— 18 mm.	Retuse ..	Elongated.
119. *lepcharum* ..	15-18 „	15-2D „	Slightly retuas ..	As *glabra.*
120. *glabra* ..	15-18 „	14-23 „	Do. ..	..
121. *vexans* ..	15 „	12 „	Do. ..	Inadequately known.
122. *oryzetorum* ..	**13-15 „**	10-15 „	Retuse ..	Rather small.
123. *gracilipes* ..	**12-15 „**	10-13 „	Truncate ..	Do.
124. *calcicola* ..	**12-14 „**	**9-1D „**	Do. ..	Small.
125. *nummularia* ..	15-18 „	18-22 „	Slightly retusB ..	As *glabra.*
128. *gedensis* ..	28 „	25 „	Do. ..	Large.
130. grata ..	2D „	15-1B „	Truncate ..	Elongated, but not WBII known.
131. *Loheri* ..	..	..	.... ..	Probably as *glabra.*
132. *divaricata* ..	15-18 „	15-1B „	Slightly retusB ..	As *glabra.*
135. *Kingii* ..	20 „	25-22 „	Do. ..	**Do.**
135. *pyrifolia* ..	15-18 „	18-22 „	Do. ..	**Do.**

ThB capsules UIB unknown in thB six species omitted from this list.

118. DIDSCDREA BELOPHYLLA, Voigt, Hort. Suburb. Dalcutt., 1845, p. 653 : Wood in Records Bot. Survey Ind., 2, 1902, p. 143 : Haines, For. Flora Chota Nagpur, 191D, p. 530 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. 10, 1914, p. 35 : Duthie, Flora Upper Gangetic plain, 3, 1920, p. 252 : Parker, For. Flora Punjab, 1924, p. 519 : R. Hnuth in Engl. Pflanzenreich, iv-43, 1924, p. 20B : Haines, Bot. Behar and Orissa, 1925, p. 1119 : Fischer in Gamble, Flora Madras Presidency, 1928, p. 1512.

Dioscorea ddtoidea, Stewart, Punjab plants, 1869, p. 229, as regards the root which he describes as edible and names tar, tardi and tharri: Balfour, Cyclopaedia of India, 1, ed. of 1871, p. 102, and ed. of 1885, p. 951, in the same, measure as Stewart: Watt, Diet. Econ. Prod. India, 3,189D, p. 129, also in the same measure.

Dioscorea deltoides, Baden-Powell, Punjab Products, 1, 18B8, p. 259, excluding his reference to "kriss."

Dioscorea glabra, Hooker fil., Flora Brit. Ind., B, 1892, p. 294, as regards the plants from the Western Himalaya and as regards the synonym *D. sagittata* : Dollett, Flora Simlensis, 1902, p. 519.

Dioscorea glabra, var. *bdophylla,* Watt, Commercial Prod. Ind., 19D8, p. 494.

Dioscorea nummularia, var. *bdophylla,* Prain, Bengal plants, 2, 19D3, p. 19B7.

Dioscorea sagittata, Royle ex Voigt, Hort. Suburb. Dalcutt., 1845, p. 653 : Aitchison, Cat. plants Punjab and Sindh, 18B9, p. 148 : Atkinson in Gazetteer N.-W. Provinces and Oudh, 10, 1881 or 1882, pp. 349, 389, 602 and 7D3 : Watt, Diet. Econ. Prod. India, 3, 1890, p. 132.

Dioscorea sp., Aitchison, Cat. plants Punjab and Sindh, 1869, p. 148, no. 1201.

Tubers 1—3 in number, carried deep intD the soil on stalks which attain 40 cm. in length and have a thickness of 2—4 cm., the tubers themselves perhaps 20 cm. in length so that the apex is, say, BO cm. away from the base of the shoot; flesh white, very tender and edible : skin pale brown. *Stems* unarmed, purple-brown, often ridged, rather tough, up tD 4 mm. in diameter. *Bulbils* very abundantly produced. *Leavzs* sagittate-ovate, or sometimes the upper cordate-ovate, but there is less change in shape than in allied species ; in the larger leaves the sides of the basal sinus remarkably straight, the lower alternate or the upper opposite, in length commonly up to 15 cm. by 12 cm. in width, but sometimes very large leaves occur up to 30 cm. in length by 20 cm. in width, 5-nerved : the nerves of the first pair enclose a broadly oblanceolate or oblanceolate-elliptic area : the nerves of the second pair diverge from the midrib at an angle of 70—80° to become submarginal in the upper third of the length of the blade : the nerves Df the third pair curve in the lobes and give off a branch pedately to run along the inner margin of the lobe : the secondary nerves are markedly conspicuous, and cross the interspaces between the primary nerves obliquely and almost without elbows : the network also is conspicuous : the upper surface dark green, glabrous, with the nervation visible : the lower surface much paler, with the primary nerves very prominent and the others prominent: the margin scarcely strengthened : the petiole up to 11 cm. long.

Male flowers in spikes upon special leafless inflorescences of very variable length; sometimes su short that they do not ec[ual the subtending leaves, and sometimes much

elongated : axis glabrous, markedly ridged, up ID 3D mm. long with about 3D flowers: bracts subtending the spikes Dvate-acuminate, glabrous : bracts subtending the flowers Dvate, acute, D-5 mm. long, glabrous, scarious : bracteoles similar, smaller but relatively broader. *Sepals* pbovate from a broad base, incurved, obtuse, 1 • 25 mm. long, with red-brown dots. *Petals* shorter than the sepals, obovate, rounded above, scarcely 1 mm. long. *Stamens* 5, not quite equalling the petals in length, the anthers as long as their filaments. *Gynoecium* a cone with three points.

Female flowers Dn short solitary spikes, to the number of about 12 tD each spike : axis glabrous, somewhat angled : bracts long-deltoid. *Sepals* broadly Dvate, 1 mm. long, thick. *Petals* similar, but a little shorter. *Staminodes* small. *Stigmas* as three pairs of sickle-like organs. *Capsules* when ripe of a slightly tawny colour and subglaucDUS, with a stipe 3 mm. long, expanding upwards to a diameter of 2-5 mm. where the wings spring out at slightly less than a right angle, to curve round evenly to the retuse apex, their length measured along the placenta 15—18 mm., their greatest width 11—15 mm. : in rare cases the capsules are larger, the length measured along the placenta to 22 mm. and the greatest width tD 18 mm. *Seeds* with a red-brown wing all round in outline more or less conform tD the loculus. More rarely capsules occur, as on the mountain of Parasnath, with the apex very retuse (see fig. 13 on plate 127).

INDIA, upon very well-drained mountain slopes from the Himalaya of Kashmir and the Salt Range of the Punjab, eastwards to the Khasia Hills and southwards to the Nilgiri Hills.

Dioszorm belophylla flourishes upDn the very crests of steep hill-slopes. In the Himalaya it occurs in Jammoo and from JammoD to some little distance towards Srinagar in Kashmir, in long. 75° E.; and it passes eastwards to Sikkim, where it is so abundant that its further extension into the Himalaya of Bhutan, though not yet proved, maybe assumed. Its appearance upon Mount Tilla in the Salt Range of the Jhelum district carries its westwards dispersal tD long. 73° E. : its appearance in the Khasia Hills carries it eastward tD long. 92° E. Probably all the higher hill-tops of the Deccan Peninsular, southwards to the Nilgiri Hills, against which the clouds bank in the South-west Monsoon, carry it, as its needs are well supplied on them by the combination of their moist air with a rapid running away of the precipitation. Under the Himalaya it descends to the edge of thB plains : upwards it ascends to 5,DD0 ft. In the south of India there is one locality—Mangalore—where perhaps it occurs almost at sea level.

Within the wide range here indicated, a range represented on the map on plate 149, the species doea not break up into varieties unless the specimens |there are two) from Parasnath with deeply retuse capsules as described above, be regarded as representing a local variety. One of these two specimens was collected by Sir Joseph Hooker ; and the other by Mr. H. H. Haines at dates almost seventy years apart.

Stress must be laid on the circumstances that it passes further than any other deep-burying *Dioscorea* towards the north-west of India. In the Punjab it is known by the names " tarar ", " turar " ani " tarri " which are words for " yam " ; these have become its own names in the villages because there are no other similar species of *Dioscorea* with which to share them : but among men of better education and wider of experience—men of the towns who are acquainted with the cultivated yams, " tarri ", " tarar ", etc. do not single it out from its allies. Thus it is that in Joshi's *Dictionary of the. Pahari dialect* *Journ. As. Sou. Bengal*, N. S., 7, 1D11, p. 238) " tarri " is given as the equivalent of " ratalu ",—a true statement, yet inadequate, for "tarri" is both " ratalu " *D. alata)* and *D. belophylla*, and would include other species Df the same section of the genus, were they to hand. " Tarri " is a word which occurs in the Emperor Akbar's great Gazetteer, the *Ain-i-Akbari* of about 1530. In the Kamaon Himalaya it is met with as " talri ". In Forsyth's *Highlands of Central India* |1883, p. 10B), mention is made of a " torri ", which name is probably" tarri" again; but an importation.

Honigberger wrote in 1852 of a " tarar patts ", sold as medicine in the bazaars of the Punjab. Exactly what he indicated, i3 uncertain : but the word " tarri " ia perhaps present.

ThB tubers *ofD. belophylla* are delicate and good to eat: but as about half a metre of earth has *to* be remcved in order to obtain them, and as when got they yield no great amount of substance, it is rarely worth while to seek them. But still they seem to have been in local demand on the occasion of certain feasts DF fasts, for Aitchison apparently was writing of them when he recorded that " near Huahiarpur it was SD much sought " that the ground where it grew was " one maas of pits from the continuous digging for the tubers ". He wrote the name " thuri ". Baden PDWBII in his *Punjab Products,* p. 259, also mentions it, but imparts very little information. Gamble has recorded it as a famine food of the foot-hills of the Himalaya outside Dehra Dun in the Saharanpur district.

In the Simla Hills it furnishes a food permitted on fast days : and thence along the Himalaya to Sikkim it is consumed on a small scale. It is eaten also in the hilly districts tD the south of the Gangetic plains from Lolitpur, through Chata Nagpur to Drissa : but the names applied to it show by the rapidity with which one gives way to another, that its uses are local.

From being the yam or " tarri " of the western extreme of its distribution area, it becomes the " wild yam " or " ban tnrul " of Nepal and the " wild yam " or " pazok bok " of the Lepchas in Sikkim. The Lepchas also call it " singul bok " and "kanchen bok", while the Paṅadas, their neighbours, call it "panu torul" and " ghita torul," though in using the last name they cerrtainly err, for " ghita " is *D. bulbifura.* The Bhutias are said tD call it " nachray kyu ". Like *D. Wallkhii* it is " dura sanga " Dr " duri sanga " among the Santals and Kols : and this name has been met with in the Mirzapur district in the form " dhuru kanda ". " Haser sanga " or earth yam is another Kol name for it; and a third and a fourth are " hone sanga " and " unur sanga ". " Nandmati " is a Gond name, which reappears in quite a number of the districts of the Central Provinces Administration, in such forms as " nan kanda ", " nana mati ", " nun mati " and possibly also " lahan mati ".

" Belia kand " in Betul, and " barsal kand " in Nimar are erroneous names containing the Korku word [11] bai " : in these two districts the proper Korku names are " dardi " and " guri ". " Manmur " is said to be a name for it in the Jhansi district. " Lokheri " is a name used for it in the Belgaum Ghats.

This enumeration does not exhaust all the names which have been recorded for *D. belophylla,* but gives the more interesting ones. Others, such as " bada kanda " or hog's yam, and " sher kanda " or tiger's yam, as they are not strictly applied, only have an interest in showing want of familiarity with the species in those places where they arB in use.

The season of flowering is from October to December, in Northern India, and there fruits have not been obtained later than January.

INDIA, south Df the Himalaya. **4 a. Malabaria.** Sawantwadi state. Dn the boundary at Amboli, *Burkill*! North Kanara district. Birchy, *Talbot* 2244 ! South Kanara district. Mangalore, *Barber* 24D8 ! Ni1giri district. Kotagherri, *Perrottet* 308 ! Gudulur ghat, *Lawson* ! **4 c. Deccan.** Belgaum district. Without precise locality, *Ritchie*! Between Poondra and the crest of the Ghats at Amboli, *Burkill* 1B956 ! Amboli, *Burkill* 1B994! **4 d. Hindustan.** Jhelam district. Mount Tilla in the Salt range, *Aitchison* ID! Gurdaspur district. Pathankot at the foot of the Himalaya, *R. R. Stewart,* 1313 ! Saharanpur district. Kesamari, *Gambh* 2B432 ! (Northern Dudh.) Kheii district. Marha, *Inayat* 2282B ! Gonda district. Without precise locality, *K. Prasad* 23561 ! Gorakhpur district. Ramgarh, *Kalka Pershad* 248D1 ! |Northern escarpments of the Deccan.) Mirzapur district. Dudhi estate, *Dwarka Prasad* 21Q99 i¸ 2110D ! Budar, *Kalka Pershad* 18241 ! Banda district, teste Gazetteer of the N.-W. P. Maihar State. Sukwari, *Kalka Pershad* 20305! Jhansi district. Lalitpur subdivision, without precise locality, P^e214Dl! Deogarh, *Silberrad* 15235 ! Jaklaun, *Kalka Pershad* 34858! **4 e. Sub-subregiDn of Rains from the Bay of Bengal.** (Central Provinces.) Amraoti district. Makla plateau, *Burkill*! On a north hill-face between Ghatang and Sembadow, *Burkill* ! On the east slope of the Dhikalda ridge at 3,4DD ft., *Burkill* 31215 ! North of Belori at 3,0DD ft., *Burkill* 31188 ! Nimar district! Betul district. Gawasen, *Kalka Pershad* 20213 ! Hoshangabad district. Dhain, *Kalka Pershad* 2D245 !

Ciihindwara district ! Narsingpur district. Salechanka and Dhangan hills, in great abundance, *Chintaman Vishwanath* 14054 ! Mandrai, *Kalka Pershad* 2D2B4 ! Saugor district ! Damoh district ! Bhandara district! Balaghat district ! Jabalpur district. Karapani, *Kalka Pershad* 20298 ! and without precise locality, *Hole* 25965 ! Raipur district. Raipur, *Drake-Brockman* 15834 ! Dhamtari, *Edkul Prasad* 1B13B ! Bilaspur district. Kanai jungles, *Turner*! Ambanala, *Kalka Pershad* 20352! (Dircars-Orissa.) Godaveri district. Demunakonda, at 4,5DO ft., *Naranaswami* 664! Vizagapatam district. Without precise locality, *Barber* 1986! Ganjam district. Devagiri, at 2,300 ft., fairly abundant, *Burkill* 17935 ! Angu1 district. Purnakot, *Haines* 4035 ! Labangi, *Raines* 4D35 ! |Chota Nagpur and Sonthalia.) 'Singbhum district. Kiringka Lor, very common, *Haims* 488 ! Gidung near Monoharpur, *Kalka Pershad* 19720 ! Saitba forest, *Haims* 5114! Porahat, *Haims* 5117 ! Ranchi district. Grumla, *Mus. R. E. P.* 18624 ! Biru, *Cardon* 2 ! 3! 7! and 8! Hazaribagh district. Parasnath at 4,0DD ft., *Hooker* ! *Prain* ! *Haines* 5116 ! Upon the north face of Parasnath, *Anderson* ! and at 2,030 ft., *C. B. Clarke* 21322 ! 33668 ! 33830 ! Koderma, *Haims* 5110 ! Pa1amau district. Southern forest range, *Haines* 5111 ! 5112 ! Garu, *Haims* 4282 ! Sonthal Pergunnahs. Dhurwas near Rajmahal, *R. K. Das* 34788 ! (Northern Bengal.) Darjeeling terai. Without precise locality, *Trafford.* Jalpaiguri district. Western Duars, *Haines.*

HIMALAYA. **5 b. North-western Himalaya.** Kashmir state. Srinagar, *Badm-Powell.* Rajaori towards Serai, southwards from the Pir Panjal pass, *Jacquemont* 1337 ! Jammoo state. Jammoo, *Thomson* ! Chamba state. Masrund to Khalel, at 2,40D ft., *Laze.* 1841 ! Kangra district. In the Kangra subdivision, without precise locality, *Mus. R. E. P.* 21171 ! 21173 ! *Hart* 497 ! Simla Hill states. Kuthar near Kasauli, *Drummond* 6339 ! DhamD-ka in the state of Suket, *Kalka Pershad* 20D21 ! Simla, bebw 5,DOD ft., *Collett* 382 ! *Maddm* 12 ! JDTB in the state of Bhajji, *Kalka Pershad* 19013! Rampur, *Thomson.* Dehra Dun district. Kheyri pass, *Royh.* In the Dun, common,Thomson ! *Haims* 25342 ! *Gamble* 23963 ! *Smythies* 157 in part! Jhanmu, *King* ! Kalianpur, *Gamble* 25612 ! Mussouri, *King* ! *Gollan* 22144 ! Kempti falls, *R. R. Stewart* 11427 ! Thano, *Kanjilal* 1173 ! 117B ! Pao, between 3,000 and 5,000 ft., *Edgeworthl* Bunasur, between 2,DDD and 4,D0D ft., *Edgeworth* 80 ! Bagesor, at 3,0D0 ft.,' *Strachey and Winterbottom* ! Tehri Garhwa 1. Tons valley, at 4,D0O ft., *Gambh* 25135! Aimora district. Bhimtal, *without collector's name,* 352 ! Birmdeo at l,0D0 ft., *Strachey and Winterbottom* 3 ! Douglas-Dale near Jeolikot, *Mus. R. E. P.* 33253 ! **5 D. Central Himalaya.** Kingdom of Nepal. Adhabhar in the terai, *Burkill* 29449 ! North side of the Bichiakoh pass, *Burkill* 29519 ! North side of the Dhessapani pass, at 4,500 ft., *Burkill* 29617 ! Sinduri in the Likhu valley, *Burkill* 29896! Under Ka'kni towards Nayakot, *Burkill*! **5 d. Eastern Himalaya.** Darjeeling district. Duter slopes Df the ridge of Sittong, *Prain* ! Ghum pahar range, *Rughu Singh* ! Bebw Sureil at 4,5DD ft., *Burkill* 322D4 ! *Russell* ! Mungpu, at 2,5DD ft., *Russell* ! Pashok, *Munro* ! *Lister* ! Rungbi, *King* 5 ! *Russell*! Tungkhng, *Lister* ! Ramnu, *Kurz* ! Tista Bridge' common, *Burkill*! Rungnit valley at 2,500 ft., *Kurz* ! Badantam, at 2,DDD ft., *Nil Kanto Singha* ! On the Little Rungnit river at 2,DDD ft., *C. B. Clarke* 24843 ! Darjeeling in the Lloyd Botanic Garden, *Cave* 58! 588! Near Darjeeling, *Sunder Singh I* Pedong and below, 4,DDD to 5,DDD ft., *Burkill* 32257 ! State of Sikkim. Between Rishi and Rinchinpong, between 2,0DD and 5,OD0 ft., *Anderson* 1327 !

WESTERN INDD-DHINA. **1D a. Hhasi-Naga Hills.** Khasia Hills, Nunklow, *Hooker and Thomson* !

PLATE 127. Dioscorea bebphylla, *Voigt.* |1) A branch with male flowers and with bulbils, nat. size : |2) male flowers and a typical leaf, nat. size : |3) male flowers upon the angled axis of the spike, XlD : |4) the parts of the male flowers, X2D : |5) stamens : |5) the gynoecium of the male flower : |7) a bract and a bracteole, XlD: |8) capsules from Drummond's no. 6339 : |9) capsules : |1D) a seed in the capsule : |11) a seed : |12) outline of a very large leaf : (13) a capsule from Haines' no. 5117, illustrating the unusual shape which has twice been found upon the hill of Parasnath. Figs. 8—13, nat. size.

119. DIDSDDREA LEPDHARUM, Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 35 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 273 : Burkill in Rec. Bot. Survey Ind., ID, 1925, p. 388.

Tubers several, produced upon the ends of bng slender stalks which spread laterally in the soil as well as descend : the stalk may be as much as 50 cm. bng : towards the distal end it swells gradually into a tuber 5—ID cm. bng with a diameter of about 1-5 cm. ; flesh white and delicate. *Stems* unarmed, glabrous, with longitudinal ridges, which are sometimes very obscure, to the number of about eight. *Bulbils* abundant, large, from the size of a walnut, roundish or irregular and bbed in various ways. *Leaves* opposite or alternate, often exactly cordate but, equally often with the lobes slightly extended in a sub-hastate way, in texture thin, up to 13 cm. bng by 8 cm. in width, though most frequently about 10 cm. long by B cm. in width, 7-nerved : the nerves of the first pair enclose a narrowly elliptic-ovate area : the nerves of the second pair diverge from the midrib at about 8D° to become submarginal in the upper half of the length of the blade : the nerves of the third pair curve in the bbes and give off a branch towards the extremity of the lobes : the secondary nerves cross the interspaces very irregularly being scarcely differentiated from the network : the upper surface glabrous, with the primary nerves distinct, but the rest indistinct: the lower surface glabrous, with the larger nerves prominent and the network in a marked way very distinct: the margin of the blade is not strengthened : petiole up to ID cm. long.

Male flowers in spikes on long special leafless branches which attain 4D cm. in length and have rather bng internodes : the spikes 15—2D mm. long, their axes glabrous, angular, with ID—15 flowers: bracts triangularly ovate, repressed against the axis by the base of the flower, shortly acuminate, very thin : bracteole similar, but much shorter : buds from their swollen base, in the basal part rather columnar, then swelling and becoming conical above at the top. *Sepals* obovate from a broad base, thick, 1 -25 mm. bng. *Petals* DbDvate from a narrower base, not quite equalling the sepals, thick. *Stamens* 6, with filaments SD short as tD be Drily half as bng as the anthers. *Gynoecium* a small cone.

Female flowers in decurved spikes which are up to 25 cm. long: axis bearing about 2D flowers angled, glabrous: bracts broadly ovate, thin : bracteoles similar, shorter and relatively broader. *Sepals* triangular-Dvate, thick, blunt, 1 -5 mm. long. *Petals* obovate, rounded above. *Staminodes* small. *Stigma* as three pairs of sickle-like hooks. *Capsuhs* with a stipe about 3 mm. bng, widening upward to a diameter of 2 mm. where the wings spring out at fully 9D° to curve round evenly to the slightly retuse apex ; the wings very much broader than semicircular, 15-2D mm. bng by 18 mm. in breadth, the walls rather thin and greyish at maturity. *Seeds* with a dark smoky wing all round which is more or less conform to the bculus.

EASTERN HIMALAYA and the hills of ASSAM and northern BURMA.

As an aid in recognizing this species, the relative remoteness of the whorls DI spikes on the mab infioresDslices is useful.

The Lepchas eat the tubers, but state that the flesh is more fibrous than that of *D. glabra* and particularly more SD than that of *D. data.* They call it " chimeo tendeD bok "; but sometimes this name is applied by them also tD *D. glabra.* In cDDking, the white flesh is apt tD turn somewhat reddish. Owing to the many tubers which a well grown plant produces and the diffuse way in which they he, it may be laborious to dig for it and not always worth while.

We recognize two varieties :—

Leaves thin : capsule-wings evenly rounded ; the stems and leaves not coloured red at all .. .. var. *vzra.*

Leaves a little thicker : capsule-wings sometimes a little oblique : stems and leaves with a red tint in them .. .. ^r. *bhamoica.*

The latter variety was found in association with *D. Hamiltonii.* Dn one side *D. hpcharum* seems to approach *D. Wallichii* and on another the group of *D. alata.*

INDIA, south of the Himalaya. 4 e. Sub-subregion off Rains from the Bay of Bengal. |Northern Bengal.) Darjeeling terai. Pahar Ghumghumia jhar, *Gamble* 34D a ! Jalpaiguri district. Madarihat, on the bank of the Torsa river, *Burkill* 32352 ! *Kalkā Pershad* ! (Brahmaputra valley.) Nowgong district. Noncurbut, *Simons* ! Lakhimpur district. Kobo, Dn the bank of the Brahmaputra, *Burkill* 359 D5 ! 359 DB ! SaikhDwa, Dn the bank of the same, *Burkill* 35797 ! Sadiya, not uncommon, *Burkill* 32656 ! 35759 ! Niagaonnear Dibrugarh, *Burkill* 32511 !

HIMALAYA. **5 d. Eastern Himalaya.** Darjeeling district. Ryang, *Ribu* ! *Kari* ! *Russell*! Rebong, *Kari* ! Silake, *Ribu* 34222 ! *Pram's collector* ! Mungpu ! *Gags* 34214 ! 34216 ! *Ribu* 342D7 ! Near Mungpu at 1,5DD ft., *Hartlzss* 9 ! Grielle kola, at 1,DDD ft., *Russell*! Labdah, at 2,0D0 ft., *Russell* ! Below Pashok, at BDD ft., *Lister* ! Tungkling, at 2,CDD ft., *Lister* ! Mungwa, at 3,DDD ft., *Lister* ! Abor Hills. By the Yambung stream, at 9DD ft., *Burkill* 37683 ! North of Sissin, *Burkill*! Kekar-monnying, *Burkill*! Egar stream, *Burkill I* Renging camp, at 2,DDD ft., *Burkilll*

WESTERN INDOCHINA. ID **a. Hhasi-Naga Hills.** North Cachar. Under Haflonp, in the Mikir mauza, *Ballantine* 31828 ! and without precise locality, *Shaik Mokim* 26534! **1D b. Northern Burma.** Bhamo district. Opposite Bhamo town, Dn the bank Df ths Irrawaidy, |var. *bhamoica), Burkill* 228D8 ! 22814 ! 2282D ! 22824 ! 22825 ! 22828 ! 22829 ! 22831 ! 22842 ! and |var. *vzra) Burkill* 22843 ! 26538 ! Kachin Hills, *Shaik Mokim* !

PLATE 115, figures A to E. Dioscorea lepcharum, *Train and Burkill.* Bulbils to show their various shapes from Gage's no. 342D7, ^ nat. size.

PLATE 128. |1) A branch with male flowers from Gage's no. 34216, nat. size : |2) a flower, Xð: |3) the same dissected, XB: |4) a stamen, X ID: |5) a female inflorescence with capsules from a specimen collected by Kari in Sikkim, nat. size : |5) the underground parts, greatly reduced: |7) an unusual leaf collected by Ribu in the Darjeeling district. Inset, the distribution of the species.

119 a. DIOSCDREA *sp.* Burkill in Rec. Bot. Survey Ind., 10, 1925, p. 389.

During the Abor Expedition specimens Df a *Dioscorea* were obtained which cannot be placed with satisfaction, **but** may represent *D. lepcharum.* As the Expedition took place during the Cold Weather, these plants were not in full growth : and this accounts for the sterility of the material collected. The *Dioscorza* in question carried thin deltaidly cordate leaves measuring up to 13 cm. in length by 12 cm. in width, with the bwer surface shining. Its tubers had bng stalks. Its new shoots were obtained in March : and old shoots had been found in December.

INDIA, south of the Himalaya. **4 e. Sub-subregion of Rains from the Bay of Bengal.** [Brahmaputra valley.) L a k h i m p u r district. HobD, *BurJdll*!

HIMALAYA. **5 d. Eastern Himalaya.** A b o r H i l l s. Under Rotung on the bank of the Dehang, at 7DD ft, *Burkill* 37505 ! Between Rotung and Kalek, at 2,5D0 ft., *Burkill* 37480 !

12D. DIDSCDREA GLABRA, Roxburgh, Hortus Bengalensis, 1814, p. 72, name only: Wallich, Cat. lith., 1830, nos. 5105 A, 51D5 B in part, 5105 F, 51D5 I and 5105K: Roxburgh, Flora Ind., 3,1832, p. 8D3: Voigt, Hort. Suburb. Calcutt., 1845, p. 652 in part: Kunth, Enum. plant., 5, 1850 p. 383 : Atkinson, Gazetteer N.-W. Prov. and Dudh, ID, 1882, p. 602: Watt, Diet. Econ. Prod. India, 3, 189D, p. 313, in small part: Prain in Journ. As. SDC. Bengal, 6D, 1891, p. 329 : Hooker fil., Fbra Brit. Ind., 6, 1892, p. 294, in chief part: Haines, Working plans forests Jalpaiguri district 1898, p. xlviii: Gage in Rec. B_Dt. Survey Ind., 1, 1898, p. 353 : Prain, Bengal plants, 2, 1903, p. 1057, excluding the variety: Gage in Rec. BDt. Survey Ind., 3, 19D4, p. 10B, and 3, 1905, p. 288 : Ridley, Materials Flora Mai. Penins., Monocot., 2, 19D7, p. 83 : Watt, Dommerc. prod. India, 1908, p. 494, excluding the variety: Ridley in Journ. Roy. As. Soc. Straits branch, 59, 1911, p. 205: Draib in Hew Bull., 1912, p. 417 : Prain and Burkill in JDUHI. AS. SDD. Bengal, N! S. ID, 1914, p. 37, excluding the variety *salicifolia*: Duthie, Flora Upper Gangetic plain, 3, 1920, p. 256 : Groff, Ding and E. Graff in Lingnaam Agrin. Rev., *2,* 1923, p. 53 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 277, excluding the variety *salicifolia* and Arsin's specimen: Haines, Bot. Behar and Drissa, 1925, p. 1119: Burkill in Rec. Bot. Survey Ind., 10, 1925, p. 3B9 : Fischer in Gamble, Flora Madras Presidency, 1928, p. 1512 : Prain and Burkill in LecDmte, Flore geh. de 1' Indoch., 5, 1934, p. 742.

Dioscorea crepitans, Buchanan-Hamilton ex Wallich in Cat. lith., 183D, HD. 51D5F.

Dioscorea laurifolia, Curtis in Journ. Roy. Aa. SDC. Straits branch, 25, 1894, p. 149 ; not of Wallich.

Diosuma oppositifolia, Haines, Working plans forests Jalpaiguri, 1898, p. xlviii: Backer, Handb. Flora van Java, 3, 1924, p. 115, in part; not of Linnaeus.

Dioscwea nummularia Roxburgh, Hortus Bengalensis, 1814, p. 72, name only : Roxburgh, Flora Ind., 3, 1832, p. 8D3 : Voigt, Hortus suburb. Calcutt., 1845, p. 653 : Long in Journ. Agric. Hort. SDC. Ind., 10, 1859, p. 346 : Watt, Diet. Econ. Prod. India, 3, 1890, p. 131, in part: Ridley and Curtis in Journ. Roy. As. SDD. Straits branch, 33 ,1902, p. 56, in part: Heinig, List plants Chittagong collectDrate and hill-tracts, 19D7, p. 58: Haines, Forest flora Chota Nagpur, 1910, p. 529; not of Lamarck.

Dioscorea siamensis, R. Knuth in Engl. l'flanzenreich, iv-43, 1924, p. 281.

Dioscorea Wallichii, Hooker fil., Flora Brit. Ind., B, 1892, p. 295, as regards reference to Roxburgh only.

Tubers one, two or more, produced as swellings on the ends of long stalks descending from a woody knot of tissue at the surface of the soil; on this woody knot leaf-scales may at times be found : each tuber may attain 50 cm. in length with a diameter of about 4 cm., the stalk nearly as long as Dr sometimes longer than the swollen part of the tuber : flesh white, edible and delicate : skin earth-coloured, with a few rootlets. *Stems* climbing to a height Df about 8 m., those of the first and second years of the plant's life unarmed : but after that in the lowest 10 cm. close to the ground freely armed with abundant recurved prickles, above unarmed, glabrous, smooth, livid green. *Bulbils* not observed and probably never formed. *Leaves* rarely exactly ovate, commonly elliptic-ovate and in var. *longifolia* long elliptic-ovate, rounded or slightly cordate at the base : hastate leaves sometimes found and probably when found only due to abnormal conditions such as the removal of overhead canopy ; the blades of typical leaves very thin in texture and in wilting inrolling from the margins ; those of var. *grisea* somewhat firmer, 5-nerved : the nerves of the first pair enclose a narrowly obovate or lanceolate area : the nerves of the second pair diverging at 8D—9D^{D} to become submarginal in large leaves above the mid-length of the blade or, if the leaf-blade be hastate, to enter the lobes : secondary nerves rather straight but hardly to be distinguished from the network : upper surface dark green, glabrous, with the nerves inconspicuous : lower surface markedly glaucous, with the nervea prominent and in var. *grisea* drying to a light chestnut brown, the secondary nervea and the network just raised : petiole usually 4—5 cm. long.

Maleflmoers in spikes upon long leafless branches Dr branch-en dings, or more rarely in fascicles in leaf-axils : the leafless branches may attain 7D cm. in length and carry upwards of 15 false whorls Df spikes : spike up to 4 cm. long, its axis angled, glabrous, its flowers tD 25 in number usually so closely packed that they touch each other : buds subglobose above their broad base : bracts broadly ovate, shortly acuminate, hardly 1 mm. long, repressed by the base of the flower against the axis : bracteole similar but smaller. *Sepals* from a broad base ovate, obtuse, about 1 mm. long, glabrous. *Petals* a little shorter, obovate, rounded above. *Stamens* B, the anthers in length equalling the filaments. *Gynoecium* a three-pointed cone.

Female flowers in long decurved solitary spikes which attain 4D cm. in length and carry upwards of 5D flowers : axis glabrous, angled : bracts ovate, acuminate, about 1 mm. long : bracteoles similar, smaller. *Sepals* triangular-ovate, thick, about 1 mm. long. *Petals* similar, smaller. *Staminodes* minute. *Stigma* as three pairs of sickle-like hooks. *Capsules* pale glaucous green until they reach maturity, when they turn yellowish and then tawny: the stipe 4 mm. long, widening upwards to a diameter of 3 mm. where the wings spring out through an angle of about 9D^{D}, to curve evenly to a slightly retuse tip, their length measured along the placenta 15 —18 mm. and their greatest width 14—2D mm. *Seeds* with a broad smoky wing all round, conform to the IDCUIUS.

SDUTH-EASTERN ASIA, very widely : its northern limit is a line in the Himalaya from Nepal |lat. 84° E.) continued eastwards to the China Sea : its southern limits on the western side of the Bay of Bengal DCCUT at the Godaveri river in lat. 17° N., but on the eastern side of the Bay southwards about Penang in lat. B° N. and in Pahang in lat. 3^{D} 5D' N.

I), glabra and *D. nummularia* are so much alike that to unite them, as was done by Roxburgh, is quite reasonable. Yet Roxburgh was responsible for basing the species *D. glabra* upon other material and keeping it apart. The circumstances may be explained. Rumpf had found and figured the common wild EnantiophyllDiis *Dioscorea* of Amboina as *Vbium nummularium :* Lamarck therefore gave the name *Dioscarea nummularia* to it. Roxburgh, after a period of service in the Madras Presidency, had been called to Calcutta to take charge) of the East India Company's new Botanic Garden and in the immediate neighbourhood of it had found what the Bengalis call " shora alu." This plant, which we now know to be identical with his *D. glabra,* hB decided to. be *D. nummularia.* At that date, such a plant had not been found in India proper, though Bulkley, the Madras physician, had obtained it on a visit to Syriam in Burma. Thus with Roxburgh's finding Df "shora alu" WB begin: then in 1812 his correspondent in Sylhet, M. R. Smith, sent to the Calcutta Garden, material of the same species : it carried male and female flowers, as Roxburgh's drawing and specimens show : and the woody knot was present from which the tubers arise : but the tubers were not present. Roxburgh, as his *Horius Bengahnsis* indicates, planted the woody knot, hoping that it would grow, and needing a name attached " *D. glabra* " to it. At the same time he drew up a brief description for his manuscript *Flora Indiza.* Voigt's *Hortus suburbanus Calcuttmsis* indicates that the plant did not flower and it may be suggested that it did not live. The name which Roxburgh used, apparently tentatively, Wallich issued in 1S3D in his lithographed' Catalogue Df the East India Company's herbarium, but in no critical way, for he placed under it specimens of three other species.

Kunth in 1850, eliminating the other species, very fully described *D. glabra* on the specimens which Wallich had distributed : but to him Roxburgh's *D. nummularia* remained obscure.

Francis Buchanan (afterwards Hamilton) in 18D9 had found this species in northern Bengal, and like Roxburgh had identified it with Rumpf's Amboina plant: but by a slip, such as he rarely made, he took the name " Funis crepitans " from the pag_B facing but not belonging to Rumpf's figure $_D$f " Ubium nummularium " and adopted *Dioscorea crepitans tar* the plant.

Thus in 185D *D. glabra,* Roxb., had two synonyms—*D. nummularia,* Roxb, not of Lamarck, and *D. erepitans.* Buch.-Ham.

We distinguish *D. glabra* from *D. nummularia* in life by its thinner paler foliage ; and in the herbarium by their different colour, for *D. glabra* dries green with a little yellowish brown pigment unevenly diffused : but *D. nummularia* goes wholly the red-brown of infused tea-leaves. Geographically they do not meet; and this circumstance is very useful in herbaria when sorting somewhat indifferent specimens.

D. glabra grows in contact with *D. pyrifolia, D. oryzrtorum, D. lepchanim, D. bshphylla* and others.

D. glabra and *D. pyrifolia* meet and intermingle in the northern part of British Malaya. The parting line is hard to define. In the island of Penang every plant of this affinity is entirely glabrous and rather thin-leaved, and therefore by our definition it is *D. glabra*: but at no great distance away in the mainland the red-brown hairy coriaceous *D. pyrifolia* takes its place. Yet in the interior of the state of Pahang is another area where thin-leaved glabrous plants rule. These we call *D. glabra* and make a variety of ^ i n - var. j>a/iange7w̆w, for we recognize in them something not quite typical.

D. glabra comes into contact also with *D. oryzetorum.* The latter has no prickles about the base of the stem ; less copiously branched male inflorescences, or these are reduced to axillary spikes ; smaller capsules, and diffuse long-stalked rounded tubers. But the character of the tubers needs checking by further examination.

D. lepcharum also has diffuse tubers. Its male inflorescences are characteristically lax.

D. behphylla is never difficult to distinguish from *D. glabra,* though similar enough to have received the name *D. glabra,* var. *fclophylla.*

D. ^ ***abra*** **is** known to overlap in distribution the smaller areas of all these species except *D. nummularia* : this we have made clear in the maps given on plates 149 and 150 . As there indicated *D. glabra* is of general, if not universal, distribution through the Western and the Eastern Indo-Chinese phytogeographical subregiona', and has extensions over the borders into the Indian and Himalayan subregions on the west, the Malaysian on the south, and the South-west Chinese on the north, but only just into the last named. We call attention to the circumstance that *D. ghbra, D.pmtaphylla* and *D.hupiia* occur at Sze-mao in south-western China but are not known to penetrate that subregion more deeply. We observe that neither *D. glabra* nor *D. behphylla* reaches the southern-most parts of India, and that *D. hispida,* though it reaches the southern districts of

Indyi, does not cross into Ceylon; while *D. pentaphylla,* although in Ceylon, is not represented there by the short-tubered varieties characteristic of the more northern parta of India and the eaatward parta ufita diatributional area. The reader will find the distribution of *D. hispida* in a map on plate 85, and remarks on the interesting distribution of the varieties of *D. pentaphylla* on p. IBB. We suggest that *D. glabra* originated to the eastward Df India and is in process of invading the Dec can, in the way in which we think the short-tubered varieties of *D. pentaphyllahavti* done. They have followed up the contraction Df the Rain-forest vegetation in which the Indian Dipterocarps originated.

As *D. glabra* does not reach southern India, none of the earlier botanists in India knew it. Rheede'a staff never collected where it is to be found : the physicians in Ceylon, under the Dutch, like Hermann and Grimm, could not become acquainted with it, nor could the physicians in Madras under the British, like Samuel Browne. Bulkley, the only Madras physician who obtained it, did so because he crossed tn Burma. His specimens, labelled "Inhame species " passed through the herbaria of Sherard and Du Bois into the pDsaeasiDn of the University of Oxford, and may be seen in the collections of the University Botanic Garden.

When herbarium specimens of *D. glabra* are sorted geographically, a measure of dissimilarity ia observed in planta from different areaa, and we have given varietal namea to mark the differencea. These varieties may be arranged in a key :—

Leaves relatively large, those about the base of the inflorescence exactly cordate :

Texture very thin, drying green or almost green, slightly glaucous .. var. *vsra.* ^

Texture thin, drying an ashy grey .. .. .. *V<LT. pahangenti*.*

Leaves relatively large, those about the base of the inflorescence long-cordate, and all the leaves rather more elongated than in the above, a purple colour in them .. .. .. *VM. tincta.*

Leaves smaller and more elongated than in the first two varieties, when dry with a brownish colour .. .. .. *vv. hmgifMa.*

Leaves small and drying grey below : the cells of the lower epidermis with a lenticular surface which gives a velvety appearance under a lens .. var. *grisea.*

Leaves linear-lanceolate or lanceolate-sagittate ; probably only a seedling CDniition .. .. .. var. *tenuifolia.*

As in allied apeciea when overhead shade is removed from a plant at the time of sending up new shoots the leaves take an unusual shape : they develop large divergent auricles : this is forma *hastifolia* which we described as a variety in our *Synopsis.*

Var. *vera* is the plant of Bengal: var. *longifolia* is found chiefly in Indo-china : var. *grisea* occurs to the south of this : var. *pahangemis* and var. *tinda* are found in the Malay Peninsula. It haa been said that var. *tincta* can be uaed for colouring cotton reddish brown ; but its tinctorial efficiency must be small.

The tubers of *D. glabra* are eaten when it is worth while to go to the trouble of digging them out. Dnc$_B$ we found them on sale in a market: this was at Bassein in Lower Burma, and buying a sample we brought it into cultivation at Calcutta for determination. The plants, which we raised, proved to be quite typical. The Burmeae, however, make very little use of it, and in general call it "taw myouk" which may be translated "wild *Dioscarea alata :"* but that they should use the noun " myouk " indicates that they know it tu be good to eat TD the aDuth of the Burmeae among the Takings in the district of Tavoy "the myouk " is a name given to it. In this name the noun "myouk " is present again, but coupled with a qualifying word which deserves study.

Southwards again, the Negritos of Baling in the State of Kedah, within British Malaya, speak of it as "uoh" a word used in the form "wauh" for allied speciea such aa *D. gibbiflora,* (see p. 292) and connected with the widespread term " khDai " which means yam. The Sakai also call it " mankel," which may be a na[1]me borrowed from the Siamese. Malays in the same neighbourhood sometimes call it " ubi padane " or y of open places, and "gadong gajah" or elephant's *D. hispida,*—names of no consequence.

It is almost certain that *D. glabra* and *D. vexans* are jointly the "gono" or "gona" of the Andama'iese ahout Port Blair and the "mino" or "mina" of those further north. Man *The Andaman islanders,* ed. Df 1932, p. 12S) indicates that it is a rather important food of these primitive people. They dig it with a pointed stick, and cook it in Dne of three ways, roasting as found, or boiling, or baking wrapped in large leaves ; then they eat it when cold.

Its importance is made evident when the many circumstances are brought to mind under which it iB a prohibited food (see A. R. Brown, *The Andaman islanders,* 1922, chapter 2).

The Kachins call it "nai hkai." The Lepthas in Sikkim, call it "chimeo bok" or "shimeo bok."

As it docs not pass far into India, it has not been given the great wealth of names which its allies often have : but it is eaten along with them, where it occurs. N. N. Banerjee in his *Report on the Agriculture of thr District of Uuttack.* 1893, p. 187, records this for Cuttack. The Sonthals and Kols uncritically call it "unur sanga " in enmmor, with *D. btbvhylla* and use as well the names " dere sanga", "biru sanga " or "bir sanga, " and "janun sanga " apparently confining none of them to this species. The name "shora alu " used by the villagers *o!* Bengal has already been mentioned. "Kanta alu " or thorny yam is a name obtained in Drissa, applicable equally to other species : and "katha alu" or woody yam is from Chota Nagpur as indicating the hard woody knot of tissue whence the stem springs, is similarly widely applicable. "Bhat alu " or rice yam is a name from Malda, given in reference to the colour of the flesh.

The Savaras of the Ganjam hills call it "paro gai."

The Khasis eat it and the Abors cultivate it. "Man mu" is recorded as a name used for it in eastern Siam.

We owe our plate to the kindness of Mr. K. Biswas who obtained the material fur it from within the area where Roxburgh found his " shora alu " and who drew the details himself.

INDIA, south Df the Himalaya |all var. *vzra).* **4 b. Dunman delia.** K i s t n a district. Jidikuppa, on the Godaveri river, *Barber* 5342 ! **4 d. Hindustan.** (Northern Dudh.) G o r a k h p u r district. Ramgarh, *Kalka Pzrshad* 34602 **14 e. Slib-SUbregion of Rains from the Bay of Bengal.** (Circars-Orissa.) G o d a v e r i district. Bison Hill, *Barber* 5173 ! V i z a g a p a t a m district. Palkonda, *J. Campbell*! G a n j a m district. Parlakimedi, *Burkill* 17985 ! 17993 ! *Corey* 44 ! D u 11 a c k district. Jajpur, *Alhn* ! *Burkill*! Between Shishua and Balampur, uncommon, *Burkill* 27419 ! B a u d state. Tikapara, *Haines* 4012! An g u l district. Labangi in the Belong block, *Haines* 512D. Bobng block, *Haines* 5123 ! Tulka forest, *Haines* 24B2 ! Bagh mandu, *Haines* 5122 ! D h e n k a n a l state ! B al as or e district. Patharchakri near Baripada, *Kalka Pershad* 3432D ! M a y u r b h a n j state. Baripada, *Holmes* 33183 ! 34311 \ N i 1 g i r i state, *Kalka Pershad* 34303! (Chota Nagpur and Sonthalia.) S i n g b h u m district. Gidung near Monuharpur, *Kalka Pershad* 1970S ! Chakulea in Dhalbhum, *Gamble* 9212 ! Santara and Koderma forests, *Haines* 351 ! 435 ! 435a ! 687 ! 2352 ! R an c h i district. Rengareh and Biru, *Cardan* 7 ! 14 ! Dekhla, *Kalka Pershad* 34347 ! 34357 ! Between Kobbireh and Biru, *Kalka Pershad* 343BB ! Horhap, *Haims* 5113 ! M a n b h u m district. Hundrugagh, *Prainl* H a z a r i b a g h district. Hazaribagh at 2,500 ft., *C. B. Clarke* 210D2 ! S o n t h a l P e r g u n n a h s . Fulzhuree hiUs near Deoghar, *R. K. Das* 34518 ! Monalghat near Rajmahal, *R. K. Das* 34778 ! Maijur kol, *R. K. Das* 34787 ! HiUs near Simru, *Haines* 5121 ! |Tirhut.) B h a g a l p u r district, north of the Ganges. Sukha-nagar, on the west Df Nallipur, *Buchanan- Hamilton* in Herb. Wallich 5105 F ! (Northern Bengal.) D a r j e e l i n g t e r a i . Between Siliguri and Naxalbari, not common, *Burkill* 34109! Between Goridora and Kuprail, *Kurz*! Pahar Ghumghumia jhar, *Gamble* 340b! D i n a j p u r district. Dinajpur, plentiful on sandy lands, *Burkill* 27368 ! J a 1 p a i g u r i district. Muraghat in the Western Duars, *Haines* 48B ! Dipu, *Burkill*! Madarihat on the Torsa river, *Burkill* 32355! B o g r a district. Bogra,

H *B. Clarke* 26838 ! Pabna district. Serajganj, *Burkill* 24523! 24540! Maida district. Malia, *C.B.* PZarib 26954! (Western Bengal.) Birbhum district. Sanparpur, near Rajnagar, *A. Ahmad* 13912 ! Burdwan district. Burdwan, plentiful, *Burkill* 18953 ! 34522 ! Bankura district. Gangajalghati, *E. K. Das.* Midnapur district. Dhandrakona, *R. K. Das.* Hughli district. Hughli, *Shadr* ! Chandernagar, *Abu Husein* ! HDwrah district. Without precise locality, but as from "Lower Bengal," *Wallich* 5105a ! Shibpur, *Shadr* ! (Central Bengal.) Murshedabad district. Guas village, *R. K. Das* 34755! District of the Twenty-four Pergunnahs. Calcutta, *Edgeworth* ! Tollygunj near Calcutta, *Burkill*! *Kalka Pershadl* Dum-Dum, *Kalka Pershad* 2B58D ! Khu1na district. Khulna, *Hooper* 12558! Bakarganj district! (Eastern Bengal.) Without locality, *Griffith* 5524! Mymensingh district. Jaganathganj, common, *Burkill* 21439 ! 21442! Mymensingh, abundant, *Burkill* 21421 ! 2143D ! Gauripur, *Burkill* 2749D ! Gafargaon, *Burkill* 275D3! Khushrupur, *C. B. Clarke* 7953 ! Madhupur, *C. B. Clarke* 7778! Dacca district. Kaoraid, *Burkill* ! Narsingdi, *Burkill* 21477 ! Narayanganj, *Burkill* 24588 ! (Surma valley.) Sy1het district. Challum, *Griffith* 5542 K. D. ! and without precise locality, *Porteous* 139B7 ! Cachar district. Monier khal, near the Lushai Hills boundary. *Gage I* (Brahmaputra valley.) Goalpara district. Goalpara, *Burkill* 27459 ! Nowgong district. Noncurbut, ? *Simons* ! and without locality, *B. C. Das* ! Darrang district. Tengali Bam, *Prain's collector 13 1* 2D ! Sibsagar district. Namtidol, *L.Sarmal* Lakhimpur district. Dibrugarh, common, *Burkill*! Makum, *Burkill*! KobD, *Burkill* 37D82 ! Between Saikhowa and Talap, *Burkill* 32695 ! Saikhowa, *Burkill*! Sadiya, plentiful, *Burkill* 32BB7 !

HIMALAYA (all var. *vera).* **5 c. Central Himalaya.** Kingdom Df Nepal. Adhabhar, in the terai, *Burkill* 29445 ! Hettminda, Dn the north side of the foot-hills, *Burkill* 29537 ! 5 !• **Eastern Himalaya.** Darjee1ing district. Mungpu, at 1,500 ft., *Hartless* 8 ! Simpri near Mungpu, *Prain's collector* ! Silake, *Prains' collector* ! Pashok, *Lister* ! Kalimpong division, at the foot of the hills, *Cowan* ! AbDr Hills. Pangi, upon a clearing at 3,500 ft., *Burkill* 37772 !

SDUTH-WEST CHINA (var. *longifolia).* **8 b. Province of Yun-nan**. Sze-mao, at 4,5DD ft., *Henry* 13540 !

EASTERN INDO-CHINA. **9 b. the Kwangs.** Province of Kwang-si, without locality, *Ren Chang Ching* 7252 ! 7523 ! Long-tcheou, *Simond* ! Hai-nan. Nodoa, Sha-pD-ling, *MzClure* 8199. 9 C. **Tonkin** (var. *vera).* Province of Lao-kay. Between Phu-lun and Thon-ba, *Lecomte and Finet*! Province of Lang-son. Lang-nac, *Eberhardt* 33BB ! Province of Quang-yen |var. *longifolia)* . Tan-keuin, on hillsides, *Balansa* 298 ! 301 ! **9 1 Anam** (var. *vera).* Province of Thua-thien. Bai-ka, towards 30D m., *Eberhardt* 2487 ! Province of Nha-trang [var. *longifolia).* Binh-thanh, *Robinson* ! Province of Binh-1huan. Ca-na at 70D—BDDm., *Poilanz* 124D3 ! Phan-thiet at the tomb of the Mandarins, *Evrard* 17D4 !

WESTERN INDD-CHINA (all var. *vera* except three). **ID a. Hhasi-Naga Hills.** Khasia Hills. Without locality, but probably MahadeD under Cherrapunji or else Myrung, *Griffith* 5543 K. D. ! Nongpriang, at 2,5D0 ft., *C. B. Clarke* 15234 ! "Living bridges," *Hooker and Thomson* 22D4 ! Wahjain, at 1,D[)D ft., *Burkill* 35117! **10 b. Northern Burma.** Bhamo district. Dn the Yun-nan expedition, but precise locality not recorded, *J. Anderson* ! BhamD, *Burkill* 22821 ! 2282B ! Katha district (var. *tmuifolia).* Katha, *Burkill* 22655! **ID C. Dhittagong-Arahan.** Chittagong district. ChittagDng, *Hooker and Thomson*! *Lister* ! Hazarikhil, *Hooper* 25513 ! 25028 ! *Heinig* ! Dhakaria, *Heinig* 26111 ! Srimati, *Cowan*! Kalimchora, *Hooper* 25851 ! Gurjania, at

1DD ft., *Heinig* 26258! Lushai Hills. Demagiri, at 5DD ft., *Gage* 252! Chitta$_r$-g$_D$ng Hill-tracts. Kodala hill, *Badal Khan* 119 ! 549 ! 572 ! Fenoa hill, *Badal Khan* 27! Northern Arakan district. Waseru choung, opposite Nataran, *Burkill* 27953 ! Akyab district. On the north border towards Nataran and near Bedun, *Burkill* 27975 ! Kyauktaw, *R. K. Das* 28217 ! Hills between Buthidaung and MaungdDung, *Burkill* 28D47 ! **ID d. Dry Central Burma.** Shwebo district. Yen, *Mus. R. E. P.* ! Minbu district. Without locality, *Gage.* Prome district. Prome, *Burkill*! Ta-taung-bn, *Burkill* 23842! Pa-doung, *Burkill* 23830! **10 e. Lower Burma.** Without locality |var. *tenuifolia), Kurz* 2631 in part! Bassein district. Diamond island, *Train* !Pegu district. Pegu, *Christie* 219D3 ! *Brandis* ! Kyauktaga, *Burkill* 21979 ! 21990 ! 22120 ! 22121 ! Pegu yomas, *Kurz* 480 ! 2631 in part! Hantha-waddy district. EangDDn, *McClelland* \ GyDgun and Victoria Lake, *Parkinson* 14DD8 ! 15190! Unlocalised but probably Syriam, *Bulkley*! **10 f. Shan Plateau.** Northern Shan States. State Df Hsi-paw, at Mansang, at 2,500 ft., *Burkill* 24175 ! State of North Hsenwi, Lashio, at 2,500 ft., *Burkill* 22537 ! Southern Shan States. State of Hsa-Mijng-Hkam or Thamakhan, *Abdul Khalil*! **10 g. Siam.** Circle of Payap. Doi Sutep, in scrub-jungle at 1,100 ft., (the type of *D. siamensis), Kerr* 1485 ! Circle of Prachinburi. Sriracha forest, *Mrs. D. J. Collins* 1544 ! Aran Pratet, P^31D7! Circle of Dhantaburi. Kaw Chang, at Klawng Nonsi, *Kerr* 9155! Ma Kawn, Chantaburi, *Lakshnakara* 488 ! Pran, *Put* 2464 ! Circle $_D$f Ra*a*hasima. Lat Bua-kao, Korat, *Put* 4348 ! **1D h. LaDS.** State of Luang Prabang. Luang Prabang, *Massie* ! Province of Savannakhet. Near Savannakhet |var. *longifolia), Poilane* 119D4 !

MALAYSIA. **11 a. Warm moist French Indo-China.** (Cambodia.) Province of Kandal. Pnom-penh, *Godefroy*! *Pierre* 1386! |Lower Cochin-china.) Without localities, *Talmy*! *Counillon* (doubtful)! *Godefroy* ! Province of Biên-hoa. Bien-hoa, *Thorel* 287 \ Between Bien-hoa and Saigon, *Lefevre* 11D! Plain of Qui-hoa, *Lefevre* 163 ! At the river Be, *Pierre* 6395! Tri-huyem, *Pierre* 1386 bis! Province of Baria. Cap S. Jacques, *Poilane* 552 ! Island of Poulo Condor, *de Lanessan* ! *Germain* ! *Talmy* ! **11b. Tenawerim.** Amherst district. Moulmein, *WaMich* 5103 F ! *Burkill* 23875 ! 23909 ! 23959 ! Choung-zon on the island of Bilu-gyun, *Burkill* 23987 ! Amherst, *Wallich* 51011! Dawna hills between Kawkareik and Thingan-nyi-nawng, *Burkill* 24338 ! 30356 ! Myawadi on the Siamese frontier, *Burkill* 24433 ! Mergui district. Mergui, *Griffith* 5559! 5561 ! **11 C. Andaman and Nicobar islands** (all var. *vtra.* except one). Great Coco Island, common, *Prain* ! Li11e CocD island, *Prain* ! Table island, *Prain* \ Barren island, *Pr ain* ! South Andaman islands. Port Blair, *King's collector* 559 ! Aberdeen, *Kurz*! Termaklu island, *Kurz* ! Goplakabang valley, *Heinig*! Ali Musjid hill, *King's collector*! Tusonabad, *King's collector*! Mount Harriet, *Prain*! Anikhet hill, *King's collector*! Balughat hill over Port Mouat, *King's collector I* Hobdaypur, *King's collector*! Bajajag valley, *Heinig I* North Bay Hill, *King's collector* ! Bamboo-flat Hill, *King's collector* ! Rutland island, on the headland t$_D$ the north of Dyer point, (the form *hastifolia), Rogers* 278 ! Nicobar islands. Kamorta, *Kurz* ! *Telenck* 26 ! **11 d. Peninsular Siam** (var. *grisea).* Circle of Rachaburi. Prachuap at Hua Hin, almost at sea-level, in open scrub, *Kerr* 13438 ! 13518! Prachuap, *Put* 268! Kaw Tao, Dn a rocky peak, *Kerr* 1BD84 ! Circle of Surat. Kaw Pangan, *Put* 1152 ! Circle DfNakawnSritamarat. Ta Samet on the edge Df evergreen forest, *Kerr* 14330 ! Kaw Yaw near Singgora, *Annandale*! Hat Yai, in scrub, *Kerr* 13545 ! 13655 ! Padang Besar, in scrub, *Kerr* 13595 ! 13549 ! Circle of Puket. Takowapa, *Mohamed Haniff and Mohamed Nur* 2072 ! Krasom, *Mohamed Haniff and Mohamed Nur* 3625 ! Pangnga, on Pulau Tebun, *Mohamed*

ffaniff and Mohamed Nur 3573 ! 36DO ! 3522 ! 3625 ! Ranawng, at Nam Dhut, *Kerr* 11715! Satul, on the edge of mangrove swamp, *Kerr* 14244! TerutaD island, in scrub, *Kzrr* 14170! **lie. Malaya.** State of Perlis. Pulau Rabano, *Henderson* 23D98 ! Kangar, in a hedge, *Henderson* 22894 ! Bukit Ketri, *Henderson* 22977! State of Kedah. Bukit Wang, *Mohamzd Haniff* 543 ! Langgar, *Burkill and Mohamed Haniff* 13338! Baling, *Schebestal* Kedah Peak, at 3,7D0 ft., *Mohamed Haniff* 513! *Mohamed Haniff and Mohamed Nur* 4742 ! Langkawi islands, *Curtis* 2613 ! 2614 ! and at Kuwah, *Curtis* 2121 ! *Moharmd Haniff and Mohamed Nur* 7058 ! and also at Kasap, *Curtis* ! Lunas estate, *Burkill* 141 ! 143 ! Settlement of Penang. Without precise locality, *Wallich* 51D5 G ! Government Hill road, between sea-level and 2,50D ft., *Kunsthr* 1315! *Burkill 531 I* 589! 11D5 ! 11D7 ! 1182! 119D! 1228! 1491! 1537! 1539! 2553! 3343! 4154! *Curtis* 53! 1413! 1504! Waterfall Gardens, *Burkill* 401 ! 1181! 1182! 1240! 5573! 76D1 ! Highlands reserved forest, *Mohamed Nur* 1195 ! 1198 ! 2434 ! Ayer Etam, *Burkill* 1452 ! 1463 ! 1454 ! Penara Bukit, *Burkill* 1466 ! 1467 ! 1468 ! 1470 ! *Curtis* 1D88 ! Moniot's road, at 1.8D0 ft., *Burkill* 1489 ! 149D ! 2425 ! 2427! 2584! 2689! Balik Pulau, *Ridley's collector* 12562! At and above the Ginting pass, *Burkill* 3054 ! 4516 ! Sungai Nipah, *Burkill* 4551 ! Batu Feringhi, *Burkill* 471! Province Wellesley. Tasek GelugDr, *Ridley* 6985! *Burkill* 6603! Bukit Mertajam, under the hill, *Burkill* 2543 ! Machang Bubo, *Burkill* 3D64 ! State of Perak. Taiping, in the plain, *Wray* 559 ! Tanjong Pondok, *Burkill and Mohamzd Haniff* 13235 ! Klian Intan, *Flippant* 7588 ! Grik, *Burkill and Mohamed Haniff* 12384 ! 124D8 ! 13821 ! 13842 ! Taiping Hills, Dn the north side of Birch's Hill, at 4,200 ft. |var. *tincta), Burkill and Mohamed Haniff* 13D16! 13020! State of Pahang. Kuala Lipis |var. *pahangensis), Burkill and Mohamzd Haniff* 15673! 17083! Between Kuala Lipis and Benta |var. *pahangensis), Burkill and Mohamed Haniff* 17158! Batu Balai |var. *pahangensis), Burkill and Mohamed Haniff* 15827 ! Sungai Pertang in Ulu Tembeling Ivar. *pahangensis), Henderson* 22105 ! Between Jerantut and Kuantan, near the Sungai Lepar |var. *pahangensis), Burkill and Mohamed Haniff* 17459 ! Raub |var. *tincta), Burkill and Mohamed Haniff* 15771 a ! Gorge of the Sungai Tras near Raub, at 500 ft., |var. *pahangznsis), Burkill and Mohamed Haniff* 15945! Sungai Sipam near Raub |var. *pahangensis), Burkill and Mohamed Haniff* 16857 ! Fraser Hill at 4,D00 ft. |var. *tincta), Burkill and Holttum* 8432 ! Under Fraser Hill in the upper Tras valley, at 3,750 ft. |var. *tincta), Burkill* 7860! Semangko pass |var. *tincta), Burkill* 7889! **11 f. Sumatra.** Residency of the East Doast. North of Deli on the border of the State of Acheh (Achin), *Bangham* 539 !

PLATE 131. Dioscorea glabra, *Roxburgh.* |1) the base of the stem and the woody knot from which it arises, nat. size : |2) a part Df the stem below that which bears flowers, nat. size: |3) male inflorescences nat. size: |4) a part of the stem bearing female inflorescences, nat. size: |5) a male spike, X 4: |6) the parts of a male flower, X 8 : |7) a half-ripe capsule, X 2 : |8) ripe capsules, nat. size : |9) a half-ripe eapsule in section, X 5: |10)the female flower, X 5. All drawn from life, from plants obtained near Calcutta.

120 a. DIOSCDREA sp., Burkill in Rec. Bot. Survey Ind., 10,1925, p. 389.

A yam which ia perhaps best placed if regarded as a form Df *D. glabra* was collected for us by an assistant at Cherrapunji in tbB Khasia hilla, and again found twice in the Abor Hills. It has very large perfectly glabrous leaves Df a dark green ; and its tubers are said, by the Khasis, to be very gDDd to Eat. They call it "phan tung". Upon all three occasions it was sterile : and an attempt which we made to cultivate it in Calcutta failed.

HIMALAYA. **5 d. Eastern Himalaya.** Abor Hill s. Janakmukh, at 70D ft., *Burkill* 35453 ! Above Yambung Dn " Signal Hill," at about 2,000 ft., *Burkill* 37713 !

WESTERN INDOCHINA. **10 a. Khasi-Naga Hills.** Redumeo, near Dherrapunji, *X. K. Das* 34947 !

121. DIOSCDREA VEXANS, Prain and Burkill in Journ. As. Soc. Bengal, N. S. 4, 19D8, p. 456, and 10,1914, p. 38 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 278.

Tubers edible, several, elongated after the fashion of those of *D. glabra,* carried tD a depth of about 5D cm. Dn stalks which descend from a WDDdy knot. *Stems* rather slender, with slight longitudinal ridges, glabrous, unarmed in the upper parts, but armed close to the soil, green or reddish. *Bulbils* not observed. *Leaves* opposite or subopposite, thin in texture but not curling from the edges SD conspicuously in wilting as do those of *D. glabra,* the largest cordate to ovate-cordate, sometimes somewhat hastate, acuminate, up to 15 cm. bng by 10 cm. in width, or the upper leaves which are associated with flowers about 8 -5 cm. bng by 6 -5 cm. in width and then instead of being cordate at the base with the petiole just expanded into the blade, 5-nerved : the nerves of the first pair embrace an area much more ample than in *D. glabra,* an area which is elliptic-obuvate, acuminate below and slightly shortly acuminate towards the apex : the nerves of the second pair run close to the margin and end about the mid-length of the blade : the secondary nerves cross the interspaces with one or two elbows : the network has a rather coarse mesh : the upper surface is glabrous with the larger nerves just raised: the lower surface is paler then the upper, glabrous with both primary and secondary nerves prominent and the network just raised, all being brownish tawny in colour when dry: the margin also brownish tawny: petiole up to 6 cm. long.

Male flowers densely packed on spikes which are grouped in fascicles in leaf-axila or more commonly arranged on special leafless branches or branch-endings : these leafless branches may attain 4D cm. in length : the axis of the spike winged, somewhat zigzag, up to 18 mm. in length, with 15-25 flowers : bracts strongly repressed against the axis by the base of the flower, ovate, acuminate. *Sepals* broadly ovate, obtuse, concave, thin, marked with short brown lines when dry, with a sub-hyaline margin, 1 -5 mm. long. *Petals* obovate, shorter than the sepals, but not thicker, marked also when dry with short brown lines. *Stamms* 6, the anthers introrse and in length equal to the filament. *Gymecium* a cone with three small points.

Female flowers on solitary or paired decurved spikes, which may be as much as 22 mm. lone • axis glabrous, conspicuously angled : bracts ovate, acuminate, brown, 1 -5 mm. long : bra-teole shorter and relatively broader. *Sepals* ovate, obtuse, concave, not thick, 2 mm. bnB *Petals* oblanceolate, thick, shorter. *Stammodes* 6, small. *Stigmas* as three uairs of small recurved hooks on a three-sided column. *Capsules* just before maturity dull tawny; stipe snort, *L—O* mm • i«"g» r . 4- \.™+ <? q mm lone widened upwards to 3 mm.; the wings arising at about *W* nearly evenly rounded, but the capsule a little retuse above, 15 mm. long by 12 mm. in width. *Seeds* with a brown wing all round more or less conform to the loculus.

ANDAMAN ISLANDS.

Th is s ies • r A \r> til* narts of the Andaman islands not remote from Port Blair. It is . h T f r o n ^ X of wh°h it seems to b E a mutant, by the way in which the nerves of th B first ^tinguis hed from *D. gU*** pair embrace a wider a m. It has also rts seem ^ ^ &xactly ^ ^ rf R *glabra* and it is mor : nit :1 , are USBd to d , * D. *glabra.* dou I a L W: -ong the B.jgyah " k.nuda" ; among th B B ea and th B Balawa Among the Yeras it is "gona."

In the Andaman Islands it flowers in October and November and may carry still unripe fruit in January : but when we cultivated it in Calcutta its growth came to an end in November with the advent of the cold wpnther.

MALAYSIA. **11 C. Andaman islands.** South Andaman islands. Port Blair, on rocky hills, *King's collector* 553 ! 569 ! Bajajag valley, *Heinig* 115 ! Namuna ghar, *King* ! Port Mouat, on forest-clad hills, *King's collector* ! Balughat near Port Mouat, *King's collector I* Baratang island, *Rogers* !

PLATE 13D, right side. Dioscorea vexans, *Prain and Burkill.* (1) A branch with male flowers from King's collector's no. 569, \ nat. size : (2) flowers, X 3 : (3) the same dissected: (4) stamens, X 12 : (5) gynoecium of the male flower, X 12: |5) a bract and a bracteole, X 5 : |7) leaves with female flowers from Heinig's no. 115, \ nat. size : |8) capsules, \ nat. size : \9) a capsule in section; |1D) a capsule with immature seeds : (12) one of the immature seeds.

122. DIOSDDREA ORYZETORUM, Prain and Burkill in Kew Bull., 1927, p. 242, and in Lecomte, Flore gen. de 1' Indoch., B, 1934, p. 742.

Tubers globular, as thick as the thumb when well grown, on long stalks which spread in the soil to a distance of about 50 cm. and are sometimes branched. *Stems* glabrous, unarmed, smooth or very minutely scaberulous Dr with tiny hairs in a ring at the base Df lateral branches. *Leaves* opposite, varying considerably in breadth on different individual plants; some plants carry leaves which are qua drat ely elliptic-cordate, others carry leaves which are ovate-lanceolate, and yet others carry leaves which are linear-lanceolate above a rounded base : the leaves always dry a light green and produce little of the liver-coloured pigment seen in allied species : they are quite glabrous, 5—7-nerved : the nerves of the firstpair in broad leaves enclose a narrowly obovate area, and in narrower leaves an Dblanceolate area and in the narrowest leaves a linear-lanceolate area, the greatest breadth of the enclosed area being in proportion to the greatest breadth of the blade about one-half: the nerves of the second pair run at a little distance within the margin of the blade : the upper surface glabrous, with the nerves distinct, but the network obscure : the lower surface glabrous, with the primary nerves conspicuous and the others distinct: petiole in the broad leaves \—£ as long as the blade, but if the leaves are narrow often less than \ : this shortness is remarkable.

Male flowers in spikes which are commonly fascicled in leaf-axils, but are also produced on short leafless or nearly leafless branches or branch-endings ; these leafless branches may be as much as 12 cm. long, but are more usually about B cm. long : at the very base of such branches a few minute hairs may be carried : the spikes bear 15—50 flowers along a very thin axis which attains at the most 4D mm. in length : bracts smooth, light brown, rather rigid, ovate when, as sometimes is the case, the bud is directed obliquely forwards, standing at a right angle to the axis, but more commonly repressed by its base and curving round it: bracteole similar in structure, smaller and relatively broader so as to be deltoid. *Sepals* light brown when dry, ovate from a broad base, obtuse above, 1 mm. long. *Petals* oblanceolate to sub.spathulate, somewhat shorter than the sepals, thickest above. *Stamens* B, with very short filaments.

Female flowers to the number of about 30 on a decurved spike : axis angled : bracts ovate. *Sepals* broadly ovate, 1 mm. long. *Petals* roundsd, thick. *Staminodes* minute. *Capsules* directed forwards, small in comparison with such species as *D. glabra,* smooth, sub-glaucous : stipe 3—4 mm. long, the wings expanding from it at a wide angle so that the

base of the capsule is more or less truncate, broader than semicircular, up to 14 mm. long by 11 mm. in width, the apex very slightly retuse. *Seeds* conform to the loculus, winged all round with a chestnut wing.

SIAM and CAMBDDIA, on ditch and canal banks, and in low-lying spots, often among trees.

This species seems to be very plentiful in the neighbourhood of Bangkok, and to spread through the plaina of the lower Me-nam river south of lat. IB^0 N.; that is to say, where they are most heavily flooded in the south-west monsoon. The conditions are interesting. In the dry weather the water-table in the soil sinks far • then in the rains there is complete saturation. It is on low banks in this flooded land that the *Dioscorea* grows • and thera apparently in abundance. It flowers as the rains diminish and fruits in December, January and February.

These plains are only a few feet above mean sea-level.

It has been collected also at various places close to the coast in Peninsular Siam and also on the east side of the Gulf of Siam. It has been found at Aran Pratet on the Siamese- Cambodian border in the valley of the river Phai which runs down to the Tale Sap, and is sure to occur in the wide swampy lands to the eastward in which the Tale Sap lies. It has been collected in Cambodia a little to the north.

In some ways the habitat resembles that of *D. glabra* in the lower Gangetic plains, where the countryside is equally a vast expanse of flooded rice-fields at the time when the JK$_{MBDreB}$ i$_{smDst}$ v$_{igDrDUS}$ v$_{egB}$t$_{a}$t$_{i}$v$_{E}$l$_{vani}$ where the water-table falls considerably in the dry season. A closer comparison than we can give seems desirable.

The way in which the tubers of *D. oryzztorum* spread in the soil should be investigated; but scarcely in expectation of establishing a direct connection between this habit and the condition of the soil, since *D. hpcharum* and *D. vrbnulata* have spreading tubers but live in soil which is not waterlogged.

The palB grByish-green colour which tiiB leaves assume in drying is characteristic.

The shape of the leaves varies greatly and there is variation also in the length of the petiole which in the very narrow leaves is disproportionately short. But broad and narrow-leaved plants grow together sometimes intertwined, and we see no differences between them other than these. However it is convenient to define varieties on the shapB of tliB leaves and WB recognize thesB three :—

Leaves up to 9 cm. long by 7 cm. in width, with the bas$_B$ just cordats, contracted abruptly to the apex, so that the general outline is quadrately elliptic •; thB nerves of the first pair enclose a narrowly obovate arsa . . . . . var. *lahfolia.*

LeavBS long-ovate or ovate-lanceolate towards the apices of ths stems, up to 8 cm. long by 5 cm. in width or narrowsr ; the nervea of the first pair encloSB a n oblancBDlate area . . . . . var. *mediifolia.*

Leaves from a rounded basB lancsolate-linear, up to 7 cm. long by 1 cm. in width | the nerves of the first pair Bnclose a linear area . . . . . var. *angustifolia.*

Dnly one fruiting apscimen of var. *anguOifMa* has been seen. The infructescences on it are short as in *D. calcicola* ; but in foliage it is abundantly distinct from that species. In the larger leaved varieties the infructescenses are like those of *D. glabra,* except for the smaller size of the c DS 1 a, ues.

The vernacular names recorded for this species, do not indicate much . Mra rui;- n J i. .> >> . , . , _ , . • . ,, r , Loluns called it manmu or hand yam, on account of the diverging stalks of the tubers which suggest fingers. She called it also " man dDang " and states that the tubera under this name may be eaten steamed in curries. Dr. Kerr called it " man nok " which is not a distinctive name, but is used also for *D. bulbife,ra,* and Put " t ao man no-t." " Man t a t" is also recorded forit.

WESTERNINDD-CHINA. **ID g. Siam, exluding the Peninsula.** Circle of Chan-t a b u r i. Sai, Ban Tap |var. *latifolia), Kerr* 9689! Dhantabun, Ma Karm, in mixed forest,

Lakshnakara 535 ! Circle of Ayuthia. Angtawng, *Put* 2544 ! Circle of Prachinburi. Bangkeng, Krabin in open scrub, *Kerr* 19850! Srir a ch a, common in the forest |var. *latifolia), Mrs. D. J. Collins* 984 ! 1343 ! 1443 ! 1542 ! 1545 ! Sriracha forest, |var. *mediifolia), Mrs. D. J. Collins* 256! lD4i! Aran Pratet, in open forest, *Kerr* 19513 ! Circle of Krungtep. Tonburi, Wat Sing, among bushes by a ditch |var. *angustifolia), Kerr* 9347 ! Bangkok, by a ditch jvar. *latifolia), Marcan* 1817 ! Bangkok, in a hedge *vai.mzdiifolia), Kerr* 9352 ! Dn a canal bank and on ditch-sides |var. *mediifolia), Marcan* 1D44! 182B ! 1827! 1828! 1838! Bangkok |var. *angustifolia), M arc an* 451 ! #en-45D! 787D! 9353! Klawng Rangsit, in scrub, (var. *angustifolia) Marcan* 1506 ! Without locality, but doubtless near Bangkok |var. *latifolia), Bradley* !

MALAYSIA. 11 **a. Warm moist French IndD-China.** (Cambodia), Province Df Siem Reop. Between Anbng Pruing and Anbng Veng near the mountains of Dangrek, |var. *latifolia), Poilane* 13948! **lid.** Peninsular Siam. Circle of Rachaburi. Hua Hin, Prachuap, *Kerr* 13427 ! Circle of Surat. KaD Tao, in dry evergreen forest at about 2D m. above sea-level |var. *latifolia), Kerr* 11135 ! KaD TaD, common in dry evergreen forest jvar. *mediifolia), Kerr* 11135 a ! Champawn, Sapli, *Put* 1D2B ! Yanyai, in scrub, |var. *mediifolia), Kerr* 18188! Circle of Nakawn Sritamarat. KaD Chem, Tung Song, *Rabil* 114 !

PLATE 133, right side. Dioscorea oryzetorum, *Prain and Burkill.* |1) A branch with male flowers from Kerr's, nD. 9347, being var. *mediifolia,* showing axillary spikes, \ nat. size: |2) twin axillary branches from Kerr's no. 19561, the lower a leafless inflorescence, the upper a leafy branch with alternate and opposite leaves in the axila of which are male flowering spikes, \ nat. size : |3) the lower half of a spike from the same, x5 : |4) a sepal, |5) a petal, and (5) a stamen, X5: |7) a part of the stem of a plant of var. *latifolia* with female flowers from Kerr's IID. 9349, \ nat. size : |8) capsules from Marcan's no. 1506, \ nat. size : |9) a seed from the same, \ nat. size : |1 D) a leaf of var. *angustifolia* from Kerr's no. 9347, \ nat. size: |11) underground parts, reduced tD j, from a plant of var. *angustifolia.* Inset, the distribution of *D. oryzetorum.*

123. DIOSCOREA GRACILIPES, Prain and Burkill in Kew Bull., 1925, p. 53, and 1927, p. 244, and in Lecomte, Flore gén. de 1' Indoch., 6,1934, p. 738.

Underground, parts unknown. *Stems* firm, wiry, terete, glabrous. *Bulbils,* none seen. *Leaves* opposite, broadly lanceolate, tapering to the mucro, rounded at the base, up to 8 cm. long by 2 cm. in width, 5-nerved : the nerves of the first pair, not nearly SD pronounced as the midrib, enclose a narrow area which tapers equally to the base and tD the apex : the nerves of the second pair run CIDSB within the margin and gradually approaching it are evanescent in the upper third of the length of the blade : secondary nerves very oblique and nearly straight: the upper surface glabrous, smooth : the lower surface also glabrous, with the nerves slightly prominent: petiole slender, about 3 cm. long or nearly Dne-third of the length of the blade.

Mah flowers Dn slender spikes in the axils Df the leaves, up to 6 cm. long, with upwards of 3D flowers, each spike solitary: axis not quite straight, very thin, angled Dr just winged under the flowers, glabrous, the flowers 1—2 mm. apart: bracts fully 1 mm. bng, transparent, Dvate bebw but drawn Dut upwards, the basal part curved round the base of the bud but not repressed by it against the axis, just overtopping the bud : bracteoles deltoid, transparent: buds flattish below and with a wart Dver the axis Dn the upper side such

as is seen in some of the species of the group of *D. alata,* a little longer than their diameter. *Sepals* very shortly ovate from a broad base and so obtuse above *as almost* to be rounded, about 1 mm. long, quite glabrous. *Petals* considerably smaller, obovate. *Stamens* with rounded anthers on filaments of the same length as they are, the two together 0 -5 mm. long. *GynoBcivm* a small point.

F zmale flowers few, wide apart on a stiff, wiry inflorescence. *Capsules* relatively few on a spike, being rarely more than three, dull grey-brown in colour, axes wiry; the stipe 4 mm. long and expanded upwards to a diameter of 2 -5 mm. where the wings arise from it in a curve which does not quite run through 9D[D]; the wings broader than semicircular, to 11 mm. in width, contracted to a slightly retuse or truncate apex : the measurement along the placenta 14—16 mm. *Szeds* with a dark smoky wing all round.

LOWER SIAM.

This species occurs DII limestone rocks, and its wiriness is probably connected with the drynesa of the situations in which it grows. It seems to be local and rare. It flowers in July and fruits in November. Its home i3 about lat. 8[D]N. where the hilla which end southwards at Puket ahaiB with Tenasserim the very heavy rainfall of tha south-west monsoon,—a rainfall which makes them from April to October almost the best watered part DfSiam.

Its affinities arB in thB one direction with *D. glabra* and in thB other with *D. alata.* TIIB mab spikes in appearance suggest thB former ; but thB curious little wart on thB upper aide of tha bud is as in the latter. No one has collected thB baSB of the stem : if this part of the plant bears prickles, thB affinity with *D. glabra* will be more firmly established : but if it does not, the position will remain open. However, as a median prickle has been seen at the base of a petiole, prickles are to be expected on the stem.

MALAYSIA. **11 d. Peninsular Siam.** Circle of P u k e t. Pulau Tebun, which is near Pangnga, *Mohamed Haniff and Mohamed Nur* 3603 ! Circle of S u r a t. Kanchanadit, at about 20 m. above sea level, among bushes on a limestone hill, *Kerr* 13D47 a !

PLATE 133, left side. Dioscorea gracilipes, *Prain and Burkill.* (1) The end of a branch with male flowers, from KBIT'S no. 13D47 a, \ nat. size: (2) a spike from the same, X5 : {3) a sepal, |4) a petal and (5) a stamen, allx5 : (6) a branch with capsules from the type specimen—Mohamed Haniff and Mahomed Nur's no. 3533, \ nat. size: (7) a seed, \ nat. size : (8) the same, enlarged. Inset, the distribution of the species.

124. DIOSDOREA CALDICOLA, Prain and Burkill in Kew Bull., 1925, p. 64, and 1927, p. 244, and in Lecomte, Flore gén. de 1' Indoch., 6, 1934, p. 740.

Underground parts unknown. *Stems* rather wiry, terete. *Bulbils,* none seen. *Leaves* alternate or opposite, narrowly lanceolate above a rounded or cordate base, tapering gradually to a mucro, up to 12 cm. long by IB cm. in width, 5-nerved: the nerves of the first pair enclose a linear-lanceolate area, being in the upper half of the blade submarginal : the nerves of the second pair diverge from the midrib at about 90° and end in the lower half of the blade : sometimes there is a very weak third pair : the secondary nerves cross the interspaces without angles, or with slight angles: the upper surface is glabrous, smooth and shining, with the primary nerves somewhat impressed: the lower surface is microscopically velvety by reason of the elevation convexly of the epidermal cells, the nerves prominent: petiole about 2—2 -25 cm. long.

Mah flowers on spikes which are produced on short leafless branches : these branches attain but to the middle of the leaf-blade ; the axis Df the spike glabrous, angled, 15-40 mm.

long, very red when dry, with 20—3D flowers: bracts ovate-acuminate, repressed against the axis by the broad base Df the flower and curving round the base : bracteole similar but smaller: flower-buds 1-75 mm. long. *Sepals* above the base with parallel sides for half their length and then narrowed to a subacute apex, 1 mm. long. *Petals* shorter, Dbovate, rounded above. *Stamens* B, shorter than the members of the perianth, their anthers equal in length to the filaments. *Gynoecium* a low three-pointed wart.

Female flowers produced on very short axillary inflorescences. *Sepals* ovate, acute above, D -75 mm. long. *Petals* smaller, blunter, thicker. *Staminodes* in length almost equalling the petals. *Capsules* bunched close to the axils in a rather marked way, 1—3 Dn each spike, tawny in colour: wings broader than semicircular and a little oblique, stipe only 1—2 mm. long, widening very rapidly : wings arising from it at about 8D° to curve round slightly obliquely to the apex, 12—14 mm. long by 9—10 mm. in width; the apex Df the capsule just retuse. *Seeds* |deep brown, with a nucleus 3 by 4 mm, and a wing conform to the IDCUIUS.

The MALAY PENINSULA between lat. B^D and lat. 9° N.

This species accur3 Dn limestone and, contrasted with other species of its group, SBBIQS to exhibit thB influence of the dry substratum in its lesser sizB, narrow leaves, and small mata flowering branchBS. Its bunched capsules are it3 most striking feature. The narrow leaves are very liltB those of *D. salizifolia,* abovB the bass which is cordate or hastatB and different in all well-formed baves. They arB much firmer than the leaves of *D. oryzetorum* var. *augustifolia.* For detecting thB male plant it is nBCBSaary to rsly on thB measurB in which the leaves match those Df thB fsmale.

MALAYSIA, **lid. Peninsular Siam.** Circle of P u k e t. Pangnga, upon a limestone hill at 17D m., *Mohamed Haniff and Mohamed Nur* 3974 ! Pulau Tebun, near Pangnga, *Mohamed Haniff and Mohamed Nur* 33D1! Circle of S u r a t. Ban Hawp-kep, climbing over bushes on a rocky limestone hill between sea-level and2DDm. (doubtful), *Kerr* 1335B ! and perhaps also Kao Chom Lem, AmpD Kao Kao, *Rabil* 3D5 ! **l i e. Malaya.** State of K e d a h. Langkawi island, Dn limestone, *Holttum* 17424 ! Kedah peak, *Mohamed Haniff and Mohamed Nur* 5189 ! Grunong Baling, upon the limestone summit at],BDDft., *Best* 21275 !

PLATE 130, left side. Dioscorea calcicola, *Prain and Burkill.* |1) A branch with male flowers from Mohamed Haniff and Mohamed Nur's no. 3BD1, \ nat. size : |2) its flowers, X5: |3) the same forced open: |4) a branch with capsules from Mohamed Haniff and Mohamed Nur's no. 3974, \ nat. size : |5) a female flower: |B) an immature seed : |7) the same, enlarged.

125. DIDSCDREA NUMMULARIA, Lamarck, Encyclop. Meth., 3,1789, p. 231 : Willdenow, Species plant., 4, 1824, p. 792 : Sprengel, Systema plant., 2, 1825, p. 152: Blume, Enum. plant. Javae, 1, 1827, p. 21 only as regards the Moluccan plant: Seemann, Flora Viti., 1873, p. 3D8: Horna, A year in Fiji, 1881, p. 8B: Drake del Castillo, Flare de la Polyn. francaise, 1893, p. 225: Prain and Burkill in Elmer's Leaflets of Philipp. botany, 5, 1913, p. 1599, and in Journ. As. SDC. Bengal, N. S. ID, 1914, p. 35: Merrill, Interpret. Rumph. Herb! AmbDin., 1917, p. 148, and in Journ. R_Dy. As. SDC, Straits branch, Special

No., 1919, p- H8, and Enum. Philipp. flowering plants, 1, 1922, p. 218: K. Heyne, Nutt. plant. Ned. Indie, ed. of 1922, p. 5DD: Setchell in Publ. Carnegie Instit. Washington, Dep. Marine Biology, 20, 1924, p. 105 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 282 : Guillaumin in Journ. Arnold Arbor., 13, 1932, p. 111.

Dioscorea angulata, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 283.

Dioscorea divarkata, Nadeaud, Plantes usuelles des Tahitiens, 1854, p. 10; not of Blanco.

Dioscorea glabra, Koorders in Meiedeel. 'sLands Plantentuin, 19, 1898, p. 312 : also, probably, K. Schumann and Lauterbach, Flora Deutsoh Schutzgeb. in Sudsee, 19D1, p. 223 ; not of Roxburgh.

Dioscorea glaucoidea, R. Knuth in op. cit., p. 284.

Dioscorea Kowdersii, Prain and Burkill ex Koorders-Schumacher, System. Verzeichn. Herbar Koorders, 3, sect 1, 1914, p. 20, name only.

Dioscorea lufensis, R. Knuth in op. cit., p. 272.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 1, 1924, p. 115, in small part: K. Heyne, Nutt. plant. Ned. Indie, ed. of 1927, p. 460 ; not of Linnaeus.

Dioscorea palauensis, R. Knuth in op. cit., p. 191.

Dioscorea pirita, Nadeaud, Enum. plantes Tahiti, 1873, p. 35.

Dioscorea Raymundii, R. Knuth in op. cit., p. 191.

Dioscorea Seemannii, Prain and Burkill in Journ. As. SDC. Bengal, N. S. 10,1914, p. 34: R. Knuth in op. cit.,p.272.

Dioscorea t villosa, Linnaeus in Stickman, Herb. Amboin., 1754, p. 24.

Dioscorea villosa, Linnaeus in the same, p. 142.

Cissus vitiginea, Linnaeus in the same, p. 24.

Tivoli yam, F. v. Mueller, Select plants for extratrop. culture, 1880, p. 101.

Prelinnzan names :—

1750. Ubium nummularium or Tali cupan, *Rumpf,* Herb. Amboin., 5, p. 444, plate 162. (Plate 163 looks as if it represents another species.)

Tuber recorded as eatsn and as good to eat, cylindrical, upwards of a metre long and as tV k as a man's arm. *Stems* armed at the very base, sometimes abundantly the prickles fewer above, at first where the stem is still thick with two perhaps at each node but above with none, glabrous, and rather wiry, not at all angled, but with ' distinct longitudinal lines, green, up tD 4 mm. thick. *Bulbils,* none sin *Leaves* usually opposite, though towards the branch-endings they tend to become alternate, very broadly elliptic with a rounded base, and equally rounded under the rather abrupt very short acumen, if cordate reaching a length of 11 cm. with a breadth of 9 cm. and if elliptic reaching a length of 9 cm. with a breadth of 8 cm, 5-7-nerved : the lowest with large basal lobes : the nerves Df the first pair after diverging from the midrib at a very small angle—say 40° —curving outwards or else for a short distance straight, then with a

reversed curve running tD the apex enclosing thus an elliptic Dr oblanceolate-ob ovate area which is acuminate towards the petiole and VEFY shortly acuminate towards the apex : the nerves DI the second pair with a course further from the first pair than the first pair are from the midrib, diverging from the midrib at an angle of BD—85° to curve round near the margin, but first Df all giving off near the base a submarginal nerve with a course along the lower side of the blade : the secondary nerves cross the interspaces rather irregularly or scarcely do so and are not much more conspicuous than the network : margin scarcely strengthened and not at all hyaline : upper surface dark green, glabrous, with the primary nerves distinct and the others indistinct : lower surface somewhat paler, with the primary nerves prominent, the secondary scarcely so and the network rather indistinct : petiole up tD 7 cm. long.

Male flowers in spikes on special leafless branches or branch-endings, the special branches attaining 3D cm. in length : at their very base a ring of small hairs may be present: the axis of the spikes up tD 4 cm. in length with about 50 flowers, angled, glabrous above the very base where there may be a few hairs : bracts ovate, acuminate, with red-brown dots or lines, very thin at the edges, repressed against the axis by the base Df the flower, not quite 1 mm. long : bracteoles half as long as the bract, otherwise very similar : buds a blunt cone above the broad base which is almost saccate in shape. *Sepals* ovate from a broad base, contracted tD a very short point at the apex, with red-brown dots or lines, 1-25 mm. long. *Petals* narrowly obovate, obtuse, a little shorter than the sepals. *Stamens* B^1 anthers nearly round, in length eijual to their filaments. *Gynoecium* a small cone.

Female flowers up tD 2D in number upon deflexed spikes, which when the capsules mature may be 15 cm. long : axis glabrous except when very young, angled : bracts are ovate, acute, less than 1 mm. bng, with red-brown dots DT lines, when newly formed with minute tawny hairs : bracteoles similar but smaller. *Sepals* thick, triangular-ovate. *Petals* similar, smaller. *Capsules* with a stipe 5 mm. long which widens tD a diameter of 3 mm. where the wings spring from it with the curve which is most common in this section of the genus : the capsule above the stipe along the placenta about 2D mm. bng : the wings evenly rounded, at the broadest part 22 mm. wide, and contracted tD a slightly retuse apex. *Seeds* with a dark chestnut wing all round more Dr less conform to the IDCUIUS.

The eastern half of MALAYSIA and eastwards through the PACIFIC.

This species seems tD be the commonest of its section in the parts of Malaysia east of Wallace's line : but the line is not exactly its western limit. Rumpf was familar with it as found in the forests of Amboina, and 2ave a figure the exact counterpart of which we have sesn, though as a rule the plant looks a little diffprent. Lamarck founded *D. nummularia* upon Rumpf 'a description and first figure |plate 1B2), taking the specific name direct from Rumpf's name *Vbium nummularium.* Christopher Smith, Teijsmann and D. B. Robinson havB subsequently collected it in Amboina, and the better to study it, the Dutch botanists have long cultivated it in the Botanic Garden at Buitenzorg. They have abundantly shown to what the name *D. nummularia,* belongs, and left us nu doubt in that matter : but the name has been used to denote other plants. Roxburgh used it for *D. ghbra,* Blume for *D. pyrifolia* and Moritzi for *D. polydaizs.*

TD US *D. nummularia* is the characteristic wild Enantiophyllous *Dioscorea* which is found to the east of *D. pyrifolia* in places of lesser rainfall. Its distribution is given on plate 15D. The discrimination of *D. pyrifolia* from it often offers difficulties. Blume came up against them in a way which made him use the name " *D. nummularia* " to cover *D. pyrifolia* ; and not a few botanists have left indications in herbaria of following him, Hasskarl actually doing SD in print. TD US *D. nummularia* differs from *D. pyrifolia* is being lesa coriaceous and in being hairless. At the same time it is not quite as thin-leaved as *D. glabra,* and the colour of its dried foliage differs in being redder.

Apparently this species is widely distributed in the Pacific and its tubers serve as a famine food. Whether it obtained its whole distribution unaided by man, DP was carried from island to island cannot be ascertained : but the latter possibility must not be dismissed : for famine compels migrations and whatever food happens to be obtainable would in time of need be taken. Seemann found it to be plentiful in the Fijian islands, and what he said regarding its use as a food caused Sir Ferdinand von Mueller to give it a place in his *Select plants for extratopical culture.* Seemann applied to it the Fijian name " ti-voli " which means a young or a small yam, and called it *D. nummularia.* This is why Guppy in his *Observations of a naturalist in the Pacific,* 2, |19DB' p. 414) states that *D. nummularia* serves as a food in the Pacific. A. W. Murray in his " *Forty years' mission work in Polynesia and New Guinea* |1B7B, p. 27D) says that the Samoans in times of dearth dig up a yam which buries its tubers as much as four feet: whether he refers to this species or to something else, is not ascertainable : but his remark would seem applicable to *D. nummularia.*

Tubers of "ti-voli" were sent from Fiji to the Royal Botanic Gardens, Kew, in 1932, and on cultivation proved to be *D. nummularia.* Nadeaud in his *Plantes usuelhs des Tahitims* |18Q4, p. 11), records that a deep-burying yam is found upon the mountains of Tahiti with bulky " rhizomes " which are greatly appreciated as food, and sometimes a plant may be fenced in, the more surely to secure the harvest. He refers the plant with some doubt to *D. divaricata* and ascribes to it the vernacular names " pirita " or " ubi pirai ". Drake del Castillo described the underground parts as " grosse tubereuse."

It looks as if all these curiously inadequate references relate to this species. Another reference to it is *yiobMy that in EnglersBotanischerJahrbucher\3\),* 1BD2, p. 4BD), where mention is made of a specimen collected in the island of Yap in the Western Pacific.

In the New Hebrides, on the island of Eromanga, Waterhouse obtained a curious plant in cultivated ground at Dillon Bay. He called it the " chief food of the natives " and " the red kind." We assign his specimen to *D. nummularia,* but note that it is not typical |cf. Guillaumin, loc. cit.) The bracts are larger than is usual and the stem almost quadrangular and we would add that if hybridization between *D. nummularia* and *D. alata* occurs this curious plant might be such a hybrid, and be retained in cultivation : but it is not possible to accept his statement that it is the chief food of the natives, which remark undoubtedly refers to *D. alata.*

Miss Moninger states that in Hai-nan the edible tubers are sought and eaten ; and she names the species "tc-a tu tang ". Ramos says that the Tagabg in the Philippine islands eat them : he calls the plant " paquit " which name belongs to *D. luzonensis,* SD that there may be a confusion. Mrs.Schlencker states that they are eaten in British New Guinea and gives the plant the name " kiloma." Dr. Knuth has put on record a statement that it is cultivated in the Palau islands.

A few other vernacular names have been obtained. " Banan " is one from Mindanao ; and " sounda " is one from eastern Java. " Marau " has been given as a name for it in the Hermit islands, and " detachel " as a name of the Palau islands. The last is used also for other species of *Diascorea.*

As it grows on either side Df the Equator and has a wide distribution, the months in which it flowers vary. In the northern parts of the Philippine islands it flowers from August to December and even to January. In Mindanao it may flower in May and be in fruit in Juna ; and then again it may be found in fruit in September and Dctober. In Dutch New Guinea it has been obtained in flower in June and Dctober : and in eastern New Guinea in January and March. In Amboina, says Rumpf, the flowers are seen in February and March, and the fruit in July and August.

Dr. R. Knuth has described five species which we refer to this one. Df his *D. angulata* he had good material with male flowers and of his *D. glaucoidm* fair material with female flowers, both from the Sepik river in New Guinea and of almost exactly the same date. His other three—*D. lufensis, D. palaumsis* and *D. Raymundii*—are based on material with leaves only.

In the Philippine islands, along with typical plants such as we term var. *vera,* plants occur with rather glaucous capsules, to which we give the name var. *glauca.* Dr. R. Knuth has described a var. *lata* with broad leaves ; but so variable are these organs that we do not venture to follow him.

Capsules not glaucous .. .. .. var. *vera.*

Capsules rather glaucous .. .. .. var. *glauca.*

EASTERN INDO-CHINA. **9 b. the Hwangs.** Hai-nan island. Near the Kachek market in the Khengdong province, *Moninger* 111 !

MALAYSIA. **11 g. Northern Borneo.** British North BorneD. Kiau, *Clemens,* 1D15B ! Ba1abac island. Katakupan, in secondary forest, *Ramos and Edano* ! **11k. Philippine islands.** (Luzon.) La Union province. Bauang, |var. *glauca),* *Elmer* 5538 ! Isabe1a province. San Mariano, in secondary forest, *Ramos and Edano* 45249! 45729! 4B69B ! Zamba1es province. Without precise locality |var. *glauca), Hallier* ! Bataan province. Mangilet, *Curran* 5455 ! Riza1 province. RID Puray, *Loher* 1883 ! Laguna province. San Antonio, along streams, *Ramos* 10920 ! 1D97Q ! 15D54 ! and (type of R. Knuth's var. *lata)* 23844 ! Mount Mailing, *Robinson* 17D07 ! *Elmer* 17951 ! Tayabas province. Atimonan, along streams at 25D ft., *Whitford* B5B ! Basiad, *Yates* 25578 ! Umiray, *Ramos* 28992 ! Casiguran, in secondary forest, *Ramos and Edano* 45249 ! Po1i11o island. Without locality, *McGregor* 1D4D3 ! Salvoza to the north of POIİIID town, near the beach, *Robinson* 6971 ! South of Polillo town, *Robinson* 9D6S ! Albay province. Albay, *Robinson* B22B ! Sorsogon province. Irosin, *Elmer* 1441D ! 15301 ! Samar island. *Merrill* 115DB ! Leyte island. JarD, at 5DD m., *Wtnzd* 1120 ! Damotes island, *Ramos* 41602 ! Camiguin island tD the north of Mindanao. MambajaD, *Elmer* 14232 ! (Mindanao.) Surigao province. Surigao, *Wenzd* 3135 ! Davao province. Santa Druz, *Williams* 3D93 ! DavaD, *Copeland* BID ! Mount ApD, *Chmens* 15701 ! Lanao province. Damp Keithley Dn Lake LanaD, *Clemens* B87 ! Zamboanga province. Malangas, *Elmer* ! Basi1an island. Basilan, *Hallier* ! **111. Celebes.** (Northern part.) Minahasa district. KajoewatDe, in the Pinamorong mountains, near Menado and near Amoerang and also near Ratahan, *Koorders* 16724b! lB72Bb! lB727b ! 16728b! 16730b ! 16732b! 16733b! 15738b ! GrDrontalD, *Riedel* ! (Southern part.) Pangkadjene, tD the north Df Makassar, *Teijsmann* 1212D ! Bikeroe, Dn the east of Bonthain peak, *Warburg* teste R. Knuth : Mapili, *Rachmat* 3B5 ! Su1a islands. Taliaboe, at Tandjong Doekoe, *van Hulstyn* 158! **11 n. Amboinese Moluccas.** Amboina, *Rumpf: Christopher Smith*! *Warburg* 17452 ! *Robinson* 374 ! 5B7 ! Seit, transported into the Botanic Gardens, Buitenzorg, *Koorders* 19 ! 2D ! Ema, *Teijsmann* ! GoeiiDeng Hona, *Boerlage* !

PAPUASIA. **12 a. Temate Moluccas.** Ternate island. Ternate, *Forsten* 40! NalīabDema, in woods, *Forsten* ! Likupang, in woods, *Forsten* ! Tandavo, in woods, *Forsten* 27 ! **12 b. Western New Guinea.** Kei islands. Keteila Tuol, *Beccari* ! Dutch NewGuinea. HDllandia camp on the Dutch-German boundary, *Gjellerup* 9B ! Van Weel's camp, Dn the same boundary, *Versteeg* 12D4 ! 1519! Naumoni, *Moszkowski* 345! Teba, *Moszkowski* 1D9 ! **12 C. Eastern New Guinea.** Kaiserin Augusta river region, near Malu Dn the Sepik river, *Schultze* 138! In the Sepik district, *Ledermann* 6674 ! 79B0 ! (the type of *D. angulata)* 1D722 ! (the type of *D. glaucoidea)* 1D73B ! Matatakum, *Weinland* 28B ! Baku, *Mrs. Schlencker*! Milne Bay, *Lord Lamington* 12! 12 d. **Bismarck islands.** New Ireland or Neu Meckbnburg. Namatanai, *Peekel* 89 teste R. Knuth. New Britain. Ralum, *Dahl.* **12 e. S0I0m0n islands.** Bougainville island. Siwai, *Waterhouse* 1D4 ! and perhaps also 137 !

PACIFIC. **14 b. Western Pacific.** Palau islands, |the types Df *D. Raymundii* and of *D. palauensis), Raymundus* 72! 301! Caroline islands. Ponape, *Ledermann* 1344B teste R. Knuth. **13 C. Central Pacific.** Fiji, *Seemann* B28 ! *Qrazffe* ! cultivated in the Royal Botanic Gardens, Kew ! Samoan islands. Tutuila, *Setchdl* 186 ! 13 d. **Eastern Pacific.** Tahiti, *Nadmud.*

PLATE 132. Dioscorea nummularia, *Lamarck.* (1) Foliage of a plant raised in the Royal Botanic Gardens, Kew from a Fijian tuber, nat. size : |2) a male inflorescence from a plant obtained in the Moluccas and cultivated in the Botanic Garden, Buitenzorg, nat. zize : |3) a male flower-spike, X ID: |4) a male flower, X -5: |5) its parts, and (5) a stamen seen from either side : |7) a female flower, and |8) an infructescence from Reorders' no. 1B728, nat. size.

125a. DIDSCOREA sp. *A.*, Roorders-Schumacher, System. Verzeichn. Hcrbar Reorders, Abt. 1, Fam. 43, 1911, p. 15.

Dioscorea 1 salicijolia Reorders, Excursionsflora Java, 1, 1911, p. 3D9 and 4, 1923, pp. 252 and 270 with fig. 5D7 e ; not of Blume.

This species, which we prefer to leave unnamed, but need to account for, has tub era which gD down into the earth tD the depth cf 2—3 feet and, being " edible both raw and cooked," are "much sought in the locality" where Reorders found it. He says that they attain the thickness of the forearm. The *stems* are densely armed at the base, wiry, glabrous, and above sparingly armed about the bases of the leaves ; the prickles are awl-shaped. *Leaves* quite glabrous, alternate, but probably not always so, Dvate-sagittate or nearly Dvate-hastate, shortly acuminate, up tD 13 cm. long by 7 cm. in width, the lobes up to 3 cm. in length, 7-nerved: the nerves of the first pair enclose a broadly lanceolate area : the nerves of the second pair embrace an exactly ovate area : the nerves of the third pair run in the lobes with one or two forks : the upper surface smooth, glabrous, with the primary nerves visible : the lower surface glabrous with the primary nerves prominent and carrying one Dr two small prickles : petiole not seen.

Flowers unknown.

Eastern JAVA.

Reorders called this plant "katak dewot" Dr sacred katak. He did not account for tha name. But it ia probable that it originated in the use of the tubers as a food on the fast days of those who profess Hinduism |SBB Gard. Bull. Straits Settlements, 3, 1924, p. 137).

Its affinity is beyond dispute, but it ia not possible te give a name satisfactorily to such inadequata material. Dr. R. Knuth has suggested that it should be called *D. preangeriana,* UlinB; and if it is this, then in our view it should be *D. pyrifoha* ; but it occurs outside the area where *D. pyrifolia,* prevails. It is certainly very near to *D. nummularia.*

MALAYSIA. **11 j. Java.** Residency of P a s o e r o e a n . Tangkil, *Koorders* 23508 b!

PLATE 91, upper right side. Dioscorea sp. A collotype figure of the material collected by Reorders and preserved in the herbarium of the Botanic Garden at Buitenzorg, \ nat. size.

12B. DIDSCDREA SITAMIANA, Prain and Burkill in Rew Bull., 1925, p. 54.

Underground parts unknown. *Stem* at least in the upper parts {which alone are known) glabrous, unarmed, when dry slightly grooved and brown. *Bulbils,* none seen. *Leaves* opposite, obbng-Dvate, abruptly acutely acuminate, thin, drying dark, very slightly un-dulate along the margin, rounded Dr very obtuse below, up to 5 cm. long by 2 -25 cm.in width, 5-nerved : the nerves of the first pair enclose a narrowly Dbovate area : the nerves DI the second pair submarginal and vanishing about the mid-length of the blade: a weak

longitudinal nerve is sometimes interposed between the midrib and each nerve of the first pair : upper surface quite smooth, with the primary nerves distinct: the lower surface with the primary nerves somewhat prominent, the others just raised : petiole about 1 -5 cm. long.

Male flowers in rather bng spikes which are grouped in false whorls on leafless branches or branch-en dings : axis 4—5 cm. long, angled, glabrous, with 2D-3D flowers : bracts Dvate, acuminate, repressed against the axis by the broad base of the bud: bracteoles smaller, broadly ovate. *Sepals* suborbicular, obtuse, glabrous, 1 mm. long. *Petals* oblong, obtuse, a little narrower than the sepals. *Stamens* B, short.

Female plant unknown.

BORNEO, near Kuching.

This species obviously belongs to the group of *D. glabra* and *D. pyrifolia* ; but it differs frnm these in the deep claret-brown colour which its leaves assume in drying. Under a lens, about the base of these leaves, extremely minutB scales may be found. Until more material has been collected, it will remain somewhat obscure-.'

MALAYSIA. **11 g. Northern Borneo.** Sarawak state. Upon the Sarawak river, *Sitam* [Haviland'a collector)!

PLATE 134, right side. Dioscorea Sitamiana, *Prain and Burkill.* |A) Branches carrying male flowers, £ nat. size : |1) the margin of a leaf, enlarged : |2) a bud and a bract X 5 : |3) a male flower forced open, X 3. Inset, the distribution of *D. Sitamiana* |the star), and *of D. Nieuwenhuisii* |the circle).

127. DIDSCDREA NIEUWENHUISII, Prain and Burkill in Kew Bull., 1925, p. 55.

Underground parts unknown. *Stem* in the upper parts, which parts alone are known, glabrous, unarmed, very faintly ridged when dry, but probably not at all in life. *Bulbils*, none seen. *Leaves* of the upper part of the stem opposite, exactly ovate, acute or subacuminate, rather firm, up to 8 cm. long by 3 -25 cm. in width, 7-nerved : the nerves of the first pair enclose an elliptic-oblanceolate area : the nerves of the second pair diverge from the midrib at 7D and run a little within the margin to the upper third of the length of the blade : the nerves of the third pair have a short course in the lowest part of the blade: secondary nerves cross the interspaces with some elbows : the upper surface glabrous, with the primary nerves distinct: the lower surface with the primary nervea prominent and the others distinct: petiole up to 5 cm. long.

Male flowers in spikes grouped upon long leafless branches or branch-ends • theae leafless branches may be 20 cm. long : axis of the spikes smooth, angled, glabruus up to *D mm. long : bracts ovate, acuminate, repressed by the base of the flower against the axis • buds subglobose from a rather broad base, set upon the axia at a right angle. *Sepal's* ovate, obtuse, about 1 mm. long. *Petals* slightly smaller.

Female plant unknown.

BDRNED, in the east-central parts.

Thia species seems to be connected with *D. jpyrifolia* through *D. Sitamïana.* A feature which m rk "t **and** should bB kept in mind is thB roundness of thB basB of thB leaf-bladB.

MALAYSIA. **11 h.. Dutch Borneo.** Residency Df the E a s t and S D U t h. Sungai Bloeoe,. *Jaheril*

PLATE 91, lower left side. A collotype figure of the type plant, \ nat. size.

128. DIDSCDREA GEDENSIS, Prain and Burkill in Kew Bull., 1925, p. 64.

Underground parts unknown. *Stem,* at least in the upper parts, unarmed, dark in colour, scarcely ridged. *Bulbils* not seen. *Leaves* opposite or sub-opposite, ovate DT very slightly cordate, acuminate, up to 8 cm. long by 4 cm. in width, 5-nerved : the nerves of the first pair enclose an ovate-elliptic area, which at its broadest occupies three-fifths of the breadth of the blade : the nerves of the second pair run near the margin and end in the upper half of the length of the blade : the secondary nerves are scarcely distinct from the reticulation : the upper surface glabrous, with the larger nerves distinct : the lower surface glabrous with them prominent, and the reticulation distinct: petiole up to 3 cm. long.

Male plant unknown.

Female flowers unknown. *Capsules* large, shining, to the number of about eight on each spike, with wings much broader than semicircular : the stipe nearly 6 mm. long, widening upwards to a diameter of 2 mm. at the point where the wings diverge in a curve which runs through rather more than 90°: the wings thence curve evenly to a retuse apex, their maximum width 25 mm. and their length along the placenta about 28 mm.

Western JAVA.

Thia species rests upon a singlB specimen in fruit,, and it is very desirable that more material shouli ha obtained. TjibDdas is a delectable spot, much visited by botanists; yet once only has this plant bBen obtained, unless thB sterilo material (BurfciZJ 8275) from the edge of the Botanic Garden at Tjibodaa is of the same species. Arsin called it "arm seselan."

MALAYSIA. **11 j. JaVi.** Residency of B a t a v i a . On Goenoeng Gede, at Tjibodas, *Arsin* 19725 !

PLATE 92, centre. Dbscorea gedunsis, *Prain and Burkill.* A collotype illustration of Arsin's plant, \ nat. size.

129. DIOSDDREA SALICIFOLIA, Blume, Enum. plant. Javae, 1, 1827, p. 23 : Koorders-Schumacher in Koorders, Excursionsflora Java, 4, 1923, p. 27D, figs. 5D7a and 5D7b : R. Knuth in Engl. Pflanzenreich, iv-43,1924, p. 29D.

Dioscorea glair a, var. *salidfolia,* Prain and Burkill in Journ. As SDC. Bengal, N. S. ID, 1914, p. 37.

Dioscorea gracillima, Ridley and Winkler in Engl. Bot. Jahrb., 44, 1910. p. 523 ; not of Miquel.

Dioszorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in small part; not of Linnaeus.

Dioscorea sarawakensis, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 291.

Underground parts unknown. *Stems* in their upper parts glabrous, unarmed, slightly ridged. *Bulbils,* none seen. *Leaves* opposite or alternate, from a rounded or even sub-cordate base lanceolate, very shortly acuminate above, up to ID cm. long by 2-5 cm. in width, 5-nerved : the nerves of the first pair enclose a linear-lanceolate area : the nervea of the second pair run to the margins and disappear at a little below the apex : the secondary nerves are lost in the network : upper surface glabrous, smooth, with the nervation just visible : the lower surface glabrous, with the primary nerves prominent and the others just raised : petiole short, usually about 2 cm. long.

Male flowers in spikes grouped along leafless branches of moderate or little length : the length of these spikes from 15 to 3D mm. the lower in position on any leafless branch conspicuously longer than the upper : axis glabrous, angled, with upwards of 35 flowers which are spaced about 1 mm. apart: bracts ovate, repressed by the base of the flower against the axis : bracteoles similar, shorter and smaller. *Sepals* ovate, rounded at the apex, about 1 mm. long. *Petals* rather smaller than the sepals.

Female plant unknown.

SUNDALAND, but not found yet in the Malay Peninsula, and apparently rather rare elsewhere.

D salicifolia was described in a few inadequate words by Bluma in his *Enumzratio plantarum Javae.* He had no flowers but had rather firm leaves of a linear-lanceolate shape abDVB a cordate baas. His spacimena were numerous and 182 and WB have seen them in several herbaria, for IID distributed small pieces Df it freely. men writing our synopsis af the genus in 1312 we had seen two further specimens collected by Koordera in western Java, and subsequently we detected in the herbarium of the Botanic Garden, Buitenzorg, morB material. The latter contained a plant with male flowera, having leaves rather thinner than those Dn BluniB's plant. WB have figured his specimen |plate 91). Owing to the texture differing WB were at first doubtful as regards thB propriety oi placing it under Blume'a name : but later yet more material reached us, collected by Bakhuizen van den brink in which thin and firm leaves are associated together, not upon the same stem, but in material of the same gathering and apparently quite rightly regarded aa identical.

TV thn *is D salicifolia,* aa accepted here,—a vine of western Java, whence WB think that it extends to Sumatra and Borneo, found on mountains or at any ratB in rough country, apparently uncommon ; and at present only known in the male plant. Two vernacular naniBs have been recorded for it in Java "chanar tjanar" and "chanar benti." Chanar |tjanar) is a noun applied to species of *Dioscorza* and of *Smilax* which are scarcely regarded as of any economic use, and here indicates that this scarcB spBciea is of na account; locally.

MALAYSIA. **11 f- Sumatra.** Residency of the East Coast. Between Pasoeboeran and Nassau near Sibolangit, at 85D m., *Lb'rzing* 7954 ! **11 g. Northern Borneo.** Sarawak state. Mount Matang, *Ridley* ! *Merrill's collector* 24B7 ! **11 h. Dutch Borneo.** Residency of the South and East. Oeloe BIDBDB (rather doubtful), *Amdjah* 27B ! and probably in ths same neighbourhood, *Amdjah* 243 ! Banjermassin, *Motley* 1254 ! Moerā Oeja, *"winkler* 2B45 ! **11 j^ Java.** Residency of Bantam. Goenoeng Kentjana, *Koorders* 41589b ! Residency of Batavia. GoenDeng Salak, *Blume* PepangD Isomewhat doubtful), *Backer* ! Buitenzorg |doubtful), *Dorters van Leeuwen* ! Residency of Preanger. Tjadas Malang, near Tjidadap to the south of Tjibeber, *Winkel* 1391 b ! Tjadas Malang, at l,DDDm., *Bakhuizen van den Brink* 2144 and, also a little doubtful, 2214 ! Near Takoka, at l,DDDm., *Koorders* 15D5B b ! Damp at Denoe by the Tji-Patudjah, in secondary jungle, *Backer* 9DD9 ! Tasek Malaja, on Noesa Rede in thB lake of Pendj'abe (doubtful), *Koorders* 772 !

PLATE 91, upper left side. Dioscorea salicifolia, *Blume.* A collotype illustration of a specimen collected by Backer, ^ nat. size.

13D. DIOSCDREA GRATA, Prain and Burkill in Journ. As. SDD. Bengal, N. S. 10, 1914, p. 35 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 293 : Merrill, Enum. Philippine flowering, plants, 1, 1922, p. 217.

Underground parts unknown. *Stems* very slender, glabrous, with one or two slight ridges, 1 mm. in diameter. *Bulbils,* none seen. *Leaves* alternate, linear-lanceolate with a very slightly cordate base, and tapering almost evenly tD the apex, up to 8 cm. long by Dnlv 8 mm. in width, 5-nerved: the nerves of the first pair enclose a linear area : the nerves of the second pair are very fine, submarginal but only disappear in the upper third of the length of the blade : the secondary nerves are not distinct from the network : the upper surface glabrous with the nerves distinct: the lower surface glabrous, with the nerves prominent to distinct, in colour the two sides are almost alike : petiole glabrous, slender, to 1 -5 cm. long.

Male flowers in spikes upon weak reddish leafless branches Dr branch-endings : the branches scarcely longer than the subtending leaves : axis slightly angled, glabrous, up to 25 mm. long, with about 20 flowers : buds slightly flattened at the base : bracts small, 2 mm. long, repressed against the axis by the base uf the flower, ovate, acute : bracteoles similar, but smaller and broader. *Sepals* thick, salmon-coloured, ovate, obtuse, D-75 mm. long. *Petals* smaller, Dbovate, thick. *Stamens* 5, nut quite equalling the petals, the anthers as bng as the filaments. *Gynoecium* a small cone.

Female flowers on short solitary spikes, the flowers themselves not seen. *Capsules* about 25 mm. long, truncate above, with a short stipe below ; this stipe 3 mm. long, the wings rather broader than semicircular and also a little oblique, arising Dut of the pedicel rather gradually, 20 mm. bng by 15 mm. in width.

PHILIPPINE ISLANDS, in Luzon, near Montalban.

This species looks like a depauperate member of its group. Loher collected it thrice—in flower in thB months of February and March and in fruit in the month of July.

It is not unlike *D. salicifolia* in the shape and texture of ita leaves, nor very clearly separated from it in th r characters ; but it may be quite unlike it in fruit, aa the capsules of *D. salicifolia* have not been collected vet As its narrow leaves are organically connected with the flowers and fruits, it is evident that these are from a maturB plant: on the other hand *D. Wilkesii* (see p. 377), which has similarly narrow leaves, is probably no more than a seedling condition.

Loher gives the vernacular names as "camarire" and "ay-panan." He does not interpret them.

Nothing economic is recorded and it seems as if its range were very restricted.

MALAYSIA. **11 k. Philippine islands** (Luzon). R i z a 1 province. Montalban, *Loher* 7012! 7D17 ! 12928 !

PLATE 134, left side. DiDScorea grata, *Prain and Burkill.* |1) A branch with male flowers from Loner's no. 7017, \ nat. size : [2) a mature bud, x5 : |3) a flower flattened : 14) a stamen : |5) a bract and a bracteole, x5 : (5) a branch with capsules, from Loher's no. 7D12, \ nat. size: |7) a capsule cut across, \ nat. size: |8) a capsule with a seed, \ nat. size: |9) a seed, \ nat. size. Inset, the distribution of *D. grata.*

130a. DIDSCDREA WILHESII, Uline ex R. Knuth in Engl. Pflanzenreich, iv-43, 1924, 271 : Merrill, Enum. Philippine flowering planta, 4, 1923 p. 242.

This name was given tD a piece of stem and a few leaves collected near LDS BanDS in the Philippino islands by Wilkes almost a century agD.

The leaves suggest *D. grata,* but they are larger than those Df that species and are sagittate. It ia probable, one may even aay certain, that *D. grata* at times produces leaves such as they are. It is preferable, however, to place *D. Wilktsii* amang the namina nuda, than to venture tD treat it as a synonym of *D. grata.*

131. DIDSDDREA LDHERI, Prain and Burkill in Journ. As. Soc Bengal, N. S. 10, 1914, P- 33: Merrill, Species Blancoanae, 1918, p. 1D1, and Enum. Philippine flowering plants, 1, 1922, p. 217: R. Knuth in Engl. Pflanzenrsich, iv-43, 1924, p. 270.

Dioscorza oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in small part; not Df Linnaeus.

Dioscorea sp. BlancD, Flora Filip., 1837, p. 798 : ed. of 1845, p. 550 : ed. Df 1879, p. 205.

Tubers edible, according tD Merrill shorter than those of *D. divaricata,* and not penetrating SD deeply into the soil. *Stems* armed conspicuously at the base, above sparingly upon the internodes, but not uncommonly at the nodes, glabrous, as thick as a gDDse-quill, firm with longitudinal lines. *Bulbils,.none* seen. *Leaves* opposite or suboppDsite, rather DIDSB set, the larger hastate with outstanding barbs, the lesser hastately cordate DT subDvate and rounded at the base, commonly up to 9 cm. long by 2 cm. in width just above the barbs, but 4 cm. across the barbs, very large leaves may attain as much as 20 cm. in length by 9 cm. in-width, 7-nerved : the nerves Df the first pair diverge from the midrib at about *12°* to enclose an oblanceolate or narrowly elliptic area : the nerves of the second pair diverge from the midrib at about 45D and become submarginal, remaining submarginal through the greater part Df their course : the nerves Df the third pair run in the barbs submarginally : the secondary nerves cross the interspaces rather obliquely and are not distinct in the network : the margin is slightly strengthened : the upper surface is glabrous, dark green, with the primary nerves distinct: the lower surface glabrous, paler, with the nerves prominent, the secondary nerves distinct and the network just visible Dr distinct: petioles usually about 4 cm. long.

Male flowers in spikes upon special leafless branches or branch-endings : axis spreading, up tD 6 cm. bng with about 4D flowers, angled, glabrous : bracts ovate, very thin, reflexed and curving round the base of the bud, marked with short red-brown lines, 1 mm. bng : bracteoles similar, but shorter : buds conical from a broad base. *Sepals* ovate from a broad base, obtuse with a hyaline margin, reddish when dry, 1 -25 mm. bng. *Petals* shorter, obovate, thick. *Stamens* 5, with slightly elongated anthers, which in length about equal their filaments. *Gynoecium* a small cone.

Female flowers Dn decurved spikes, which are about 14 cm. bng or perhaps more : axis angled, glabrous : bracts Dvate, acute. *Sepals* triangular-Dvate, thick, about 1 mm. fong. *Petals* similar, smaller. *Staminodes* small. *Stigmas* as three pairs of short sickle-like hooks. *Capsules* probably exactly as those Df the following species.

PHILIPPINE ISLANDS, in the mountains of Luzon.

Dr. Merrill suggests that perhaps this species may pDVB identical with *D. divarizata :* that the *two* are very closely allied is indisputable : however he quotes Blanco as calling this *Dioscarza* sp. when using thB name *D. divaricata ior* the other.

In the Bizal province it is called "kobag" or "ubag" and the tuber3 are eaten. Kamel used the name as "ubay," but it is not quite certain that hs used it for this species. It flowers in October and November.

MALAYSIA, **l i d . Philippine islands.** (Luzon.) B a t a an province. Near Mongilet, *Curran* 5455! R i z a l province. "Manila," *Perrottetl* S. Francisco del Monte near Manila, *Loher* 1885 ! 1886 ! Montalban in the Cerro Bigaa, *Loher* 1899 ! Antipole, *Ramos* 5 ! *MvrrilVs Spscizs Blancoanae* 534 ! Parawagan near Montalban, *Monahan5H99*! L a g u n a province. Mt. Maquiling, *Copdand* 1809!

PLATE 135, left side. Dioscorea Lc-hBri, *Prain and Burkill.* |1) and (2) branches with màle flowers from Loher's nos. 1885 and 1886, \ nat. size : |3) parts of the male flower, X7: (4) a bract,x7: |5) a large leaf, \ nat. size. Inset, the distribution Df *D. Loheri.*

132. DIDSCDREA DIVARIDATA, Blanco, Flora Filip., 1837, p. 797; ed. of 1845, 2, p. 550 ; ed. of 1879, p. 2D7 : Wester in Philipp. Agric. Rev. 9, 1915, p. 178: Merrill, Species Blancoanae, 1918, p. 1D1 : W. H. Brown in Bull. *22,* Bur. Forestry Philipp., 2, 1921, p. 257 : Merrill, Enum. Philipp. flowering plants, 1, 1922, p. 216 in part.

Dioscorea oxyphylla, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 259.

Dioswrea soror, Prain and Burkill in Elmer's Leaflets Philipp. Bot., 5, 1913 p. 1598 : and in Journ. As. SDC. Bengal, N. S. 10, 1914, p. 34 : Merrill' Enum. Philipp. flowering plants, 1, 1922, p. 219: R. Knuth in Engl' Pflanzenreich, iv-43, 1924, p. 274.

Tubers descending deeply, edible, bng stalked, the stalk sometimes a metre long |Merrill). *Stems* unarmed in all the specimens seen, but Merrill states that they are armed close to the ground, glabrous and above rather wiry, with very slight longitudinal ridges. *Bulbils,* none seen. *Lmvzs* opposite, subsagittate Dr cordately sagittate, the auricles rounded or very blunt, the apex of the blade acuminate, its texture herbaceous, to 16 cm. in length by 8 cm. in width across the auricles, 7-nerved : the nerves of the first pair enclose a broadly oblanceolate shortly acuminate area, having diverged from the midrib at about 20° *:* the nerves Df the second pair are much further from the first pair than the first pair are from the midrib, diverging from the midrib at about 75°, they become sub-marginal about the middle of the length of the blade: the nerves of the third pair run into the auricles where they fork : the secondary nerves cross the interspaces obliquely and irregularly and are not quite distinct from the network: the margin is just strengthened: the upper surface glabrous, dark green, with the primary nerves distinct, the others scarcely visible : the lower surface paler, glabrous, with the primary nerves prominent, the secondary nerves and the network rather indistinct: the petiole up to 7 cm. in length.

Mah flowers in rather slender spikes which are arranged on special leafless branches or branch-endings : the only position in the whole plant where hairs may be found is at the very base Df these special leafless branches : axis of the spike up to 6 cm. long, with about 30 flowers, slender, angled: bracts narrowly ovate, repressed by the base°of th$_R$

bud against the axis, very thin, with red-brown dots and lines : bracteoles similar but much smaller : buds conical above their broad base. *Sepals* somewhat quadrately ovate, i.e., with parallel sides near the base and then a rather abrupt narrowing to an obtuse apex, rather thick, with red-brown dots and lines, nearly 1 -5 mm. long. *Petals* broadly oblanceolate, acute, with red-brown dots and lines, a little shorter than the sepals. *Stamens* 6, with shortly ovate anthers on equally long filaments, the inner sometimes rather smaller than the outer. *Gynoecium* a small cone.

Female flowers to the number of about 2D Dn solitary decurved spikes : the axis up tD 18 cm. in length, angled : bracts ovate, acuminate, thin, dotted with red-brown, 1 -5 mm. long. *Sepals* broadly ovate, thick. *Petals* similar, smaller. *Staminodes* very[1] minute. *Stigmas* as three pairs of curved sickle-like organs. *Capsules* with a stipe 4 mm. long which expands to a diameter of 3 mm. at the point where the wings emerge from it in a typical curve : from this point to the apex Df the capsule is about 21 mm. : the wings are 2D mm. broad, curved evenly to the apex of the capsule which is slightly retuse. *Seeds* with a smoky wing all round, not quite evenly, but conform to the loculus.

PHILIPPINE ISLANDS, in Luzon, Panay and Cebu.

Blanco did not describe his *Dioscorea divaricata* in such detail as to place its identity beyond all doubt, and it has been necessary to study his terrain rather than hia writings, making sure what he might havo obtained in the country over which he was able to collect, and gradually eliminating the unlikely. By thia method Dr. E. D. Merrill approached the question and in 1914 his knowledga had arrived at a sufficient degree of completeness to establish with reasonable certainty what Blanco meant. His conclusions were not available to us, till after we had already published the name *D. soror.*

Blanco used the name "cobag" for it, a name which is but a variant of "ubag" by which the Tagalog indicate it, as well as such very close allies as *D. Lohtri.*

Its tubers go down intu the soil to a depth of two metres, and sometimes branch ; the maximum diameter ia said to be 4[) cm., so that they are bulky. As the stalk of auch a large tuber reaches a metre in length, tha labour of digging it out for food is great, and not lightly undertaken.

The species varies a little in the colour of the capsulea, so that we distinguish two varieties :—

Capsules not glaucous .. .. var. *vera.*

Capsules glaucous .. . . var. *glauca.*

It flowers around Manila Bay in October and November, that ia when *D. Loheri* also flowers, and produces fruit between December and February.

The name "ubag" used in the Rizal province, has already been given. "Banayan" is used for it in tha island of Panay.

ThB name *D. oxyphylla* is based on two leaves and a fragment of stem.

MALAYSIA. **11 k. Philippine islands.** (Luzon; all var. *vera* unless otherwise stated.) Without locality, *Vidal* 1979 ! Ilocos Norte province. Mount Nagapatan, *Ramos* 33185 ! Lepanto sub-province. Without precise locality, *Bona* ! Isabela province. Malunu (or Maluma fide Dr. R. Knuth), *Warburg* 11668 ! Pangasinan province. Mount S. Isidro, *Fenix* 2996D! Pampanga province. Mount Arayat at 2DD m., in thickets, *Merrill* 3924! Bataan province. Mount Mariveles, *Elmer* 6737 ! Lamao river on Mount Mariveles, *Borden* 2572 ! *Merrill* ! Bulucan province. NozDgaray (var. *glauca), Yoder* 3137! Rizal province. Mount Maquiling, *Copeland* ! Antipolo, *Merrill* 391 ! *Ramos* ! Montalban in the Derro Bieaa, *Loher* 1899! (Panay island.) Ilo-ilo province. Maasin, *Robinson* 18D23 ! Cebu island. Limusan, upon the top of a hill, *Ramos* 111D5 !

PLATE 135, right side. DiDScorea divaricata, *Blanco.* (1) a male inflorescence and a leaf from Merrill's no. 3167, \ nat. size : (2) a female inflorescence from Letter's no. 1899, \ nat. size : (3) a large leaf from Borden's no. 2572, \ nat. size : (4) capsules from the same, \ nat. size : (5) a male bud, X 5. Inset, the distribution Df *D. divaricata.*

133. DIDSDOREAFOXWORTHYI, Prain and Burkill in Journ. As. Soc. Bengal, N. S. 10,1914, p. 84 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 272, in part.

Dioscorea divaricata, Merrill, Enum. Philipp. flower, plants, 1, 1922, p. 215, in part.

Underground parts unknown. *Skms* 3—5 m. long, unarmed at least in the upper parts, though it would not be a matter of surprise to fmd that they are armed at the base, not at all angled, rather wiry, green, glabrous. *Bulbils,* none seen. *Lzaves* opposite or subopposite ovate-hastate, and those above becoming ovate-cordate, acuminate above, glabrous, up to 13 cm. bug by 5 cm. in width both at the mid-length of the blade and across the barbs, 7-nerved: the nerves of the first pair diverge from the midrib at only *W* and curving round to the apex enclose an oblanceolate area : the nerves of the second pair diverge from the midrib at 45° to become submarginal about the mid-length of the blade : the nerves of the third pair diverge at 90° from the midrib and then fork, the inner part becoming submarginal in the lower part of the blade, the outer forking again in the barbs : the secondary nerves cross the interspaces obliquely and are only a little more conspicuous than the network : the margin is just strengthened : the upper surface rather dark green, glabrous, with the primary nerves distinct, but not the others : the lower surface paler than the upper, glabrous, with the primary nerves prominent and the others distinct: petiole up to 5 cm. long.

Male fiowtrs in spreading spikes upon special leafless branches or branch-endings: the only hairs upon the whole plant are a few found at the very base of these inflorescences : axis of the spike glabrous, slender, comparatively long being up to ID cm. in length, with about 25 flowers, angled: bracts ovate, acuminate, very thin, repressed against the axis by the broad base of the flower, bracteoles similar, smaller: buds conical above their broad base. *Sepals* quadrately ovate, obtuse, marked with red-brown lines Dr dots, not thin at the edges, 1 mm. long. *Pttals* obovate, shorter by a little than the sepals. *Stamens* 6, the roundish anthers about as long as their filaments. *Gynoecium* a small cone.

Femah plant unknown.

PHILIPPINE ISLANDS, in Luzon.

This species occurs within the region of I), *divaricata,* with which it has been united by Dr. Merrill. His view is quite reasonable ; but there are differences which are clearly shown on our plates nos. 135 and 136.

MALAYSIA. **11h. Philippine islands.** (Luzon). B a t a a n province. Lamao forest reserve, *Foxworthy* 1558 !

PLATE 135, left side. Dioscorea Foxworthyi, *Prain and Burkill.* |1) A branch with male flowers from the type specimen, \ nat. size : (2) a mature bud, X 5 : (3) a flower flattened, X 5 : |4) stamens : and |5) a bract and abracteole, x 5. Inset, the distribution of *D. Foxworthyi.*

134. DIDSCDREAMERRILLII, Prain andBurkill in Elmer'a Leaflets of Philipp. Bot., 5,1913, p. 1598, and in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 35 : Merrill, Enum. Philipp. flowering plants, 1, 1922, p. 218 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 271.

Dioscorea cirrhosa, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 288, as regards the Philippine specimen ; not Df Loureiro.

Dioscorea numnnrfaria, Merrill in Philipp, Journ. Sci., C-2, 1907, p. 2B7 ; not Df Lamarck.

Underground parts unknown. *Stems* assuredly abundantly armed at the base, but this part of the plant has not been seen, with a pair of prickles at the nodes in the middle part but above unarmed, green, wiry. *Bulbils,* none seen. *Leaves* opposite, rather bng-Dvate, tapering to the tip, sometimes very slightly cordate at the base, otherwise rounded, rather coriaceous, up to 12 cm. in length by 5 cm. in width, 7-nerved : the nerves of the first pair diverge from the midrib at an angle of about 3D° tD curve round to the apex enclosing a broadly lanceolate-elliptic area : the nerves of the second pair diverge at about 8D° to curve round tD the proximity of the margin : the nerves of the third pair diverge from the midrib at about 1DD° and are submarginal through almost the whole length Df the blade : the secondary nerves cross the interspaces obliquely and are Dnly a little more conspicuous than the network : the upper surface dark green, glabrous, with the primary nerves distinct: the lower surface drying reddish, glabrous, with the primary nerves prominent. The secondary nerves just prominent and the network indistinct : petiole aboul 5 cm. long.

Mah flowers in spreading spikes Dn special leafless branches Dr branoh-endings which have a few crisp hairs upon most parts : axis Df the spikes, which are usually paired, angled, glabrous : bracts Dvcte, acuminate, rather markedly repressed against the axis by the base Df the flowers, 1 mm. long: bracteoles broader than long, otherwise similar tD the bracts : buds nearly globular above a flattened base. *Sepals* Dvate, thick, obtuse, 1 mm long. *Petals* Dbovate, very thick, shorter than the sepals. *Stamens* 5, with anthers about as long as their filaments. *Gynoecium* a small cone.

Female plant unknown.

PHILIPPINE ISLANDS, in the southern half Df the group.

This species is more coriaceous than *D. nummularia* but very near to it. It has Dnly been collected twicB, on bath occasions on mountains.

MALAYSIA. **I l k Philippine islands.** Island of M i n d or o. Mount Halcon, on old clearings at 2,3D0 ft., *Merrill* 5557 ! (Mindanao.) D a v a o district. Todaya' on MDuntApo, *Elmer* 11924!

PLATE 135, right side. DiDscorea Merrillii, *Prain and Burkill.* |1) A branch with male flowers from Merrill's no. 5557, \ nat. size : |2) flowers, x 7 : |3) the parts of the flower, X 7: |4) stamens. Inset, the distribution Df *D. Merrillii.*

135. DIDSDDREA KINGII, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 289 : Prain and Burkill in Kew Bull., 1925, p. 66.

Dioscorea Nurii, R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 352.

Dioscorea Harrissii, R. Knuth in Dp. cit., p. 352.

Dioscorea Porteri, Prain and Burkill ex R. Knuth, in op. cit., p. 353, an(j ex Ridley, Flora Mai. Penins., 4, 1924, p. 318.

Tubers several, produced on long stalks from a large woody knot of tissue at the surface of the ground, soft and more Dr less esculent. *Stem* very prickly at the base, but in the upper parts more Dr less unarmed, quite glabrous, attaining a diameter of B mm. *Bulbils,* never seen. *Leaves* of a seedling plant sagittate by reason of the way in which the auricles are drawn out conspicuously : leaves Df more mature plants cordate or long-cordate ; and the upper leaves gradually losing the cordate base, and becoming exactly semicircular about the insertion of the petiole, the sides above this rounded base markedly parallel until they begin rather abruptly to narrow to the short acumen ; the length up to 2D cm. with a width of 4 -5 cm., more usually about 15 cm. long and 4 -5 to 5 -5 cm. in width, 5—7-nerved : the nervation is an important distinguishing character ; the nerves Df the first pair diverge at a very narrow angle from the midrib and keep cbse to it for a short distance before they curve from it toward the margin whereafter they run in an arched course to meet the midrib again in the acumen, enclosing a space which varies from linear-oblanceolate to Dblanceolate Dr nearly to narrowly elliptic with either end acuminate : the nerves of the second pair embrace an ovate-elliptic area, and are evanescent in the upper third of the length Df the leaf-blade : the nerves of the third pair are submarginal and evanescent at the mid-length of the blade : the secondary nerves run a broken course between the primary nerves : upper surface dark green, smooth : lower surface green, with or without red nerves (the plants with red nerves constitute a variety); these nerves prominent, but the network rather obscure : petiole about 4 cm. long, i.e., very much shorter than the leaf-blade.

Male flowers are hard to find and those we are able to describe here are attached to specimens not collected by us, but were dried by Kunstler, Mohamed Haniff and Mohamed Nur : but, however, we believe we have associated them rightly with sterile material which we have seen alive in plenty. *Spikes* ascending obliquely like those of *D. orbiculata,* but differing in being glabrous and in being more wiry : axes about 3 cm. long, angular with 2D-3D flowers: bracts lanceolate-acuminate, repressed against the axis by the broad base of the bud. *Sepals* ovate, obtuse, brown-lineolate, 1 -5 cm. long. *Petals* a little shorter, obDvate. *Stamens* 6, their filaments about as long as their anthers.

Female flowers in solitary axillary decurved spikes, to the number of about fifteen. *Sepals* very broadly ovate from a broad base, almost rounded above, 1 mm. long. *Petals* similar in shape, but smaller. *Staminodes* B, small. *Stigmas* as three pairs of small hooks. *Capsules* on a stipe B mm. long which widens upwards to 3 mm. in diameter at the point where the wings spring from it: wings wider (to 20-22 mm.) than their length (2D mm.) measured along the placenta, rounded, with their broadest part a little above the mid-length SD that the base Df the capsule is nearly truncate and the apex slightly retuse. *Seeds* with a deep brown wing more Dr less conform to the loculus.

The MALAY PENINSULA.

Among the species of the section *Enantiophyllum, D. Kingii* is BaSy to recognise on account of the unuaual coursB which the first pair Df primary nerves take at the base of the leaf as they part from th midrib : part, one may say in illustration, as railway lines part, with an S-curve though munh flattened and not *Jl* usual, somewhat fan-wise. *D. Kingn* in this curvature is not unique in the genus, for the corresponding nervea in the leaves of *D. hispida* do the same ; but *D. Kingii* is the only species of the section *Enantwphyllum* with this peculiarity strongly marked. There is some indication of it in *D. nummularia,* but less. We had had it for several years under study, before we could obtain flowers : and even now we are not thoroughly satisfied with our material. Dr. Thomas Anderson collected it in Singapore in the year 18R1, when he passed th rough on a journey to Java. In Penang as well as in Singapore we have found it: and from 1915 tD 1925 ke t i A constant observation in Singapore, where largB vigoroua, planta, one on the edge of the Botanic G p i un er another in the Holland Eoad, werB watched month by month : but neither flowered. Dnrin th ar ens, and Holland Road plant once reached a very constable size ; but it waa cut back by those responsible for the edges of the road at a time when flowering seemed likely. We found the splits abundantly on the borders of

Malacca **and** the Negri-Sembilan. Differences caused us to regard what we had observed in Punang, Malacca and Singapore aa varietally distinct, and we named them var. *v?ra,* var. *purpuno-vmia* and var. *Anihrsonii* . Thess names were published by Mr. Ridley in his *Flora of the Malay Peninsula* at the end uf the year l.')24 •: but a *fow* months earlier Dr. R. Knuth in his monograph of thi) *Dioscoreaccap,* had givcm tlio name? *D. Kin gii T). Harrissii* and *D. Nurii* tD different individual gatherings of it. We adopt Dr. Knuth's first name, and'the typB is Kunstlcr'a no. 1748, From Penang. We reduce the three varieties to two and define thorn thus. •_

Leaves with their backs green .. .. .. _ _ .. y'ar. *vera.*

Leaves with thB primary nerves at the back carmine-purple .. .. var. *purviirco-venia.*

It may be that flowers and fruits are only hard to find, because they are not produced until cirrumHtancea enable the plants tD reach the top of the forest ; and then they escape observation. We wish we foul 11 have found them ourselves in order to have obtained material from all parts of the vines instead of wlr t th e collectors have taken,—i.e., the upper parts only. Anderson's .specimens were sterile : Kunstler obtained male flowers, and so too did Mohamed Haniff anil Mohamed Nur : the two last named collectors also obtain d capsules. But it must be remarked that Dr. R. Knuth's *D. Harrissii* |he had meant bv this nan le to compliment Mr. Haniff) and *D. Nurii* were not founded on these fertile plants, but upon sterile specimens .

The situation which this species affects is a well-drained but not dry slope.

MALAYSIA. **11 e. Malaya.** State of K B d a h [all var. *vera).* Jitra, *Burkill and Mohamed Haniff* 13348 ! Kedah Peak, at 2,5D0 ft., *Mohamed Haniff and Mohamed Nur* 5191 ! at 3,000 ft. (a little doubtful), *Holttum* 148 i[)! P r o v i n c e W B 11 B s 1 B y. Tasek GelugDr forest |var. *vera), Burkill* 6601 ! Settlement of P c n a n g (all var. *vera).* Hills at 2,000 to 2,500 ft., *Kunstler* (King's collector) 1748, the type ! Government hill, between 1,800 and 2,5DD ft., *Burkill* 582! 1520! 1538! 261B! 2Blil ! 2667! Moniot's road at l,30D ft., at l,5D0 ft., and at 1,700 ft., *Burkill* 1488 ! 24D5 ! 2424 ! 2426 ! 2B81 ! Government hill road, *Burkill* 4159 ! Above Ayer Etam, at BOO ft., *Burkill* 3271 ! Quarry near the Waterfall, at 1,DOD ft., *Mohamed Nur* 123[)! State Df P e r a k. Gtrik |var. *vera), Burkill and Mohamed Haniff* 12384 ! State of P a h a n g |var. *vera,* except the two indicated). Ulu Chineras near Kuala Lipis, *Burkill and Mohamed Haniff* 15710 ! 15731 ! 17086 ! Sungai Tahan |var. *purpureo-venia), Holttum* 20077 ! Dong near llaub, *Burkill and Mohamed Haniff* 139D9 ! Sungai Perting near Bsntong, at 700 ft. (var. *purpureo-venia), Burkill and Mohamed Haniff* 16524! State D f S e l a n g o r (all var. *vera).* Sungai Bui oh forest, *Foxworthy and Burkill* 10041! 10D42 ! *MohamedNur* 11872! 11878! Weld Hill at Kuala Lumpur, *Mohamed Nur and Hashim* 4799 ! Bukit Raja forest near Klang, *Burkill* 6834 ! States of the N e g r i S e m b i l a n [all var. *purpureo-venia).* Gunong Angsi, on the west side at 1,500 ft.7 *Mohamed Nur* 11537 ! Tampin, *Burkill* 25D5 ! *Mohamed Nur* 2D38 ! Gunong Tampin, from 8D0 to 1,800 ft., *Burkill* 11B9 i. 1173 ! 2179 ! 2521 ! Gemas, *Burkill* 3535 ! 449D ! 4972 ! M a l a c c a territory [all var. *purpureo-venia).* Selandar forest, *Burkill* 1342 ! Jasin road at 13 miles from Malacca, *Burkill* 1355 ! State of J 0 h 0 r e [all var. *purpureo-venia).* Kluang, at 6 miles towards Batu Pahat, *Holttum* 9471 ! and at 7 milea towards Mersing, *Holttum* 9293 ! Ulu Kahang, *Holttum* 1D875! and on the north side of Gunong Belumut, *Holttum* 10507! Sungai Pulai Dua, *Mohamed Nur and Kiak 17^5* ! Settlement of S i n g a p o r e [all var. *vera).* Without locality, *T. Anderson* ! Edge of the Botanic Gardens, *Burkill 2237* ! Holland road, *Burkill* 2035 ! 2215 !

PLATE 129, right side. Dioscorea Kingii, *Prain and Burkill.* (1) Two male inflorescences from the sheet at Kew of Kunstler's no. 1748, a CD-type, ½ nat. size: |2) a part of a male spike from the same, X5: (3) a sepal, and (4) a stamen from it, x5-. 15) capsules from Mohamed Nur'a no. 11872, \ nat. size : and |6) a seed from the same, \ nat. size : |7) a leaf from Mohamed NUT'S no. 2D38, \ nat. size : |8) a leaf from Burkill's no. 5834, \ nat. size : (9) a leaf from a new shoot produced in the sun, from Holttum's no. 20077, \ nat. size : |1D) the lower part of a stem, from Burkill's no. 2651, \ nat. size.

135. DIDSDDREA PYRIFDLIA, Kunth, Enum. plant., 5, 185D, p. 38^: MiquBl, Flora Ind. Bat., 3, 1855, p. 571 : Hooker fil., Fbra Brit. Ind., B, 1B92, p. 292 : Rendle in Journ. Bot., 19D1, p. 177 : Ridley and Curtis in Journ. Roy. As. SDC. Straits branch, 33, 1902, p. 65 : Ridley, Mat. Flora Mai. Penins., Monocot. 2, 1907, p. 82 : Koorders, Excursionsflora Java, 1, 1911, p. 31D (as *pirifolia):* Koorders-Schumacher, System. Verzeichn' Herbar Koorders. Lief. 9, 1912, genus 1252 : Ridley ex Gibbs in Journ.' Linn. Soc. Lend., Bot. 42, 1914, p. 155 : Prain and Burkill in Journ As Soc. Bengal, N. S. ID, 1914, p. 33: Burkill in Journ. Roy. As. Soc' Straits branch, 73, 1916, p. 257 : Ridley in Journ. F. M. S. Mus., 8 1917, p. 115: Merrill in Journ. Roy. As. Soc. Straits branch, special no. 1919, p. 118: Koorders, Excursionsflora Java, 4, 1923 p 255- R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 278 : Ridley in Journ Bot., 1925 suppl., p. 123: Prain and Burkill in Lecomte, Flore gen de l'lndoch., 5. 1934, p. 743: Burkill, Diet. Econ Prod Mai Penins., 1935, p. 824.

Dioscorea cornifolia, Ridley in Mat. Flora Mai. Penins., Monocot. 2, 1907, p. 81 ; not Df Kunth.

Dioscorea Diepenhorstii, Miguel, Flora Ind. Bat. Suppl., 1850, p. 511 • KDorders-Schumacher in Koorders, Excursionsflora Java, 4, 1923, p. 271.

Dioscorea ferruginca, Thunberg in Herb. prDpr.

Dioscorea nummularia, Blume, Enum. plant. Javae, 1, 1827, p. 21 : Hasskarl in Tijdschr. Nat. Geachied., 9, 1842, p. 135 ; not of Lamarck ;

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, « 115, in part; not of Linnaeus.

Dioscorea ornata, Wallich in Herb, propr.

Dioscorea preangeriana, Harms in Herb. Lugd., and ex Prain and Burkill in JDurn. As. SOD. Bengal, N. S. 10, 1914, p. 33 : also probably Uline in Herb. Berlin.

Dioscorea repanda, Hallier in Herb. Lugd.

Dioscorea Zoilingeriana, Kunth, Enum. plant., 5, 1850, p. 384.

Tubers several, produced below a very hard woody knot, penetrating deeply, by means of a stalk which may be even as much as two and half metres long, at the end of which stalk they swell abruptly and are cylindrical: skin brown and almost free from rootlets • flesh white. *Stems* climbing to a height of about ID metres, pubescent with tawny or pale hair when young and sometimes very closely pubescent, in age more or less glabrescent and then sometimes quite glabrous except for a ring of very small hairs at the bases of the leafless inflorescences, becoming red-brown, abundantly armed close to the ground, the prickles decreasing in abundance upwards and at first confined to the nodes, then in the remoter parts absent. *Bulbils* not produced. *Leaves* alternate towards the base of the stem, but above always opposite, typically ovate-elliptic with a cordate base and acuminate at the apex, generally rather abruptly so, up tD 11 cm. long by 8 cm. in width, rather

parchmenty in texture and considerably firmer than the leaves of *D. glabra* var. *vira,* 7-nerved : abnormally sagittate Dr hastate leaves are produced Dn new shoots if the overhead shade haa been removed : the nerves of the first pair enclose a narrowly obovate-elliptic area : the nerves Df the second pair diverge from the midrib at an angle of about 80° tD run at a gradually lessening distance from the margin until they become submarginal just below the acumen : the nerves of the third pair are weak and have a course submarginally in the bbes : the secondary nerves are scarcely distinct from the network, but may be picked out as crossing the interspaces with an elbow *or* two : the upper surface glabrous, very dark green as a rule and reflecting the light from their smoothness which is broken only by a very slight depression along the course of the primary nerves : the lower surface glaucous green and not reflecting the light, the main nerves prominent, the secondary nerves just raised and the network moderately distinct; the margin is just strengthened : petiole up to 4-5 cm. long.

Male flowers smelling strongly of benzoin, produced in spikes on special leafless branches or branch-endings in false whorls of 2-8, or rather rarely in spikes produced in some of the the leaf-axila : axis of the spikes exhibiting a slight response to geotropism by which they curve through their whole length with their apices ascending, about 5 cm. long, puberulous with tawny or pale hairs, angled, their flowers 3D-5D in number : bracts ovate, acuminate, D-75 mm. long, deep red-brown, and somewhat repressed against the axis by the broad base of the flower : bracteoles smaller, but otherwise similar : buds globular except for the broad base and standing at a right angle to the axis. *Sepals* ovate from very broad bases which, the three sepals together, make the base of the bud triangular in section, thick, green in life but in drying developing red-brown dots and lines, with a transparent margin, 1 mm. Ion'g. *Petals* shorter, thicker, ckvate, *Stamens* 6, the anthers equalling the filaments in length, round. *Gy'ndecium* a wart with three points.

Female flowers in long downwardly directed spikes which arise as a rule in pairs in leaf axils so that, the leaves being opposite, there are four together at a node in the fertile art of the vine : axis pubescent, angled, up to 24 cm. long, with about 30 flowers : bracts Pa . , i .K „„, innp *Sevals* Dvate, obtuse, incurved from a rather broad ovate, acuminate, 1 o mm. iuug. r
b thick 1 mm. bng, red-brown when dry. *Petals* shorter, ovate, obtuse, thick. ase, ic , *stiamas* as three pairs Df sickle-like hooks. *Ovary* pubescent. *Staminodzs* b, smau. «»!/"' r
Cavsuhs glabrous at maturity, with a stipe 3 mm. long expanding to a diameter of 3 mm. where the wings spring from it in a rather sharp curve, the placenta from this point to the W .BrB ing 15-18 mm. bng : the wings curving evenly come together at a slightly retuse apex uPBX !8_22 mm broad at the broadest part. *Sezds* chestnut-brown, winged all round with a'shghtly uneven wing which is more or less conform to the loculus.

WESTERN MALAYSIA, very abundantly from Cambodia to Java.

There ia no specie s o f the genus *Dioscvrea* more abundant in the Malay Peninsula than this ; and it seema to be the most^a b t equally m eit]ier siJB Df the Sunda Straits, i.e., in southern Sumatra and western Java. Eastwar a D tftkM its placB; an[i northwards *D. glabra.* Segregating spECiBSj Dr as SDmB may call them witliin its area and probably hybrids arc produced with some freedom wh grDW8 with it. The botanist, confronted with difficulties in determining hia species, may find an on in assuming such an event.

We have a. rea y E ad ex lainedhDWWB distinguish it from *D. gfobra.* As an aid in distinguishing when confronted with hBrbarium apBCimens Df *D. pubera* and *D. palyelades* we would call attention to the hairs. The hairs of *pyrifolia* are short and when the leaf is mature are dead and crumpled: the hairs of the other two are twice as luut though they may be quite dead retain their shape and show a nBat point,

We recognize the following varieties :—

Stems abundantly prickly in the lowest ten Dr more centimetres Df such plants as havB passed the seedling stage :

Lower surface of the leaf grey :

Hairs present over the the whole of the lower surface Df the leaf-blade *vtra.*

Hairs only at ths petiolar end .. .. *Dizpmhorstii.*

Lower surface of the leaf coated with tawny hairs .. .. *borneensis.*

Lower surface of the leaf a bright rust-red .. .. .. *ferruginea.*

Stems without prickles even on the fully mature plant .. .. *aubimrmis.*

The condition which we call *subimrmis* should be studied experimentally in cultivation with the object Df proving that the absence of prickles is constant.

MALAYSIA. **11 e. Malaya.** State of Perak. Taipinghills at all elevations jvar. *vera), King's collector* 5125 ! *Moharmd Haniff and Moharmd Nur* 2337 ! 2399 ! 2473 ! Kuala Kendrong, *Burkill* ! Salak |var. *ferruginea), Moharmd Haniff and Moharmd Nur* 5934! Sungai Siput |var. *ferruginea), Burkill* 6315! Between Ipoh and Tanjong Rambutan (var. *vera), Burkill* 15D1 ! Ipoh |var. *vera), Burkill* 15D7 ! 5265! and |var. *ferruginea), Burkill* 2783 ! Foot of Gunong Keledang |var. *ferruginea), Burkill 2111* ! 2778 12779! Near Pusing, *Burkill*! Gopeng |var. *vera), King's collector* 60D ! Tapah |var. *vera.), Burkill and Mohamed Haniff* 13539 ! and |var. *ferruginea), Ridley* 14028 ! At eleven miles from Tapah towards JDI |var. *subinermis), Mohamed Haniff* 142D2 ! Jor |var. *vera), Mohamed Haniff* 14288 ! Dindings. Pengkalan Bharu |var. *vera), Burkill* 5D0 ! Simpit |var. *ferruginea), Ridley* 1D279 ! State Df Kelantan, (all var. *vera).* Riverside, *Mohamed Haniff and Mohamed Nur* 1D051 ! Kelumpur, *Mohamed Haniff and Mohamed Nur* 10271 ! Kuala Pertang, *Mohamed Haniff, dnd Mohamed Nur* 1D372! State of Pahang. Dhegar Perah on Bukit Senai |var. *vera), Henderson* 19428 ! Ulu Chineras near Kuala Lipis |var. *ferruginea), Burkill and Mohamed Haniff* 15672 ! Five miles south of Kuala Lipis |var. *ferruginea), Burkill and Mohamed Haniff* 17183! 1719D! and |var. *subinermis),* 17184! Teku stream on Gunong Tahan between 1,5DD and 2,DDD ft. |var. *vera), Mohamed Haniff and Moharmd Nur* 81D5 ! Jerantut |var. *subinermis), Burkill and Mohamed Haniff* 15830 ! Kuantan, Telok Sesik [var. *ferruginea), Burkill and Mohamed Haniff* 16145 ! Pekan |var. *ferruginea), Burkill and Mohamed Haniff* 17115 ! Dong near Raub |var. *subinermis), Burkill and Mohamed Haniff* 1591B ! Gali near Raub |var. *ferruginea), Burkill and Mohamed Haniff* 16927! Raub |var. *ferruginea), Burkill and Mohamed Haniff* 16645! 17154! and |var. *subinermis),* 17D50! Bentong |var. *vera), Burkill and Mohamed Haniff* 15582! and (var. *vera),* 15071! and Ivar. *subinermis),* 15522! 15578! and |var. *ferruginea),* 15423! 15558! Gunong Raya near BentDng |var. *vera), Best* 13855 ! Pelangai |var. *vera), Burkill and Mohamed Haniff* 15785 ! 16786! Pulau Tiuman, Gunong Rukam |var. *subinermis), Mohamed Nur* 1879D ! Joara bay |var. *vera), Burkill* 989 ! 992 ! State Df Selangor. (The following all var. *vera.)* Rawang, *Goodenough* 1D489 ! Kanching forest, *Fozworthyi and Burkill*! Batu Daves, *Burkill* 2255 ! Kuala Lumpur, *Mohamed Nur* 48DO ! Bukit Raja, *Burkill* 15D4 ! 1505 ! 7827! Padang Jawa, *Burkill* 1509! Telok Gadong near Port Swettenham," *Mohamed Nur* 3790 ! Telok forest reserve, *Burkill* 3133 ! 5525 ! 6558 ! 655D ! IThe following not var. *vera),* Ayer Kuning reservoir |var. *inermis), Burkill* 7533 ! Ginting Sempah, *Burkill*! States Df Negri Sembilan. Bukit Setul (written B. Sutu Dn the labels), north of Seremban |var. *vera), Alvins* 1931 ! Perhentian Tinggi |var. *ferruginea), Burkill and Mohamed Haniff* 16376 ! Rantau |var. *ferruginea), Alvins* 23D2 ! Kendong (var. *vera), Mohamed Nur* 2284 ! Tampin (var. *ferruginea), Mohamed Nur* 1524 ! 2294 ! *Burkill* 3120 ! and (var. *vera), Mohamed Nur* 221D ! *Burkill* 1643! 22D4 ! and (var.

subinermis), Burkill 1174! North of Batang Malaka |var. *ferruginea), Burkill* 1151! Ayer Kuning |var. *ferruginea), Alvins* 3321 ! Gemas |var. *vera), Burkill* B393 ! Malacca territory. Without precise locality |var. *vera), Cuming* 2314 ! and |var. *ferruginea), Griffith* 5557 K.D. ! 5552 K.D. ! *Maingay* 1702 in part! Sungai Bharu forest |var. *vera), Burkill* 444 ! and |var. *ferruginea),* 3217 ! Piilau Sabang |var. *ferruginea), Burkill* 2195 ! Gadek |var. *vera), Burkill* 2152 ! 2155 ! Alor Rajah |var. *vera), Burkill* 2195 ! |var. *ferruginea),* 20D5 ! 2275 ! 2275 ! 2277 ! 2789 ! 2799 ! 3037 ! 3528 ! 3530 ! Durian Tunggal |var. *vera), Burkill* 542 ! Sebatu |var. *vera), Burkill* 548 ! Bukit Seianan forest |var. *vera), Holttum* 9588 ! and |var. *ferruginea),* 9592 ! Selandar forest |var. *vera), Burkill* 2193 ! Selandar |var. *ferruginea), Alvins* 522 ! *Burkill* 2192 ! Batang Malaka |var. *vera), Burkill* 2047 ! 3199 ! Kemendor |var. *vera), Burkill* 455 ! 4465 ! Bemban |var. *vera), Burkill* 4453 ! |var. *ferruginea), Alvins* ! Merlimau |var. *vera), Burkill* 424! State of Johoˆe. Rihlau on the Malacca border |var. *ferruginea), Feilding* ! Ulu Kahang (var. *vera), Lake and Kelsall* 4D08 ! Kluang (var. *vera), Holttum* 9215! Kuala Tebing Tinggi |var. *ferruginea), Ridley* 1119D ! Under Gunong Pulai |var. *vera), Best* 8289 ! Pineiro estate |var. *vera), Burkill* 121 ! 122 ! and |var. *subinermis),* 123 ! Tanjong Kopang |var. *ferruginea), Ridley* 5311 ! Kota Tinggi |var. *ferruginea), Ridley* ! Singapore island. (All but the last var. *ferruginea).* Mandai road, *Ridley* 3758 ! 4619 ! 5109 ! Seletar, *Ridley* ! Bukit Timah, *Ridley* 11432 ! *Hullett* 479! *Goodenoughl Mohamed Nur* 229! Chan-chu-kang, *Ridley* 1654! 3943! Upper JurDng river, *Mohamed Nur*! Tanglin, *Ridley* 4127! 5939! 113B9 ! *Burkill* 131 ! *Mohamed Nur* ! Irwell bank road, *Ridley* 11353 ! Dhangi, *Goodenough* 4595 ! and Tanglin |var. *vera), Burkill* 4D7 ! 2D34 ! Residency of Ri Duw. Pulau Bum |var. *vera), Ridley* 170D ! 4519 ! Lingga island, Resoen jvar. *ferruginea), Bunnemeijer* 5754! **11 f. Sumatra.** Residency of the East Coast. Asahan, at Silo Maradja, *Bartlett* 7251 ! 8448 ! Near Aek Kanopan on the Loendoel concession, *Bartlett* 5933! Kuala Masihi, *Yates* 2190! Boenoet, at 100 ft. |var *ferruginea), Yates* 1247 ! 1301 ! Between Natras and Kopas, *Rachmat* 1447 ! Koealoe on the Loendoet concession, *Bartlett* 7117 ! Residency c-fWest Doast. Ajer MantJDer in the Padang province |var. *ferruginea), Beccari* 788 in part! and |var. *Diepenhorstii), Beccari* 788 the other part! Priam an |var *Diepenhorstii), Diepenhorst* 2358 ! Pasir Ranting, on the coast in lat. $2^{D}7'S$ |?var. *Diepenhorstii), H. C. Robinson and Kloss* ! Doekoo |var. *ferruginea), Korthals* ! Residency of Djambi. Near the Sungai Manau, at 180 m. |var. *ferruginea), Posthumus* 839 ! BangkD, at Merangin |var. *ferruginea), Posthumus* 582 ! Residency DfPalembang. Matapoera (var. *ferruginea), Bal* 62! Banjokasin |var. *ferruginea), Grashojfl* FDDt of Mount Kaba, at l,2D0 ft. and at 3,0DD ft. |var. *ferruginea), Forbes* 2853 ! **11 g. Northern Borneo.** Sarawak. Kuching |var. *ferruginea), Beccari* 2720! *Ridley*! and jvar. *vera), Hewitt*! *Merrill's collector* 309! 4D3 ! 824! 1D54! *Ridley* 12249! Mount Matang |var. *ferruginea), Beccari* 2D81 ! and |var. *Diepenhorstii), Beccari* 271D! 2715! Sungai Kantir |var. *ferruginea), Beccari* 3444 ! Gunong Batang-batang Lupar |var. *ferruginea), Beccari* 3255 ! Baram river |var. *ferruginea), C. Hose* 80 ! Sadong jvar. *vera), Moulton* ! Brunei. Bundu, *Goklin* 2802! British North Borneo. Jesselton, *Wood* 2D52 ! Sandakan |var. *ferruginea), Ramos* 1297 ! 1415 ! Between Koung and Ghinambur |var. *Diepenhorstii), Gibbs* 4297 ! Dallas, at 3,0D0 ft. |var. *Diepenhorstii), J. and M. S. Clemens* 25598 ! 25599 ! |var. *ferruginea), J. and M. S. Clemens* 27724 ! (approaching var. *ferruginea), J. and M. S. Clemens* 25442! 27041! 30D92 ! (somewhat uncertain), 25143 !2B728 in part! 25729 ! 30D91! Tenompok, at5,O0Dft,, *J. and M.S. Clemens* 28055 ! **11 h. Dutch Borneo.** Residency of the East and South. Without locality |var. *vera), de Vriese*! Banjermassin (var. *Diepenhorstii), Motley* 557 ! Sosngai Kenepai,

|var. *ferrugima), Hallkr* B-2D0D! Soeka Lanting jvar. *ferrugima), Hallkr* B-129*! Hayoep, in virgin forest (var. *ferrugima), Winkler* 2509 ! Doesun (var. *ferrugima), Korthals*! Matapoera |var. *vera), Korthals*! Goenoeng Pamattan |var. *vera), Korthals* \ Billiton |var. *Dkpenhorstii), Rkdell* **11 j. Java.** Residency of Bantam. Goenoeng Djamoengkol, at 1D0 m. |var. *Diepenhorstii), Koorders* 41502 b ! Danoe Moeran, at 100 in. |var. *Dkpenhorstii), Koorders* 40581 b ! Goenoeng Kent]ana |var. *ferrugima), Koorders* 4D951 b ! 41227 b ! 41341 b ! 414D2 b ! Between Tjilelis and GoenDeng Kent]ana on the edge of forest |var. *vera), Backer* 1210! Between GoenDeng Kendong and Malingping, from 100 to 301) m. |var. *vera), Backer* 1310! Bodjingmanik |var. *ferrugima), Koorders* 40428 b ! 4D863 b ! Residency of Batavia. Without jtrecise locality jvar. *ferrugima), Rzinwardtl Blume* \ *de Vriesel Teijsmannl* Without locality and not certainly in this Residency |var. *vera), Thunberg* ! Batavia at Pasir Tjerewed (var. *ferrugima), Bakhuisen van den Brink3lS2l* Depok, very common {var. *ferruginea),'Bakhuisenvan den* £mi&5489 ! *Koorders* 31177 b ! 31178b! *Hallkr* 11! 17 ! 3D ! *Backer* 239S1 ! and |var. *vera), Hallkr* 884 ! Between Batavia and Tandj Dng Priok (var. *Diepenhorstii), Backer* 8433 ! |?var. *Dkpenhorstii), Bmmee* 5874 ! Tjilodong to the south-east of Depok, *van Overeem, Backer an d van Shot en* 35127 ! (var. uncertain), *Koorders* 44D19b! Buitenzorg (var. *vera), Blume*! *Kuhl and van Hasseltl Teijsmannl* Mega-mendoeng (var. *ferrugima), Lam* 3805 ! Kabandoengan at 1,200 ft. (var. *ferrugima), Kurz* 70D! Tjipakoe (var. *vera), Hallkr* 22! 591 ! Tjiliwoeng |var. *ferrugima), Hallkr* ! Desa Kali Bata near the Tjiliwoeng, in forest and about village gardens [var. *vera), Hallkr* ID! 523! Tjipaes jvar. *vera), Hallkr Ml I* Tjiangata (var. *ferrugima), Reinwardt*! Mantarema |var. *ferrugima), Hallkr* 5 ! Tjiampea (var. *vera), Koorders* 3D7D9b! Pandjassen (var. *vera), Hallkr*! Koeripan (var. *vera), Backer!* Goenoeng Tji-salak (var. *vera),* without collector's name! (var. *ferrugima), Koorders* 24191 b ! GoenoengNangnonglvar^era), *Blume:* Loeboek Nanka (var. *vera), Blume I* Wanajasa near Poerwakarta, at BDD m. (var. *ferrugima), Bakhuisen van den Brink* 4859 ! (var. *vera), Backer* 14412 ! Residency of Preanger. Denoe by the Tjipatoendja, in secondary jungle (var. *Dkpenhorstii), Backer* 8997 ! Tjidadap to the South of Tjibeber in a ravine, common at 1,000 m., (?var. *ferrugima), Bakhuisenvan den Brink* 873 ! Ravine of the Tjisokan to the south of Tjibeber (var. *ferrugima), Backer* 22395 ! 22393 ! Tjitjiroeg, near Tjidadap, common at 1,000 m. (var. *ferrugima), Bakhuisen van den Brink* 581 ! Tjadasmalang, near Tjidadap, at l,0OD m. (var. *ferrugima), Winckel* 1474 b ! *Bakhuisen van den Brink* 2145 ! Goenoeng TJD3poe south of Bandjar, in a swamp, *Beumk* 710! West Df Palabuehan ratoe (var. *Diepenhorstii), van Steenis* 2876 ! Noesa Gede near Pendjabe, *Koorders* 115 ! 135 ! 251 ! Tjibelong between 1,DOD and 2,DDD ft. (var. *ferrugima* called var. *puberula* by the collector), *Kuntzz*! Tjipanas (var. *ferrugima), Kurt* 918! *Hallkr* 18! On Mount Pangjar near Tjipanas (var. *vera), Ploeml* Goenoeng Endut-Parakansalak (var. *Dkpenhorstii,* and type of *D. preangeriana), Warburg*! Bandoeng, *Zollinger* 917 (photo seen !). Residency of Besoeki. Poeger Watangan, in forest (var. *vera), Koorders* 20732 b !

PLATE 137. Dioscorea pyrifolia *Kunth.* |1) A male inflorescence with two normal leaves from Duming's no. 2314, nat. size : (2) an opening male flower, X 5 : |3) its parts, X 5: (4) the stamens, X 10: (5) an infructescence from Burkill's no. 456, nat. size: |5) a leaf from the base of a vigorous plant growing under normal conditions, namely, with the overhead cover present, from Burkill's no. 1174, nat. size: (7) another from Holttum's no. 9588, nat. size : (8) a pair of leaves typical of the upper parts of the stem of var. *ferrugima,* from Burkill's no. 2777, nat. size : (9) a hastate leaf such as is produced under abnormal conditions due to the removal of the overhead canopy, from Burkill's no. 500, nat. size.

PLATE 138, left side. Part of a very vigorous plant showing the lower parts of several stems, and the upper part of the stalks of several tubers, from a plant dug near the Botanic Gardens, Singapore. Inset, the distribution *of D. pyrifolia.*

Group of D. oppnsitifolia (species 137—140). Unarmed species Df India, both with and without hairs among the flowers, as a result Df which it has not been possible to place thorn together in the key on pp. 212-219. For that renSDii a small key to the group is inserted here :—

Without hairs ; the first primary nerves in the leaves near the margin .. *intermedia.*

With hairs :

Leaf-blade drying green, Dvate, the first pair of nerves rather remote from the midrib .. .. *oppositifolia.*

Leaf-blade drying reddish, rather large and elongated, the first pair Df nerves rather neac the midrib .. .. *trinervia.*

Leaf-blade drying green, in outline between ovate and obcuneate .. *obzumata.*

137. DIDSCDREA INTERMEDIA, Thwaites, Enum. plant. Zeylan., 1834, p. 325: HDDker fil., Flora Brit. Ind., 5, 1892, p. 297: Macmillan in Circulars Roy. Bot. Gard. Ceylon, 3D, 191)5, p. 17, but with some uncertainty : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 1914, p. 29 : R. Knuth in Engl. Pflanzenreich, iv-43,1924, p. 28D : Fischer in Gamble, Flora Presidency Madras, 1928, p. 1512 : Alston in Trimen, Handb. Flora Ceylon, 5, 1931, p. 287.

Dioscorea spicata, Hooker fil. in Trimen, Handb. Flora Ceylon, 4,1898, p. 277, in part.

Tubers frequently two or three together, rarely branched, descending into the soil to a depth of 7D cm., with a diameter Df 6—8 cm. towards the blunt tip, the surface more particularly in the upperpart beset with small rootlets and sometimes rather nodular: flesh white. *Stems* cylindrical, smooth, slender, unarmed. *Bulbils,* none seen. *Leaves* alternate, coriaceous, narrowly ovate, rounded below, acuminate above, up to 9 cm. in length by 3 cm. in width, 3-nerved : the lateral nerves submarginal through the greater part of the length Df the blade so that the area which they enclose is of the same shape as the blade itself: the secondary nerves few, crossing the interspaces almost without elbows, with a conspicuous network between them : the margin slightly thickened : the upper surface a very dark green, with the nerves slightly prominent: the lower surface with the primary nerves prominent, and the others just prominent: the petiole relatively short, about 1-5 cm. long.

Male flowers in axillary spikes which arise 2—4 together, sometimes as bng, special, leafless inflorescences, sometimes in leaf-axils : axis up to 3 cm. long with about 25 flowers, glabrous, spike angled : bracts Dvate, acuminate, 1 mm. long : bracteoles similar, much smaller and relatively broader : buds subglobose. *Sepals* ovate, acute, 1 mm. long, reddish brown. *Petals* narrower and thicker, a little shorter. *Stamens* B, with small anthers. *Gynoeciurn* a small wart.

Female flowers not precisely known, though Thwaites collected remains of them attached to capsules on a plant which is intermediate between this species and *D. spicata.* A capsule of this intermediate plant is drawn Dn plate 140.

CEYLON and the nearest parts of southern INDIA.

This species was described in 1861 by Thwaites, who had the assistance of Sir Joseph Hooker in his work of cataloguing the plants of Ceylon: in 1888 the latter elaborated a new and ampler description apparently upon exactly the same material as ThwaitBs had had.

Thwaites had allied it to *D. oppositifolia,* finding it to differ in the nervation of the leaves and in the longer male flowering spikes : he added to his description that it was well distinguished from *D. spicata* (which to him included *D. Trimmii)* by its shorter and more numerous spikes as well as by the nervation. This implied that in regard to the length of the spikes it was intermediate—SD IIB called it *intarmndia*—between *D. oppositifolia* and *D. spicata,* but outside the characters of both in having the first pair of lateral nerves thrust out CIDSB to the margin. Hooker doubted if it be anything but a state of *D. oppositifolia* with a glabrous inflorescence ; and he commented further upon ono specimen with narrow leaves |a specimen from Medamahanuwara which we refer to *D. Trimmii)* as being different from all the others.

About 1904 we cultivated the species in Calcutta and at the same time examined the specimens in tha Peradeniya Herbarium. We concluded that it must be not uncommon in the neighbourhood of Kandy and that Trimen had left notes upon its tubers but under the wrong determination of *D. spiuata.*

We have since re-examined much of this material in an effort to define as fully as possible not only it but *D. spuata, D. Trimmii, D. obcumata* and *D. oppositifolia* which seem to intergrade in Ceylon. It seems to us possible that at one time *D. spkata* was a species fenced in by geographic isolation from its allies of the section *Enantiophyllum,* and that, the isolation having been broken down, we obseve now the result of its hybridization in plants which show affinities to *D. spicata,* but vary from it^this in one degree that in another degree-in respect of its three chief characteristics, i.e., long male flowering spikes from the leaf-axils, much broadened capsules, and coriaceous leaf-blades.

If hybridization has been proceeding in Ceylon with the fashioning of spBciBS intermediate between *D. spicata* and, say, *D. oppusihfoha,* then, probably *D. Wightii,* which is Indian, is likewise of hybrid origin. The elongation of the male flower-spikes derived from *D. spicata* is, we think, seen in *D. Trirmmi* and *D. Wightii,* and in *D. Trimmii* is seen the coriaceous foliage. The thinner foliage of *D. obcuneata* is like that of *D. oppositifolia,* but the arrangement of the nerves is as in *D. spicata. D. intermzdia* occupies the most intermediate position ; but it must not be forgotten that it is not intermediate in respect of its nervation.

All the species of this close alliance should be sought for and studied alive, for they have been inadequately collected in Ceylon. A few remarks Dn them may be useful.

Thwaites by writing " ubique " twice, in place of a locality, on the sheets of *D. oppositifolia* in the Peradeniya herbarium implied that, of the group of *D. oppusitifdia,* it is in Deybn general, and if so, the most common species : but the records of its distribution do not substantiate this inference. ' Perhaps'he meant by " ubique " no more than that it was everywhere in the neighbourhood of Peradeniya which he knew so well and made his home for thirty-three years. The other known localities for *D. oppositifolia* are in the provinces Sabaragamuwa and Uva, i.e., south-west and south-east of Kandy, at some distance : yet Hermann and Thunberg, who had no access to the centre of Ceylon, had obtained it. Let it be said here that Trimen as the result of much critical examination of Hermann's records, has stated that he neither travelled far from the coast nor had the opportunity of penetrating into any tract of untouched forest, and Thunberg records only two expeditions from Colombo, the one along the coast northward to Negombo, the other along the coast southward to Matara. As both gathered *D. oppositifolia,* their records are evidence of its occurrence in the low country of the coast which faces the south-west monsoon.

D. spicata was not obtained by these early botanists, and as far as we know does not descend towards Colombo ; but Thwaites got it twice on the south coast. Nor was *D. Trimmii* got by the earlier botanists for it too does not descend the hills towards Colombo. But *D. intermedia* has been nbtiin^ f- +u n i i_ ' uuiainea iromthe Colombo coast, even from as far north as Puttalam to which town the south-west monsoon brings only forty-seven inches of rain, and from the low country somewhere inland from Negombo. Then again it grows in the hills, where *D. spicata* grows, in the Central Province and southwards towards Galle in the Kukul Horale.

Thus apparently at the present time an association of *D. spicata* and *D. oppositifolia* is demonstrated in central Ceylon ; but there are parts where *D. spicata* seems to be the only one of the two, and there are parts where the reverse seems to be the case. *D. Trimenii* and *D. intermedia* are associates of both, where the overlap occurs, but are also found where as yet no overlap has been demonstrated.

Thwaites' type of *D. intermedia* cannot be fixed. He did not number in the field ; but having amassed a considerable amount of material sorted it, like Wallich and others, in the herbarium and then gave numbers for the purpose of distribution. Induing this he gave to his *D. intermedia* the nos. 2,S7D and 3022. Part of his no. 3D22, the Modamahanuwara specimen referred to above, which was his female plant, we exclude. His description of the male covers both numbers, and we have figured a portion of each on plate 140 as figs. 1 |nD. 2870) and 4 |nD. 3022). Figure 4 has iilbiTiiatc leaves and in the axil is a lea/less bran eh in association with four elongated spikes. Figure 1 has opposite leaves and the spikes are on leafless inflorescences. Hooker's idea of the species seems tD have been based chiefly on the latter, for he regards the alternation of the leaves as unusual, but he takes his dimensions from a specimen Df no. 2S7U gathered on a journey from Negombo inland to Kurunegala.

Thwaites gave as its habitat, the hotter parts of the island, adding not very common. His journey from Negombo would be through hot country and moreover he had found it at Puttalam DH the coast a little further north. He had obtained it also in the Kukul Korale which is north of Galle. But he had collected it also Dn various sides of Kandy, and in localities in the country which Trimen calls the "intermediate tract" betwesn the dry and the moist regions.

Hooker called it rather common. We believe that it is common about Peradeniya.

The tubers may there be eaten under the name Df "gDiia alia". This name means antler yam, for they branch. " Kombu valli kilangu " is an equivalent in Tamil. In south-western India it may be called " kamala kilangu " and " cedava kilangu " or yam of the month of May, doubtless because the needy dig it at that time. Apparently none of these names are restricted to it, and "gDiiaalla" least of all, for that name is used also for the allies which have been mentioned, and MDOII used it for the deep-going varieties of *D. pentaphylla.*

Macmillan says that for eating it is Df indifferent quality. MolegDde *[Handb. Veg. Cult.,* Dolomba, 1916, p. 68) contrasts it with *D. escuknta* and says that it is not as good to eat. He states that the tubers may be not only two or thriys, but even four. He names it *D. spicata,* but by the use Df certain vernacular names indicates that he refers tD this species.

INDIA. **4 a. Malabaria.** Malabar district. Without precise locality, *Barber* 2546 ! 2921 ! Travancore state. Without precise locality, *Bourdillon* 1550 ! 1554 \ Malayattur, *Bourdillon* 1258 ! Mandaniurai at 7 [10 ft., *Hooper and Ramaswami* 39317 ! Southern Ceylon. North-westsrn Province, Puttalam, *Thwaites* teste Hooker. Perhaps in this province, or perhaps in the Western Province, between Nsgombo and Kurunegala, *Thwaites* ! Central Province. Peradeniya, *Willis* ! Gangarowa, *Trimen* ! Between Haragaina and Rajawella, *Thwaites*! Maturata, *Thwaites* ! Maskeliya, near the Gartenne estate, *J. M. Silva* ! Southern Province. Kukul Korale, *Thwaites* !

PLATE 140, left side. Dioscorea intermedia, *Thwaites.* |1) A branch with opposite leaves and the male flowering spikes arranged in leafless inflorescences, drawn from that part of Thwaites' no. 2870 which was collected between Negombo and Kurunegala, i nat. size: (2) the parts of the flower of the same, X 6: [3) a stamen seen from the front and the back, X 12: (4) a branch with alternate leaves, in the axil of the leaf a long leafless inflorescence and four simple spikes, drawn from Thwaites' specimen in the Peradeniya herbarium which he obtained in the Kukul Kraale, \ nat. size: |5) a pair of opposite leaves each with an axillary spike from a specimen collected near Maskeliya by J.M. Silva, which connects *D. intermedia* with *D. Trimmii, I.* nat. size: |5) a capsule from a specimen collected by Thwaites which connects *D. intermedia* with *D. spkata* 1 nat. size. Inset, the distribution of *D. intermedia.*

138. DIDSCDREA OPPDSITIFDLIA, Linnaeus, Spec, plant., 1753, p. 103?, and earlier in his Flora Zeylanica, 1747, no. 351, but excluding his reference to Petiver's GazDphylacium: Burman, Flora Indica, 1758, no. 215, excluding var. b : Lamarck, Encyclop. Meth., 3, 1789, p. 23D, excluding the reference to Petiver : Willdenaw, Spec, plant., 4, 1805, p. 791, excluding the reference to Petiver: Roxburgh, Hort. Bengalensis, 1814, p. 105: Wallich, Cat. lith., 183D, no. 51D4 : Roxburgh, Flora Ind., 3, 1832, p. 8D4 • Graham, Cat. plants Bombay, 1839, p. 219 : Wight, Icones, 3, 1843, p. 7, and t. 813 : Voigt, Hort. Suburb. Dalcutt., 1845, p. 353 : Ku'nth, Enum! plant., 5,1850, p. 390, excluding the references t_D Petiver and t_D Thunberg : Elliot, Flora Andhrica, 1859, pp. IB and 18: Dalziel and Gibson, Bombay Flora, 1851, p. 247 : Thwaites, Enum. plant. Zeylan., 1854, p. 325: Trimen in Journ. Linn. Soc. Lond., Bot. 24, 1887, p. 151 : Hooker fil., Flora Brit. Ind., 5, 1892, p. 292: Nairn, Flowering plants W. India, 1894, p. 344- Dalgado, Flora Goa, 1898, p. 193: Hooker fil. in Trimen, Handb. Flora Ceylon, 4,1898, p. 273 : Woodrow in Journ. Bombay Nat. Hist. SDC, 5,1899, p. 523 : HDIB, List trees, shrubs, climbers Northern Forest Circle' Central Provinces, 1905, p. 69 . Cooke, Flora Bombay Presidency, 2, 1907, p 758 • Watt, Commerc. Prod. India, 19D8, p. 494: Witt, Forest Flora Berar Circle 19D8, p. 77 : Prain and Burkill in Journ. As. Soc. Bengal, N. S. ID, 19M' p. 3D : Witt, Descript. list trees herbs N. and Berar Forest Circle, Central Provinces, 1916, p. 221 : Ramaswami in Rec. Bot. Survey Ind., 5 1915, p. 153: Fischer in Rec. Bot. Survey Ind., 9, 1921, p *i$\ '*. R. Knuth in Engl. PflanzenrBich, iv-43, 1924, p. 285: Haines, Bot' Behar and Drissa, 1925, p. 1118: Fischer in Gamble, Flora Presidency Madras, 1928, p. 1512 Alston in Trimen, Handb. Flora Ceylon 5 1931 p. 288.

Dioscorea coriacea, Wight in Wallich, Cat. lith., 1830, no. 51D4B.

Dioscorea dliptica, Thunberg in Herb, propr., and ex Prain and Burkill in Journ. As. Soc. Bengal, N. S., ID, 1914, p. 3D.

Dioscorea lancwlata, Heyne ex Hooker fil., Flora Brit. Ind., 6, 1892, p. 292.

Dioscorea ovata, Thunberg in part in Herb, propr., and ex Prain and Burkill inJDurn. As. SDC. Bengal, N. S. ID, 1914, p. 3D.

Smilax pseudo-china, Koenig in Herb. Linnaei.

Prelinnean names :—

about 17DD. TriDpteris malabarica Inhame folio, Plukenet in his Herbarium.

17 D 4. TriDpteris malabarica scandens Inhame folio, an Katu Katsjil, Hort. Malab., Petiver in Phil. Trans. Roy. Soc. 23, p. USD.

1745. DiDSDDrea Indiae Drientalis scandens, folio utrinque acuminato, fructu flavescente laevissimo, Ammann, Herb. Ammann. in Mus. Imp. PetrDp. 1, pars 2, p. 257.

TriDpteris malabarica scandens Inhame folio, Petiver. Ammann, IDC. cit.

1747. DiDScorea fDliis oppDsitis ovatis acuminatis, Linnaeus, Flora zeylanica, p. 171 as regards Hermann's description, but not as regards the reference tD Petiver's GazDphylacium.

Tuber usually single, descending deep into the soil, attaining 2 metres in length with a thickness of about 2—3 cm., not much thickened downwards, but in the main cylindrical; skin a reddish earth-colour with a few rootlets ; flesh white, soft, edible. *Stem* glabrous or very finely pubescent and then in ag3 glabrescent, attaining a length of 3—4 metres. *Bulbils*, none seen. *Leaves* more often alternate than apposite (belying the specific name), elliptic-obovate or rarely nearly circular, sometimes thr lowr.st of all cordato, acuminate, with a brown subhyaline margin, up to 12 cm. long by 7 cm. in width or in rare cases up to 11 cm. in width, 5—7-nerved : the nerves of the first pair with a course nearer tD the margin at the mid-length of the blade than to the midrib, enclose an Dbovate DI oblanceolate-DbDvate area : the nerves of the second pair diverge from the midrib at a rather variable angle between 55° and 80° tD run submarginally : the nerves of the third pair, if present, very weak : the secondary nerves cross the interspaces in a slightly oblique direction : upper surface glabrous, with the primary nerves distinct: lower surface glabrous or pubescent, with the primary nerves prominent and the others just raised : petiole up to 4 cm. long.

Male flowers in spikes which, ine th most wide-spread variety, are grouped in the axils Df the leaves, but in other varieties are Dn special leafless branches : axis of the spikes 2—3 mm. long, with about 30 flowers, glabrous or pubescent, angled: bracts ovate-acuminate, somewhat repressed against the axis, scarious : bracteoles ovate, acuminate, similar to the bracts but shorter. *Sepals* broadly ovate, 1—To mm. bng. *Petals* almost oblong, equalling the sepals in length. *Stamens* 5, Dn filaments which approximately equal the anthers in length. *Gynoecium* three very small points.

Female flowers tD the number of about 20 or sometimes more, on simple decurved spikes which may be 15 cm. long, and are solitary in leaf-axils : axis glabrous or pubescent: bracts as in the male plant. *Sepals* ovate, almost rounded above, 1 mm. long. *Petals* a little smaller. *Staminodes* half as large as the stamens of the male flowers. *Stigmas* three pairs Df small hDDks. *Ovary* at flowering about 4 mm. bng. *Capsules* with a stipe 3—4 mm. long expanding upwards tD a diameter Df 2-5 mm. at the point where the wings spring out with a curve which does not quite run through a right angle ; then the wings are evenly rounded tD a truncate apex, their greatest width 12—17 mm. and their length along the placenta IB—24 mm. *Seeds* with a brown wing all round, conform to the loculus.

INDIA through the hills Df the Deccan and in CEYLON.

This species is by IID means uncommon in the Deccan, its long thin tubers going deep into the stony soil Df the hills in places where the clouds DI the south-west monsoon bunk. It is there tD be sought chiefly at elevations Df2,DDDtD 4,DD[> feet and in Cuylon it seems to ocDiir in caiTBspDnding .situations, but to be found also down to the coast.

It occurs in different varieties in the northern part and in the southern part of the country which it occupies. We distinguish four of them thus :—

Leaves pubescent, lanceolate-ovate or broadly ovate, drying brown ; the axis of the inflorescence abundantly pubescent .. .. .. var. *Thwaitzsii.*

Leaves glabrous :

Male flowers Dn leafless branches :

Leaves broadly lanceolate or ovate : male inflorescence with brownish pubescence .. .. var. *Linnani.*

Leaves broadly Dvate : male inflorescence almost glabrous, up to 15 cm. long .. .. *vivr. Jileeboldii.*

Male flowers Dn spikes which are axillary or Duly on very rare occasions collected on leafless inflorescences : hairs few .. .. var. *duhhunensie.*

Variety *Linnaei* is that which found its way into the hands of Linnaeus, and therefore includes the type. Hermann had cDUscted it, but he had not published anything about it. Bulkley was the next to collect the species. His specimens are the variety *dukhimmsis.* Dated 17D1 and named " cooty pallee " (intended for kodi pani, i.e., climber with a leaf like betel pepper) is a specimen from him in DuBois' herbarium at Oxford, and another dated 17D2 named "villy calungo" |for velli kilangu). In the British Museum of Natural History are further specimens which Samuel Doody, of the Chelsea Gardens, had received and had sent on to Petiver.

Yet another early collector was Koenig, who sent a scrap to Linnaeus of the variety *dukhunensis,* which in the Linnean herbarium bears the name "pseu do-china, Hoenig". Sir James Smith's handwriting is Dn another sheet in that collection.

Linnaeus had not recognized his own species in Koenig's specimen, nor hud he at its very initiation fully isolated it, for he had added a reference to Petiver 'a Gazophylacium |Gazophylacii Naturae, 1 ; plate 31, fig. B) where *Stemona tuberosa,* Lour., is figured.

The collectors who travelled most in Ceylon in the last century—Walker and Thwaites—obtained *D. oppositifolia* in the variety which we have named var. *Thwaitzsii.* It was this variety which served Thwaites as his model for the species ; and it was the same which Sir Joseph Hooker used in Trimen's *Handbook of the, Flora of Ceylon.* Thwaites has stated explicitly that the whole plant is more or IDSS villous.

The variety *dukhunensis,* which is the remotest in characters from var. *Thwaitesii,* was brought by Roxburgh into the Honourable East India Company's Botanic Garden at Calcutta. He described it afresh (Flora Ind., 3, p. 8D4) and figured it, his figure afterwards serving Wight for a plate in his *hones,* where is reprinted the diagnostic half of Roxburgh's description.

Thunberg who was in Ceylon in 1777 and 1778, obtained there both var. *Thwaitesii* and var. *Linnaei,* and left them in his Herbarium under different names, which have been quoted above, recognizing neither as *D. oppositifolia,* when he described his *D. opposita* as a plant of Japan, and used the words of Linnaeus' diagnosis of *D. oppositifolia* for defining it.

Backer in 1924 (HandbDbkvDor de Flora van Java, 3, p. 115) used the name *"oppositifolia"* as if in despair for an astonishing series of plants.

The tubers of this species are esculent, but tedious to dig for so small a return as they give. We have never seen more than Diie to a plant, but Molegode *Handb. Vej. Cult.,* Colombo, 191B, p. 68) sajs that "hiritala", by which he should indicate this species, has 5— B of them. The Bhils and Baigus of the Bombay Ghats eat them : SD also the Korkus of the Melghat and the Bonds Df Central India, the Yanadis of'Nellore and the Savaras of Ganjam. In famine times others resort tD them ; and there are records of this in the Central Provinces, in the districts of Bilaspur, Bhandara, Balaghat, Chhindwara, Amraoti, Betul and Hoshangabad ; in the Bombay Presidency, in the districts of West Hhandesh and Belgaum; in the Madras Presidency in the districts of Ganjam and Vizagapatam ; and in Orissa in the district of Duttack. Two errors in reference to its use exist and must be pointed Dut, so that they may not be repeated. The one began in Graham's *Catalogue of the Plants of Bombay and its vicinity* and lies in the application to it of the name "mar pashpoli"—a name belonging to *D. hispida.* This error Dalzell and Gibson, Lisboa, Nairne, DymDck and CDDke all copied : its implication that the tubers are poisonous is quite incorrect. The other error has already been in part exposed. It arose in a confusion of *D. bulbifzra* with *D. oppositifolia* and lies in a statement in Watt's *Dictionary of the Economic Products of India* that the Sontals eat its tubers : Sir George Watt appended a surmise that *D. bulbifera* should have been written. The Sontals do not live in a country where this species grows, for them tD use it.

D. oppositifolia has over sixty different vernacular names in India, many of them shared with species which are similar in general appearance and similarly used. Among such, the chief is perhaps *D. belophylla,* which occupies hill-crests in the Deccan in the same way and demands as much labour for any one who would dig the tubers for food. But in the Districts of Cuttack and Angul and in the neighbouring state of Narsingpur where that species is "tunga" or "tunga alu", this is "pani a,lu" in quite a distinct degree. "Pan alu" in the Mayurbhanj state and "panpatria" in the Nilgiri state are but variants. TD the westward the same two species share the names "nanmati", which comes from the language of the Gonds. It has been recorded as "nanmati" in the districts of SaugDr and Chhindwara, and as "nanamati" or "nunmati" in the district of Bhundara. But the plant's proper CJc-ndname seems tD be "krasmati", which appears as "kiras kanda" and "kirchikand" among those in the Balaghat district who do not talk the pure Gond language, and as "krishna mati" in the districts Df HDshangabad and Betul, and also as "kircha" in the district of Saugor.

Towards the wostBrn side of thB Central Provinces, the Korkus have a word "bail" and this naniB ia responsible for tht) naniua "belya kund," bclni kand" and " Lular " which uro at timra incorrectly applied tD *D. oppositifolia.* Rightly, "bail " ia *D. bulbifera.*

" Dardi," met with in thB district of Bstul and in the Melghat of tho district of Amraoti, indicates *D. oppositifolia.* " Oria " aeema to bB a Bhil name for it. " Lokheri " indicates it in thu hills of Belgaum. " Rabi " and " ravi kand" are used for it in the district of Raipur. " Thavai kachchu," " thana kacha," [11] thavai kaju " and " kavi kacchu " arB names received from the Nilgiri Hills. The Savaias of Ganjam call it " gadogai;" and widely in the Dircars it is "ari tega " and "avi tega."

A number of names have bean recordad as denoting bhia species in Tamil, but almost all apply equally to other species Df *Dioacorea.*

INDIA. **4 a. Malabaria** (var. *dukhunmsis,* unless otherwise specified). Thana district. Rajaoli forest near Baasein, *Ryan* 893! Vetoli, *Ryan* 410! Sawantwadi state. Between Amboli and Danoli, at 2,2D0 and 1,500 ft., *Buricill* 175D5 ! 17518 ! Goa territory. Common Dn the Ghata, *Dalgado.* North Kanara district. East of Caatbrock, *Buricill*! *Gamble* 15BB1 ! Karwar, *Talbot* 587! 597! Birchop, at 2,0DD ft., *Talbot* 2127 ! Devenainghat, *L. B. Kulkarim* ! South Kanara district. Mangalore |var. *Linnaei), Hohenacker's colhctor \Metz)* 597 ! Jahlsur, *Barber* 24D7 ! 2432 ! Nilgiri district. DoDnoor, *Beddome* 7748 ! *Bourne* ! *Barber* 2183 ! Between Mettupalaiyam and Segor, *Lawson* ! Kolhatti, *Lawson* ! Kotagiri, *Perrottet* 173, and at 5,000 ft., *Gamble* 14494! Dsvala, at 3,DDD ft., *Gamble* 15505! Huchguch, *Lawson I* Barliyar, at4,DDD ft., *Gamble* 177B8 ! *Lawson* ! Cochin district. Perambikolam, between 3,DDO and 4, D DO ft. |var. *Meeboldii), Meebold* 12374! Travancore state. Ariyantram, *Lawson* 4D1 ! ThodcoracDnum, *Lawson* 185 ! Dhimunji, at 4,DDO ft., *Bourdillon* 1391 ! Malayattur, *Bourdillon* 1258! Quilon, *Bourdillon* 2B ! Towards Courtallam, *Rama Rao* 1905 ! Thalappara, *Rama Rao* 1730 ! Southern Ceylon. Without locality, *Walker* ! |var. *Linnaei), Hermann,* a drawing! *Walker* 45 ! and (var. *Thwaitesii), Thunberg] Walker* 147! 219! *Thwaites* 23D3! Central Province. Peradeniya |var. *Thwaitesii), deSilval5* Hantane, at 2.3D0 ft. (var. *Thwaitesii), Gardner 898* ! *Thwaites* ! Uva province. Moneragala, *Alston* IB in part! |var. *Thwaitesii), Gardner* 898! *Thwaites I* Meddeniya |var. *Linnaei), Alston* 141B ! Moneragala, *Alston* IB in part! **4 b. CorDmandelia** |var. *dukhunensis,* unless otherwise specified). Northern Ceylon. Trincomali (var. *Linnaei). Rottler* ! Tinnevelly district. Courtallam |var. *Linnaei), Wight* 2824! Mundandurai at 7D0 ft,, *Ramaswami* 39317! Machur to Tandigudi, *Madras herb.* 15BB9 ! Madura district. Palni hills, *Beddome* 7751! and at 3,DDD ft., *Saulifre* 499! Alagar hills, at 1,000 ft., *Fischer* 3152! 31B3 ! Kodaikanal ghat, *Bourne*\ Between Kodaikanal and Periakulam, at 4,0D[) ft., *Angladz* 128 ! Periashola, *Bourne*! Sirumallai hills, *Beddome,* 7747! *Barber* 9144! Tanjore district, doubtfully, labelled " Coromandel " {var. *Linnaei), Koenig* ! Coimbatore district. Anamallai hills, *Beddome* 7744 ! 7749 ! 7751 bis ! *Fischer* ! Hassanur, *Barber* 1D58B ! Tamarakarai, at 3,500 ft., *Fischer* 109! High Wavy Mountain, between 4,DDD and 5,500 ft., *Blatter and Hallberg* 558 ! 5B9! Trichinopoly district. Kollimalai, *Barber* 1D53S bis ! Salem district. South Salem, without precise locality, *Mus. R. E. P.*\ North Salem, without precise locality, *Mus. R. E. P.* ! Yerkaud, *Bidie* 187B ! Shevaroi hills, *Perrottet* 472! *Grant Duff*! *Bourns* ! Namakhal range, *Barber* 1583 ! South Arcot district. Melpat, *Barber* 979 ! 1D2S! 1D30! 1031! 1041! Chingleput district. Madras, *Saulière* 413! Vandalur, *Barnes* 10DD! 1DD2! 1027! North Arcot district. Mamandur, *Barber* 10175 1

Nellore district. Shriharikota, *Gambh* 21753 ! VeligDnda hills, *Eamaswami* 1370! 4 C. **DBCCan.** (Mysore.) Shimoga district. Shimoga, between 2,DDt) and 3,D0D ft., *Meebold* 10O79 ! Ananthapura, between 2,DDD and 3,000 ft., *Mttbold* 1D078 ! (Madras abovB the Ghats.) Cuddapah district. Cuddapah ghats, *Beddome* 1880 ! Horsleykonda, at 4,5DD to 5,OD0 ft., *Gamble* 15093 ! 15179 ! 2D95B ! 20962 ! 2D96B ! Murdamalai, ? *Beddome*! Kurno D1 district. Nallamalai, *Barber* 2412 ! (Bombay above the Ghats). Belgaum district. Ambon," on the crest of the Ghats, *Burkill* 16961 ! lb'952 ! 1B969 ! Satara district. Mahableshwar, *Graham.* Poona district. Poona, *Woodrow*! Boudhan near PDDna, *Kanitkar.* Singhar, *Bhide*! Kandala, *Graham* ! *Gooke* ! *Garade* ! Shivapur, *Kanitkar* ! Karli, *Gammie* 15141 ! Malkapur, *Shevade*! District of Khandesh West. Akrani plateau, common, *Burkill* 33284 ! 4 d. Hindustan, jlndore sub-sub-subregion.) A1i-Rajpur state. Without precise locality, *Mus. R. E. P.* 915B ! Barwani state. Barwani, *Kalka Pershad I* 4 B. Sub-SUbregion **of** Rains **from the Bay Bf Bengal.** |Central Provinces.) Ako1a district. Without locality, *Mus. R. E. P.I* Buidana district. Without precise locality, *Mus. R. E. P.*\ Amraoti district. Sembadow, on slopes facing north, *Burkill*! South face of the Makla plateau, *Burkill*! In the Ban valley between Draigarh and Somthana, *Burkill* 33141 ! Edge of the Mota plateau, at 3.DD0 ft., *Burkill* 31235 ! North of Labada, at 3,DDD ft., *Burkill* 31176 ! Ghatang, *Burkill* 31249 ! Dn the watershed north of Belori, at 3,000 ft., *Burkill* 31187 ! Nimar district. Without precise locality, *Mus. R. E.P.*\ Betu1 district. Without precise locality, *Mus. R. E. P.I* HDshangabad district. Without precise locality, *Mus. R. E. P.I* Chhindwara district. Without precise locality, *Mus. R. E. P.* ! Sauger district. Rangir and Halkho, *Chintaman Vishwanath* 2D8D5 ! Chanda district. Without precise locality, *Mus. R. E. P.* ! Mohinalla in South Chanda, *Haines* 3578 ! Nagpur district, Without precise locality, *Mus. R. E. P.*\ Bhandara district. Without precise locality, *Mus. R. E. P.I* Ba1agh^,t district. Without precise locality, *Mus. R. E. P.* ! Mandla district. Without precise locality, *Mus. R. E. P.* ! Raipur district. Gundai, *Drake-Brockman* 15441! Bilaspur district. Ambanala, *Kalka Pershad* 2D354 ! Dhikpalli, *Haines* 1DD ! Dhaba, *Haines* 3580 ! (Circars-Drissa.) Godaveri district. Samalkotta, *Herb. Rotthr*! Tummileru, *Barber* 5283 ! Ramʻpa hill, *Ramaswami* 1577 ! Kappikonda hill, *Ramaswami* 1645! Palakonda, *Narayanaswami* 352 ! Top of Buggimatta, at 5DD ft., *Narayanaswami* 279 ! Between Gokaveram and Andavaram, *Narayanaswami* 18! Vizagapatam district. Golgonda, *Barber* 19B3 ! Palkonda, *J. Campbell*! Ganjam district. Chatrapur, *Mus.R.E.P.* 11056 ! Parlakimedi, very common in rocky places, *Burkill* 12991 ! 12997 ! *Corey* 112 ! *Rama Murti* 18D09 ! Foot of Deva giri, at about 1,DOD ft., very abundant, *Burkill* 17945 ! and at 2,3DD ft., *Burkill* 17954! Puri district. Barkuda island in the Dhilka Lake, *Annandah* 1331! Cuttack district. Jajpur, *Allen* 20581! Madhupur estate, *Gopi Mohan Roy* ! Narsingpur, *Mohamad Atahar* 14037 ! Kendrapara, *Sriram Chandra Base* 14119 ! Angu1 district. Durgapur Forest-block, *Haines* 4D29-5123 ! Dhenkana1 state, *Jagan Mohan Ghosel* Nilgiri state. Nilgiri, *Kalka Pershad* 343 D2! Mayurbhanj state. Baripada, *Holmes* 33181 ! 34312 ! Patharchokri, *Kalka Pershad* 34318 !

PLATE 139. Dioscorea Dppositifolia, *Linnaeus.* (1) A branch with male flowers of the variety *Thwaitwi;* from Thwaites' no. 2303 : |2) a branch with young capsules from Thwaites' no. 2303 also: (3) mature capsules. All nat. size. Inset: the distribution Df *D. oppositifolia.*

139. DIDSDDREA TRINERVIA, Roxburgh ex Prain and Burkill in Joum. As. SDC. Bengal, N. S. 10, 1914, p. 32: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 281).

Dioscorea glabra, Wallich in Cat. lith., 183D, no. 51D5 D and 5105 E.

Dioscorea oppoaitifolia, HDDker fil., Flora Brit. Ind., B, 1892, p. 292, in part.

Tuber descending deeply into the soil, up tD a metre in length, dark-skinned with tender white edible flesh, which in age towards the surface of the SDïI goes Drange-coloured, sparingly rooty, slightly increased in diameter downwards, nearly but not quite to the tip. *Stem* slender, unarmed, glabrous below, but pubescent above especially among the inflorescences. *Bulbils* elongated, up to 15 mm. in diameter. *Leaves* generally alternate, but the uppermost often opposite, lanceolate-Dvate and obtuse at the base, or sometimes ovate and then obtusely rounded at the base, apex very shortly acuminate or else mucronate, up to 15 cm. long by 5 cm. in width or, if ovate, by 8 cm. in width, rarely as much as 2D cm. long by only 5 cm. in width, 5-nerved : the nerves of the first pair enclose a broadly lanceolate area and run nearer to the margin than to the midrib except near their point of origin : the nerves of the second pair submarginal in the lower part of the length of the blade and soon vanishing : the secondary nerves cross the interspaces obliquely, few and inconspicuous : the network nearly as conspicuous as they are : the upper surface dark green, glabrous, with the main nerves just prominent: the lower surface nearly or quite glabrous, with the main nerves prominent and the secondary nerves just raised ; the network visible : the margin strengthened by a tawny brown edge as in *D. oppositifolia:* petiole about 2 cm. long or sometimes a little longer, generally finely pubescent.

Male flowers in spikes arranged along leafless special branches which may reach a length Df 30 cm. : the spikes usually paired in the axils of opposite Dr subopposite bracts, each pair of bracts 1—2 cm. remote from those immediately preceding : the axis of the inflorescence pubescent with short grey hairs : the axes of the spikes angled, pubescent, up to 23 mm. long, with upwards of 35 flowers : bracts Dvate, acuminate, scarious, nearly glabrous, 1 mm. long : bracteoles similar but smaller. *Sepals* Dvate from a broad base, obtuse, incurved, 1 mm. long, glabrous. *Petals* broadly elliptic-ovate, shorter, glabrous. *Stamens* 6, on short filaments and not quite equalling the petals. *Gynoecium* a small blunt cone.

Female flowers in spikes which are generally simple and decurved, produced in the 1 eaf-axils : axis reaching 15 cm. in length with 10—15 flowers, pubescent: bracts ovatB-acuminate, nearly glabrous, 1 mm. long. *Sepals* triangularly Dvate, obtuse, thick, D-75 mm. long, glabrous. *Petals* similar, smaller. *Staminodes* minute. *Stigmas* as threu pairs of sickle-like organs. *Capsules* grey-brown flecked with red-brown, rather small, the stipe 4—5 mm. long expanding upwards to a diameter Df 3 mm. at the point where the wings arise abruptly at a right angle to curve round evenly to the truncate apex, their maximum width 12 mm. and their length along the placenta about 15 mm. *Seeds* in a mature state have not been seen.

NORTH-EASTERN INDIA, in the hilly country between Assam and Burma.

In its pubescence this species suggests an alliance with some of tho3e which follow,—specias which are not Indian but Indo-Chinese in dispersal. The margin of its leaf-blade caused Sir Joseph Hooker to place it in *D. oppositifolia,* but it is really quite distinct. Wallich had included it in *D. glabra* by ignoring the pubeacen CB,

and the venation of its leaves which is distinct. Roxburgh had observed that venation and in his herbarium had written the speciBB up as *D. trinervia,* which name WB adopted fDr it in 1914.

It *is* a species v.ry common in North Dachar where it flowers in August, rather earlisr than the allied DioscorsELS of those hills. The Khasis, Cacharis and Mikirs Bat its tubers : the Khasis call thorn " phan um," thB Dacharia " tha-nairang " or " tha-nairoh " and thB Mikirs " rui-ring."

INDIA. **4 e. Sub-subregion of Rains from the Bay of Bengal.** (Brahmaputra valhy.) Nowgong district. Lumding, *Burkill* 353D9 ! *Kalka Pershad* 35575 ! (Surma valley, but perhaps not really in the valley.) "Sylhet," without precise locality *F fa Silva* in Herb. Walhch 51D5 E ! Cachar district. Alnee on the Barak river, *Gage* !

WESTERN INDO-CHINA. **ID a. Khasi-Naga hills.** Khasia Hills. Without precise locality, *Masters* in Herb. Griffith 5549 ! at 2,QDO to 3 DDD ft *G Mann* ! Bor Pam river, *Hooker and Thomson I* North Cachar subdivision. Damcherra, *Ketnanl* Haflong, between *2,m* and 3.DDD ft., *Ballantine* 31835! *Craib* 13 ' *Burkill* 33011! f 022 ! 33D2*! *Shaik Mokim* 184 ! **MO c. Chittagong-Arakan. Dhi11a-**gong district. Dhittagong, *Bruce* in Herb. Wallich 51D5D! Lushai Hills, Lungleh, *Wmgermi* San do way district. Without precise locality, *Mus. E. E. P.* 15094 !

f ^ I ' M ^ 8 1 ^ " ^SD DreatrinBrvia, ^^^- IDA branch with male flowers **from** Shaik Mokim s nD. 184, ^nat. size : 12) a flower v ln. IQWI. J- ^ J *IA* u i. 4U if o, ., „ ' uuwer, x 1J : |3) the same dissected; |4) a branch with capsules from Shaik Mokim's no 273 ± nat aAa • » , . (cV) I , . .,, . J ^ • SBEdS; **nat• ai2E: |7) a immature** capsule, nat m« : ' |8) a large leaf from BurM's », 353D9, J nat. sizB. In3et, the distribution of *I). trinervia.*

139 .. DJDSCOEEA sp., BurkiU in Rs, Bot. SurTey Ind., i0, 1B2g, p. 388.

A yam similar to *D. trinarvia* was found in cultivation in fhe Ak mi ' a sterile condition. Thi lBaVB8 wBrB quite glabrous and in drying turned a rusty brown a dD ioT ft " *glabra* and of *D. trinervia.* Dn tha wholB it aPpBarBd to bB more likB *D. trinzrvia* than Z) rfl". W -f . prBciedy. ThB Abor8 of Bal.k gavB the name of »ngi-iin. » " Tn T " . " impDBsiblB to ^tarmine it Iv <•• • „• r , ,. . "Pl"»B- In Lorraine's *Dictionary of the Abor lanquaq?* the name "JB-ngin is found, which appBars to bB the 8ame word tt *i.- ,- , Kwii/uai/e wild plants known in thosa hills was not ascertain^. * thl8 CUltlVatei pknt di«Br8from

HIMALAYA. **5 1 Eutem Himalaya.** Abor Hi11B », u vi..age, *Ka..a Pershai* 3B453 ! Panji village, in a clearing at 3.50D ft., *Bvrteli* 37772?

MB. DIDSCDEEA DBCUNEATA, HoOker fil., Flora Brit Ind 6 1892, p.293, and in Trin, Bn, Handb. FlDra Ceylon 4 ISBgT WQ " », .n ' in Circuit Roy. Bot. Bard. Ueylon, 3 2 3D 19D5 . M acmi.. ^ ^ Builrill in Journ. As. Soc. Bengal NS ID nil , P. --, ..ain a.. Engl. Pflanzenreich, iv-43, 1924 p 1 AH . 3D V . : *R1^uthia* Ceylon 6, 1931, p. 288. * " Aratmm ..men, **Handb. Flora**

VniW^i parts unknown. A« gUbrou8, terBte, or very faintly ridged **Adhb.** nno seen• £«». betwem obovate and ob™neate, towarda the ape/rounded and then drawn Ulto an abrupt acumen which i. almort paraUel-sided under thB mucro, the whole blade up to 7 cm. long by 3;5 cm. in width, 3-nervEd or rarely Served: the nerve, of the tot pair ™ • "*> ™thjn the margin for the grater part of the length of the blade of the leaf SD that they enclose an area which in alm™+ * *.*. ,
,, , i j ii r 41. j • Almost ot tne same shape as the blade : the nerves of the second pair when present very weak and almost in th»

margin: the secondary nerves cross the interspaces obscurely and with some elbows and "arB rather far apart: the upper surface glabrous, very smooth, with the nerves not at all prominent and the network quite obscure: the lower surface glabrous, smooth, dull green, with the primary nerves prominent but not the others : petiole about 1 cm. long.

Male flowers on spikes which are arranged on short leafless branches in the axils of leaves, these branches up to 8 cm. lung : axes of the spikes about 2 cm. long carrying about 20 flowers, angled: buds ovoid, directed obliquely forward : bracts lanceolate, ovate, acuminate : bracteoles ovate, acuminate, smaller. *Sepals* ovate, obtuse, promising at maturity to be but 0-5 mm. long, but mature sepals have not been seen. *Petals* narrower, almost as long, obtuse. *Stamens* Ei with very short filaments in their immature state. *Gynoecium* a small wart.

Femak flowers in spikes about 6 cm. long, up tD the number of about a dozen : axis approximately triangular, glabrous: bracts long-deltoid, about 1 mm. long. *Sepals* glabrous, ovate, 0•75 mm. long. *Petals* almost equalling the sepals. *Capsules* rather large : the stipe 4—5 mm. long expanding upwards to a diamater of 2-5 mm. where the wings expand from it curving rather abruptly through 90^{D}; they are somewhat obliquely rounded to the slightly retuse apex ; the greatest width of the wing IB mm., the length measured along the placenta 18—2D mm. *Seeds* with a smoky brown wing all round, in size almost conform to the loculus.

CEYLON.

Three or perhaps four collectors have obtained thin plant in Ceylon; but not onp of them, before Alston, recorded the locality where it was obtained. The first of them was James Macrae, for four years, **1827** to 183D, Superintendent of the Peradeniya Garden, who is likely to have obtained his specimen nearPeradeniya. ThwaiteB, who went to Dnylon in 1849 and lived for the rest of his life in the island, collected it and numbered it 2870- but he nttmberedinthe herbarium, placing sprcimenK from viiriutm localities together, SD that the number is no guide to the locality : and thirdly came Parlett, of whose localities nothing is ascertainable.

Alston, Dn 4th March **1928,** obtained one *Dioscorea* in flower and another in fruit at the same place,—the edge of forest near Moneragala which is a locality at the eastern end of th? mountains of central Ceylon. The *Dioscorea* in flower was *D. oppositifolia* var. *Thwmimi*; that in fruit wan this specie. Hi; thought them to represent a single species, which in a reasonable view : if he be right *D. obcuneata* becomes a variety or a hybrid, or a form of *D. oppositifolia.* As a species it is indisputably very close to *D. oppositifolia,* the difference being in the shape Df the leaves together with |aB regards the forms of *D. oppositifolia* which are met with in C^ylonJanabsencBDfhaiMalDngtheaxisDfthL-inflorfsccnce. It looks like a hybrid of *D. oppaiitifolia* with *D. spitata,* the former predominating.

Macmillan says that it is called " hintala " or benumbing yam, because the freshly eut surface benumbs the fingers. WBhave ourselves experienced the bmUmbing sensation when handling its allies.

INDIA. **4 a. Malabaria.** Southern Ceylon (presumedly southern Ceylon, but no localities recorded), *Macrae* 111, *Thwaites* 2827 ! *Parlett* ! and without collector's name ! Uva province. Moneragala, *Alston* 16 in part!

PLATE 140, right side. Dioscorea Dbcuneata, *Hooker fil.* (1) A branch with male flowers from a specimen in the Hooker Herbarium at the Royal Botanic Gardens, Kew, without collector's name, \ nat. size : (2) a bud : (3) a bud dissected : (4) capsules from Alston's no. 16, J nat. size.

Group ol D. dacipiani [species 141). Markedly characterized by having only three fertile stamens, but in nil other respects very like the aperies of the group which immediately follows.

141. DIDSCOREA DEOIPIENS, Hooker fil., Flora Brit. Ind., B, 1892, p. 293 : Gage in Rec. Bot. Survey Ind., 3, 1904, p. IDS : Craib in Kew Bull., 1912, p. 4D7 : Prain and Burkill in Journ. As. SDC. Bengal, N. S., ID, 1914, p. 31 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 287 : Prain and Burkill in Kew Bull., 1927, p. 245, and in Lecomte, Flare gén. de 1' Indoch., 5, 1934, p. 745.

Dioscorea glabra, Wallich, Dat. lith., 1830, no. 51D5 S and 51D5 H.

Diosoorza oppositifolia, Collett and Hemsley in Journ. Linn. Soc. LDnd., Bot. 28, 189D, p. 137 : Backer, Handb. Flora van Java, 3, 1924, p. 115, in part; not Df Linnaeus.

Bioswrea rotundifolia, Wallich, Ms. in Herb, propr. nD. 51D5 H.

Tubers descending deeply into the soil, usually one each year, but sometimes more, up tD a metre and a half in length with a maximum diameter of about 9 cm., not distinctly stalked, but very gradually increased in thickness downwards from the point of origin from a woody knot, the skin a yellowish ochre, sparingly beset with weak rootlets, the flesh white and edible. *Stems* for the most part one from each TDDt per annum, unarmed, with slight longitudinal ridges, glabrescent except at the nodes or very tardily glabrescent there where a dust-like patch of minute down is almost sure tD persist, in diameter about 5 mm. *Bulbils* seen. *Leaves* alternate or often upon the thinner branches opposite, usually exactly ovate, shortly acuminate, about ID cm. long and 5-5 cm. in width, but the largest leaves may be as much as 14 cm. long by 14 cm. in width and then they are just cordate at the base, and possess a small abrupt mucro at the apex, 5—7-nerved : the nerves of the first pair curve gently away from the midrib tD meet again in the apex, enclosing an oblanceolate area : the nerves of the second pair increase the curve and become submarginal towards the apex and are lost: the nerves of the third pair are weak and almost submarginal from their very origin and disappear before the mid-length of the blade: the secondary nerves cross the interspaces obliquely and are rather obscure: the upper surface glabrous, dark green, with the primary nerves alone visible : the lower surface thickly covered with short white hairs, with the primary nerves prominent, the secondary nerves visible but scarely distinct, the surface when dry and often also in life showing brownish markings : margin a firm tawny rim : petiole up to S cm. in length, hairy especially at the two pulvini.

Male flowers very sweetly scented (Lace), densely arranged on short spikes which are rarely in groups in leaf-axils, but commonly Dn long leafless branches which arise from the leaf-axils : these special leafless branches attain a length of about 25 cm. and carry the spikes in false whorls of about six, three from each Df two opposed bracts, with internodes between the pairs Df 5—2D mm. : the axis of the spike attains about 2D mm. and bears more than 4D flowers, is angled and hairy with white hairs : bracts Dvate-lanceolate, long-acuminate, uniformly dark brown, D-5 mm. long : bracteoles similar, smaller. *Sepals* broadly ovate, obtuse, concave, nearly uniformly dark brown, 1 mm. long. *Petals* shorter than the sepals, much thicker, concave. *Stamens* three fertile, arising at the base of the sepals, their filaments only 0-25 mm. long, their anthers D-5 mm., introrse : alternating with three staminodes from the base of the petals, standing as filamentous organs between the stamens and equalling them in length. *Gynoecium* a small cone, D-25 mm. high.

Female flowers Dn spikes either from the axils of the leaves Dr ofteh grouped Dn special leafless branches which may be ID cm. long : the branches hairy : axes of the spikes very slightly ridged and very hairy : bracts ovate-acuminate, pubescent, 2 mm. long, brown:

lyracteoles similar, narrower. *Sepals* Dvate, very thick, incurved, hairy outside, D-75 mm. long. *Petals* similar but smaller. *Staminodes* 5, those opposite the petals deformed. *Ovary* densely pubescent. *Capsules* relatively small, the stipe 2 mm. long, expanding upwards to a diameter Df 1 mm. at the place where the wings arise in a curve which runs through 9D^{D}, the wings then evenly rounded tD a slightly retuse apex, their maximum width 11 mm. and their length along the placenta 13 mm., their surface covered with white hair until they are ripe at which period they are glabrescent and become shining, showing themselves yellowish tawny with some brown markings. *Seeds* dark brown with a wing all round somewhat unevenly, but more Dr less conform to the loculus.

BURMA, extending northwards int$_{D}$ ASSAM, CHINA and INDD-CHINA and southwards into SIAM.

This species was collected first by Wallich, who in the field called it *Dioscorearotundifolia,* but afterwards substituted the erroneous name *Dioscorea glabra.* From *D. glabra,* Sir Joseph Hooker rescued it, calling it *D. decipiens* as under a commonplace appearance it hides the Unexpected character of three fertile stamens. It is evident that he was very much struck by this ; and we have given not a little thought to an estimate of the value Df the character. Dn the whole it now seems less important than at first. It is true that a reduction of the stamens to three runs through all the species of the section *Lasiophyton* until we come to *D. hispida* : but it does not characterize any solid block in the section *Stznophora,* though it DCcUrsin isolated species. Such a reduction appears possible up and down the genus. Leavingthe character aside, and looking at other features seen in *D. dtcipizns,* we notice many points of resemblance between it and *D. puhzra* and it is with the last named that we think the affinity lies. We regard therefore *D. decipiens* as best placed next to *D. pubzra,* and think that it may have arisen from the same stock with, as its chief departure, a change in the androecium by which half the anthers lost their fertility. That such a loss has been no disadvantage may be assumed from the considerable distribution which it has acquired. It occurs from the forests of Upper Burma, northwards into the Naga Hills and eastwards over the China border and into the Laos country : southwards it is in Tenasserim and just enters northern Siam. It is quite an, abundant plant in Burma, where the Burmese know it well as " thin-douk-U ." They dig it up and eat the softer parts of the tubers in times of need. The Shans call it " man nam " *n* " man nim." The Laos of the northernmost part of Siam call it " man tung." Both know that the tubers are edible. And again Kerr says that, by the Siamese near Petchaburi, it is very much sought after.

SOUTH-WEST CHINA. **Be. Yun-nan.** Pu-teng plain Dn the south *of* Sze-mao, *Henry* 1316R !

WESTERN INDD-CHINA. **ID a. Hhasi-Naga Hills.** Naga Hi11s. Thesama, *Prainl* **ID b. Northern Burma.** Bhamo district. BhamD, *Burkill* 22767 ! 22785! East of BhamD, *Forrest* 9196! From Bhamo to Momouk, common, *Burkill* 21510! Katha district. Katha, plentiful, *Ram Chandra* 22712 ! 2271.3 ! *Burkill* 22498 ! 22641 ! 22B49 ! 22BB2 ! 22SB9 ! Shanzu, *Burkill*! Pyet-ka ywa, *Shwe Ganaung* 15D32 ! Naba, *Burkill*! Upper Chindw.in district. Mingin and Kale, general, *Gaitskell* : Molieglin, *Prazer* 3B4 ! Kindat, *Gaitskell* 21554 ! Chin Hi11s. Falam, *Mus. R. E. P.* 2D472 ! Pakokku Chin Hills. Gangaw valley, *Millar* 2DB28 ! **10 C. Chittagong-Arahan.** North Arakan district. Without precise locality, *Mus. R. E. P.* 2D521 ! **ID d. Dry Central Burma.** Shwebo district. Yen, *Keith* ! *Gaitskell:* Mu forest division, *Haines* 5129 ! Kyauk-myoung, *Burkill* 2247D ! Tantabin, *Gaitskell.* Lower Chindwin district. Budalin, *Maung Shway* 14DB3 ! Pale, *Maung Hpay* 14DB3. Kyaukse district. Pwelongyaw, *Aplin* 22289 ! Myingyan district. Mount Popa, *Gaitskell H\)91*! Pak Dkku district. Pakokku, *Gaitskell* 21151! Seik-pyu, *Mus. R. E. P.* 2DB5B ! Pasok, *Mus. R. E. P*\ Minbu district. Sidoktaya, *Gage.* Sidoktaya road, *Shaik Mokim* 439 ! Prome district. Prome hills, *Wallich* 51D5 G ! Magwe district, without further information ! Yamethin district. Kanni, Sinthe chaung, at 5DD ft., *Lace* 494B ! Meiktila district. Without precise locality, *Collett* 8B5 ! *Gaitskell*

2DB63 ! **ID e. Lower Burma.** P e g u district. Kyauktaga, very abundant, *Burkitil* T D u n g u district. Pyinmana, *Abdul Huq* ! ID **I. Shan Plateau.** M a y m y D subdivision. Toung-dong, *Wallich,* 5105 H.! Maymyo, *GaitsJcell.* H s i-p a w state. Hsi-paw, between 1,3DD and l,5t)D ft., *Burkill* 24D7D! 24124! 24125! 24125 ! 24311! N o r t h Ha B n w i state. LashiD, at 2,500 ft., *Burkill* 22555 ! Y a u n g h w e state. Saga, *Abdul Khalill* Laikaw, *Abdul Huq I* Fort Stedman, *Abdul Huql* N a m h k o k state, without precise locality. **1D g. Siam, excluding the Peninsula.** Circle of P a y a p. Doi Sutep, in mixed forest at 4D0 m., *Kerr* 1449 ! Chiengmai, in deciduous forest at 300 m., *Kerr* 5651 ! Chiengrai, Me Yen at 43D m., in deciduous forest, *Winit* 765 ! **ID h. Laos country.** Without precise locality, *Counillon* ! State of L u a n g P r a b a n g . Luang Prabang, *Massie* !

:MALAYSIA. **11b. Tenasserim.** T a v D y district. Without further information ! **11 d. Peninsular Siam.** Circle o f R a c h a b u r i . Tung Luang, Petchaburi, in scrub, *Kerr* 2 0632 !

PLATE 142. Dioscorea decipiens, *Hooker Jil.* (1) A branch with male flowers from Henry's no. 13169, nat. size: (2) a flower from the same, x l 5 : (3) this dissected, X21): |4) stamens, X 20 : |5) staminodes and the gynoecium of a male flower, X 2D : |6) a branch with capsules from Burkill's no. 22559, nat. size : |7) and |8) the capsule in section, nat. size : |9) a seed, nat. size : |1D) a small tuber, raised in the Royal Botanic Garden, Calcutta, from no. 2D645, \ nat. size: |11) and (12) parts of it.

Broup DI D. pubtra (species 142—144). With abundant hair and crowded male flowers.

142. DIDSDDREA PUBERA, Blume, Enum. plant. Javae, 1, 1827, p. 21 : Kunth, Enum. plant., 5, 185D, p. 39D: Reorders, Excursionsfl. Java, 1, 1911, p. 310: Beum6e, Flor. Analyt. Dnderzoek. kunstmatig Djatiplantsoenen, 1922, p. 89 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 282, in part.

Dioscarsa anguina, Roxburgh, Hort. Bengalensis, 1814, p. 72, name only, and Flora Ind., 3, 1832, p. 803, excluding the reference to Rumpf's Ubium anguinum : Voigt, Hort. Suburb. Calcutt., 1845, p. 652 : Masters in Journ, Agric.-Hort. Soc. Ind., 4, 1845, p. 232: Kunth, Enum. plant., 5, 1850, p. 390 : Long in Journ. Agric.-Hort. SDC. Ind., ID, 1859, p. 345 : Watt, Diet. Econ. Prod. India, 3, 189D, p. 127 : Hooker fil., Flora Brit. Ind., 5, 1892, p. 293: Wood in Rec. B D I Survey Ind., 2, 1892, p. 143: Prain, Bengal plants, 2, 19D3, p. 1065: and in Rec. Bot. Survey Ind., 3, 1905, p. 288: Watt, Commerc. prod. India, 1908, p. 493 : Haines, Forest flora Chota Nagpur, 1910 p. 529: Reorders, Excursions^[1]. Java, 1, 1911, p. 310: KoDrders-Schumacher, System. Verzeichn. Herbar KDDrders, Lief. 9, 1912, p. 265 : Prain and Burkill in Journ. As. SDC. Bengal, N. S. 10, 1914, p. 32; Koorders, Excursionsfl. Java, 4, 1923, p. 255: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 274: Burkill in Rec. Bot. Survey Ind., ID, 1924, p. 388: Haines, Bot. Behar and Driasa, 1925, p. 1117 : Fischer in Gamble, Flora Presidency Madras, 1928, p. 1513.

Dioscorea combilium, Buchanan-Hamilton in Wallich, Cat. lith., 1B30 no. 51D3B.

Dioscorea cornifolia, Kunth, Enum. plant., 5, 185D, p. 385 :

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in part.

Dioscorea spinosa, Wallich, Cat. lith., 1830 nD. 51D3 H and with a query also B. and Gr.; not of Roxburgh.

Kasa alu, N. N. Banerjee, Rep. Agric. Distr. Cuttack, 1893, p. 187.

Tubers one Dr twD, penetrating into the soil, very deeply, often to two metres with a diameter of 3 cm. and up to 8 cm., with tawny-orange skin sparingly beset with small rootlets, with lemon yellow flesh conspicuously run through with fibrovascular bundles which in the upper or older parts are somewhat resistant, but acquire no firmness in the lower younger parts. *Stems* at the base up tD 8 mm. in diameter, never prickly but with elongated brownish green warts close to the ground, covered with white hair and in age faintly lined with brown. *Bulbils* growing to be nearly as large as a man's fist. *Leaves* alternate or towards the apex of the stems sometimes opposite, often exactly cordate, or if not cordate cordate-ovate, shortly acuminate, generally about 12 cm. in length with a width of 9—lD cm. but sometimes as large as 24 cm. long by 20 cm. in width, 7—9-nerved : the nerves of the first pair diverge from the midrib at about 30° tD enclose an elongated obDVate area : the nerves of the second pair diverge from the midrib at about 75—80° to curve round and become submarginal in the upper half of the length of the leaf-blade : the nerves of the third pair curve in the lobes and are almost submarginal in 7-nerved leaves; in 9-nerved leaves this position is taken by the fourth pair : the secondary nerves are somewhat distant and cross the interspaces almost without elbows: the network is obscure: the upper surface softly pubescent and then glabrescent, with the nerves scarcely raised : the lower surface pubescent through life, with the primary nerves prominent and the secondary nerves just prominent: the margin not thickened at all : petiole about as long as the leaf-blade Dr a little longer, grey-pubescent, more particularly upon the pulvini, but there a livid pigment is present which alters the grey tD a dull lilac.

Male flowers in spikes on special leafless branches which are about 15 —18 cm. long and densely pubescent: the axes of the spikes up to 2 cm. long, with about 30 flowers ; these spikes are generally twinned SD that there are four at each node, two from each of the opposed bracts ; sometimes the bracts are only suboppDsite : bracts subtending the flowers ovate-acuminate, scarcely 1 mm. long, pubescent without, scarious : bracteoles similar, about half the size of the bracts. *Sepals* shortly ovate, much incurved, obtuse, pubescent without, thin, 1 mm. long. *Petals* elliptic-ovate, obtuse, almost glabrous, shorter than the sepals. *Stamens* 5, on filaments which are a little shorter than the anthers, the three inner just overtopping the three outer (Kunth described " D. cornifolia" as having three fertile and three infertile). *Gynoecium* of three small points.

Female flowers in simple or branched spikes, these spikes sometimes freely branched, several together from the leaf-axils ; axis up to 15 cm. long, densely pubescent, with flowers to the number of 4D : bracts ovate-acuminate, pubescent without, 1 mm. long ; bracteoles similar but rather shorter. *Sepals* broadly ovate, obtuse, 075 mm. long, pubescent without, moderately thick. *Petals* similar, but rather shorter, not pubescent. *Staminodes* minute. *Stigmas* as three pairs of sickle-like organs. *Capsules* to the number of about. 12 to a spike, retaining their pubescence in protected places, such as the placentar angles, until after maturity, the stipe 3—4 mm. long expanding upwards to a diamter of 25 mm.

at the point where the wings spring out at almost a right angle to curve round evenly to a retuse apex, their maximum width 18 mm. and their length along the placenta 15 mm. *Seeds* with a rather dark brown wing all round, more or less conform to the loculus.

Discontinuously distributed, its largest area across INDIA about the tropic from Indore to Upper Burma ; its discontinuous areas in south-western India and in JAVA.

WB give its interesting distribution in a map. In the wet Himalaya it ascends tD 3DDD Dr 3,50D feet and is present in the forests under the mountains. It is absent from the districts of Bengal which are most nearly submerged when the rains are at their height, but the least elevation in them is enough to give it harbourage and :SD it happens that it is found on raised river-banks as for instance at Kaliyaganj in the Purnea district, at Rajendrapur near Dacca, and at Tollyganj in the suburbs of Calcutta. The hills from Indore to the Dircars contain it in abundance : and SD also does the lull-country of Assam and southwards to DhittagDng. From there its distribution is doubtless continuous tD the edge Df China across the little known forests of Upper Burma, for it has bsen collected at Bhamo.

Its occurrence in Malabaria is demonstrated by only two collections both in the State of Travanccre.

In Java it does not reach the dry end of the island though it is associated with teak in some places.

The place of its known Himalayan localities most remote from the plains is Pemionchi in Sikkim at a distance of 3D miles in a straight line.

In India it flowers fram August to December : in Java in April, May Dr June.

It is unfortunate that as yet nD collector has obtained the ripe capsules of this species in Malaysia : those we have described here and figured on plate 138 are from the Indian *D. anguina.* Should the Malaysian plant have larger capsules, say, Df the same size as its close allies, a varietal name will be necessary and the Indian plant may then become *D. pubera* var. *anguina.*

It is said that formerly the tubers were eaten in the neighbourhood of Calcutta. They are eaten by the Lepchas of Sikkim who discard the upper parts. The species is to them " soong bok " or " sDum bok." The Paharias who live in the same mountains with the Lepchas call it "panglang " or " pangla torul." The Garos, Cacharis and Mikiis of the hills on the south of the Brahmaputra valley eat it. The Garos call it " tha ja " and the Cacharis "ta shep." The Mikirs call it " rui re." A name for it—" hukai "—has reached us from Sylhet in which we see the Khami word i:huai "—a WDid Df the same source as the Mon "khoai " whence cams the Burmese" kywe."

In the hills south of the Ganges valley, it is also eaten. The Sontals and Hols call it "kukuisanga" or " kukare sanga." Further to the south it seems to be called " pani alu " and " kanta alu," in both cases in confusion with other sps cies, and it may be assumed that where SD confused it is in no demand for food. " Pani alu " is a fairly well-known name which came to us from several parts of Drissa, along with "kanta alu ". In "kodi pani", we have a name applied tD *D. oppositifolia* further tD the south. " Kasa alu " or "kusa alu " is yet another name met with in Drissa and fairly strictly applied to *D. pubera.*

The Korkus call it " toralia : "and they eat it.

"Samiya," " siar, " " serh " and " senrh " are names from the Jhansi district used by people WIID eat it.

" Aman " is a name ascribed to it in the extreme south of Rajputana.

Lastly there remains one name from the Assam plains—" haldia alu "—which is rather widely used, and means the yam with the colour Df turmeric, from the yellow of the upper parts Df the tubers.

Roxburgh studied the species in the East India Company's Botanic Garden at Calcutta, and mistaking its tone tubers fc-r those which Rumpf had described as *Vbium anguimim,* called it *Diuswrtu anguina.* But before his *Flora Indica* was in print, Blume had met with it in Java and had published the name *Dioscona pubera.* He did not describe his plant adequately—no Dne did describe the species of *Dioscorea* adequately in those days—and for a long time it seemed that Brume's name belonged to the species which is *D. polycludes,* H ooker fil. : but we have examined Blume's type and consider it to be a specimen of the species with which are dealing. It is not to be regretted that the name " anguina " must be abandoned.

Kunth did not know what to make *of D.pubzra,* BlumB, and in his *Enumeratio* stated that it had come from the Moluccas, although it lay before him from Java and he had named it *D. cornifolia.* R. Knuth has quoted that name twine (pages 27S and 282 in his monograph) : his second citation is correct.

INDIA. **4 a. Malabafia.** Stats Df Travancore. Quilon, *Bourdillon* 149 8 B ! Malayattur, *Bourdillon* 1252 ! **4 1 Hindustan.** (Indore sub-sub-subregion.) Ali-Rajpur state. Ali-Rajpur, *dz Laessoe* 29! Barwani state! Narsinghar state. Narsinghar, *Kalka Pershad* 149DD ! 2DD97 ! IndDre state ! Bhopa1 state ! iNorthern Escarpments.) Banda district! Jhansi district. Deoghar near Lalitpur, *Silberad* 15235 ! Jaklaun, *Kalka Pershad* 34854 ! Fatehgarh, *without collector's* name! (Northern Dudh.) Bahraich district. Without precise locality, *Harsukh* 22821! Gorakhpur district. Ramgarh, *Kalka Pershad* 348D9 ! **4 B. Sub-Sllbregion nf Rains from the Bay of Bengal.** (Central Provinces.) Amraoti district. In the Melghat, *Dadimaster* 22381 ! Hoshangabad district. Maradpani, *Kalka Pershad* 2D248 ! SaugDr district! DamDh district! Bhandara district ! Ba1aghat district! Jaba1pur district! Raipur district. Raipur, *Drake -Brockman* 15349 ! *Durga Prasad Pandi* 2D949 ! Chanda district. South Dhanda, *Hainzsl* (Sonthalia-Dhota Nao-pur.) Sonthal Pergunnahs. Fulzhuri hills near Deoghar, *R. K. Das* 34515! Nawabdari near Rajmehal, *R. K.* Das 34775 ! Hazaribagh district. Koderma, *Haines* 2353 ! 2845 ! Pa1amau district. Ranaghur ghat near Lohadaga, at 9,DDD ft, *C.B. Clarke* 33859! Ranchi district. Ranchi, *Prainl* Rengarih and Biru, *Cardon* 2! 5 ! Hundrugagh, *Prain* 3! Manbhum district. Without precise locality, *A. Campbell* 98D8 ! Singhbhum district. Gidung, *Kalka Pershad* 19718 ! Santara forest, *Haines* 588 ! 21223 ! 21228! (Circars-Drissa.) Godaveri district. Rampa hill, *Ramaswami* 1577 ! Peddakonda at 2DDD ft., *Narayanaswami* 157 ! Ganjam district. Parlakimedi, not uncommon, *Corey* 12D ! *Grant, Candkr and Burkill* 2D440 ! Foot Df Devagiri at BOD ft., *Burkill* 17932! Angu1 district. Jacobo block, *Haines* 5125 ! "Ra lasDre district. Patharchakri, *Kalka Pershad* 24322! Mayurbhanj state. Baripada, *Holmes* 33182 ! 34313! (Behar.) Monghyr district. Monghyr, *Buchanan-Hamilton* in Herb. Wallich 51D3B ! (Western Bengal.) Midnapur district. DasTjur, *R. K. Das* 35449 ! Dhandrakona jungle, *R. K. Das* 35452 ! Birbhum district. Dechandra, in Dubrajpur, *A. Ahmed* 13911 ! (Central Bengal.) District of the Twenty-four Pergunnahs. Tollyganj, *Burkill* 18910! 18911! (Northern Bengal.) *V* urnea district. Kaliyaganj on the banks Df the Mahananda river, *Burkill* 34141 ! Bahadurganj, *Buchanan- Hamilton* in Herb. Wallich 51D3H! Darjeeling terai. Between Huprail and Goridora, *Kurz* ! Phansidewa, at 5DD ft., *C. B. Clarke* 31772 ! Dumduma jhar, *Gamble* 337 ! Chenga, *Gamble* 2383 ! Jalpaiguri district. Western Duars, common, *Haines* 484 1487! Maida district, without precise locality, *Mus.* 7? *E P.* 21239! (Eastern Bengal.) Dacca district. Rajendrapur, common in the forest, *Burkill* 21409! (Brahmaputra valley.) Goalpara district. GrDalpara, *Buchanan-Hamilton* in Herb. Wallich 51D3B. ! Nowgong district. Without precise 1oc alitv *Simons* ! Lumding, *Burkill* 353D5 ! *Kalka Pershad* 33578 ! Darrang district. Bhoreli'river banks, *Cole* ! Phulbari near Tezpur, *H. H. Mann* 23889! 2725D ! Sib-sagar district. Golaghat, *M asters* 382 D ! Namtidol, *L. Sarma* 14! Lakhimpur district. Probably this district, but without ID cahty, *Griffith* 5545 K. D.! Makum, *Burkilll* Kobo, *Burkill* 3591D! Sadiya, *Burkilll* |Surma valley.) Sylhet district. Without precise locality, *de Silva* in Herb. Wallich 51 [13 H ! Sylhet, *Hooper* 34744 ! Cachar district. Monierkhal, near the Lushai Hills, *Gage* \ Rotteapur, *Keenan's collector* !

HIMALAYA. **5 C. Central Himalaya.** Kingdom Df Nepal. Adhabhar in the terai, *Burkill* 29445 ! Hettounda, common, *Wallich* 51D3 Gr. ! *Burkill*! Bhimpede,

Wallich 51D3 G. ! **5 d. Eastern Himalaya.** Darj Beling district. Tista valley, from 2,000 ft., to 3,000 ft., *Osmaston* 2D482 ! *Trafford* ! *Prain* ! Rebong, *Kari*! Rishap, *Train* ! *Ribu* ! Mungpu, at 3,000 ft., *Russell*! Simguri near Mungpu, *Kari*! Riang, *Russell*! Munsong, at 3,000 ft., *Meebold* 428! Badantam, at 1,000 ft., *Nillcanto Singhal* Pashok at 3,500 ft., *Munro* ! *Lister* ! *Gamble,* 957! Tassiding, at 2,DD0 ft., *Lister*! Tista Bridge, plentiful, *BurkilV.* Sikkim state. Great Rungit valley, *Hooker* \ Under Pemionchi, in forests of Shorea, *Burkilll* Bhutan state. Without precise locality, *Griffith* 5588 K.D.!

WESTERN INDOCHINA. **ID a. Khasi-Naga Hills.** Garo Hills. Without locality, *Colquhoun* 21204! 21205! Khasia Hills. Bor pani, at 2,000 ft., *Hooker and Thomson* ! *G. Mann* ! Naya bungalow, *C. B. Clarke* 40550 ! Between the Unran and the Unling rivers on the Shillong-Gauhati road, *R. K. Das* ! Edge of the grass-land near Naya bungalow, *Burkilll* North Cachar. Haflong, *Baker* 13943! *Shaik Mokim 211* ! *Ballantine* 31827! MehoDn, *Shaik Mokim* 292 ! **10 b. Northern Burma.** Bhamo district. Near Bhamo Dn the bank of the Irrawaddy river, *Burkill* 22833 ! 22835! **ID C. Chittagong-Arakan.** Dhittagong district. Barisedhala, *Hooper* 25545!

MALAYSIA. **11 f. Sumatra.** Residency of the West Coast. Doekoe, *Korthals* ! **11 j. Java.** Without locality, *Zollinger* 875 (the type of *D. cornifolia),* and 1418! Residency of Bantam. Goenoeng Kantjana, *Koorders* 41428 b! Bantam, common, *van der Zijl* 52 ! Residency of Batavia. Without precise locality, (probably this Residency), *Blume*! *de Vriese and Teijsmann*! Batavia, *Lahaie* 2333 ! Depok, *Soegandiredja,* 263! Tjilodong tD the east of Depok, *Backer* 31237! *van Slooten, Backer and van Overeem* 35139 ! Buitenzorg, *Bakhuistn van den Brink* 2694 ! Krawang, perhaps *Blume*! Between Poerwakarta and Tjikampek, fairly common, *Beumeé* 5395! Residency of Preanger. Palaboean Ratoi, *Koorders* 34490 b ! Soekaboemi, near Palaboean Ratoe, *Koorders* 34592 b ! Bodjong Terong, *Aarts* 14 ! Ranang in the district of Tasekmalaja, at 720 m., without collector'3 name ! Bandoeng, *K. Heyne* 137 ! Residency of Banjoemas. Pringombo, *Horsfield* 525 ! Residency of Pekalongan. Subah, *Koorders* ! Residency of Semarang. Manggar forest at 5D m., *Beumeé* 5445 ! Residency of Djapara, Ngarengan, *Koorders* 231B0 b ! Residency of Rembang. Ngandang, *Koorders* 36424 b! In teak forest at Bab, *Beumeé* 5B20 ! Residency of Madioen. Ngebel on Goenoeng Wilis, at 700 m.f *Koorders* 23124 b !

PLATE 143. Dioscorea pubera, *Blume.* (1) A branch with male flowers from a plant collected by Prain at Lebong, nat. size : |2) a mature bud, X10 : |3) a male flower flattened out, x 10 : (4) a stamen : (5) capsules from Burkill's no. 17932, nat. size : (6) a large leaf from Hooper's no. 34744, nat. size : (7) a half-grown tuber from R. K. Das' no. 35462, reduced greatly.

PLATE 138, right side. Dioscorea pubera. Infructescences from Burkill's no. 22835, showing the position which they take in life, nat. size.

143. DIOSCOREA LISTERI, Prain and Burkffl in Journ. As. Soc. Bengal, N. S. 6,1908, p. 452 and 10,1914, p. 32 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 274.

Underground parts unknown. *Stem* glabrous, climbing to a fair height, unarmed at least above, when old of a rusty straw-colour, up to 3 mm. in diameter in the parts seen.

Bulbils very large, pyriiDrm, up tD ID cm. in length, on short stalks, produced in great abundance, when cut and dry with flesh which has taken DII a rusty red colour in patches and with black blotches. *Leaves* alternate, exactly cordate Dr ovate-cordate, the sinus very broad, almost parchmenty, acuminate, up to 28 cm. in length by 23 cm. in width, 7-nerved : the nerves of the first pair enclose an elliptic-Dbovate area : the nerves of the second pair diverge from the midrib at 9D° tD curve round and be bst submarginally just above the mid-length Df the blade : the nerves Df the third pair submarginal in the lobes : the secondary nerves cross the interspaces with Dne Dr two elbows, not conspicuous Dr numerous, but almost bst in the very similar network : the upper surface glabrous with the larger nerves just prominent: the bwer surface with stellate hairs about the base Df the blade ; with the primary nerves very prominent and the others just prominent: petiob pubescent up to 15 cm. bng.

Mah plant unknown.

Female flowers in rather few-flowered spikes ; axis angled, pubescent. The flowers themselves unknown. *Capsules* large with a stipe ID mm. long, densely covered with stellate hairs, expanding upwards to a diameter Df 7 mm. where the wings arise in a short curve which carries the margin through 9D[D] , tD curve evenly tD a truncate Dr just retuse apex, the greatest width Df the wing being 30 mm. and the length along the placenta 35 mm. *Seeds* with a chestnut membranous wing all round slightly unequally and more or less conform to the bculus.

5 The Brahmaputra valley in ASSAM and Dn the hills nearby.

*X This species may be regarded a9 a segregate from *D. pubera* but is easily distinguished by its larger capsules and very striking bulbils. It has been collected thrice, but ia still inadequately known.

INDIA. **4 B. Sub-subregion of Rains from the Bay of Bengal.** (Brahmaputra valley.) S i b s a g a r district. Tengali Bam within the valley, *Huq* !

HIMALAYA. **5 d. Eastern Himalaya.** D u p h 1 a H i 11 s, at the ninth camp of the Duphla expedition of 1874, *Lister* 248 !

WESTERN INDD-DHINA. ID **a. Hhasi-Naga Hills.** N a g a H i l l s . Dekho valley, *Watt* 11083 !

PLATE 141, right side. Dioscorea Listeri, *Prain and Burkill.* |1) A branch with capsules from Lister's nD. 248, \ nat. size: |2) a branch and leaf from the same gathering, \ nat. size : |3) a seed, \ nat. size: |4), |5) and |B) bulbils from Watt's nD. 11D83, \ nat. size.

144. DIDSDDREA POLYDLADES, Hooker fil., Flora Brit. Ind., 6, 1892, p. 294 : Ridley, Mat. Flora Mai. Penins., Monocot. 2, 1907, p. 81 : Prain and Burkill in Journ. As. SDC. Bengal, N.S. ID, 1914, p. 32 : Koorders-Schumacher in Koorders, Excursbnsfl. Java, 4, 1923, p. 2B9, aa polyclaudos: R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 275 • Ridley, Flora Mai. Penins., 4, 1924, p. 315: Burkill, Diet. Econ. Prod' Ma]. Penins., 1935, p. 823.

Dioscorea nummularia, Moritzi, System. Verzeichn. gesammelt. Pflanzen, 1846, p. 92 : Kunth, Enum. plant., 5,185D, p. 38B, as regards the description but not as regards the references (by a misprint reference is made to

Zollinger's no. 283 as 183): Miquel, Flora Ind. Bat. 3, 1855, p. 572:" Zollinger, System. Verzeichn. d. im Ind. Archipel gesammelt. Pflanzen, 1854, p. 58 ; not of Lamarck.

Dioscorea nummularia, vars. *puberula* and *velutina,* Kuntze in Herb, propr.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in part ; not of Linnaeus.

Dioscorea puberula, Prain and Burkill in Koorders-Schumacher, System. Verzeichn. Herbar Reorders, Lief. 9, 1912, genus 1252: E, Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 282, in part; not of Blume.

Underground parts very like those of *D. pyrifolia* consisting of a woody knot whence descend several long-stalked edible tubers. *Stems* up to 3D metres in length, tomentosely pubescent, armed rather plentifully at the base with small prickles, but in the upper parts unarmed, with many longitudinal very faint grooves. *Bulbils,* none seen. *Leaves* opposite, elliptic-cordate or exactly cordate, abruptly acuminate at the apex, the sinus sometimes with rather straight margins and wide, the blade not uncommonly 12 cm. bng by 12 cm. in width, but attaining 25 cm. in length by 22 cm. in width, 7-nerved : the nerves of the first pair enclose a narrowly obovate area : the nerves of the second pair diverge from the midrib at an angle of about 9D° to curve round gradually towards the margin and to end just under themucro : the nerves of the third pair run into the lobes and curve round tD end close under the margin just above the mid-length of the blade : secondary nerves fairly numerous, crossing the interspaces with some irregularities : the network with a rather fine mesh : the upper surface at first covered with crisp tawny hairs, then glabrescent and ultimately glabrous, the larger nerves distinct, the colour dull': the lower surface tomentose-pubescent with tawny hairs, of a lighter[1] green than the upper surface, the main nerves prominent, the secondary nerves just prominent as also are the larger elements of the network : the margin with a narrow rim : petiole glabrescent, sometimes with minute prickles, up to 6 cm. long, but generally only 3—4 cm. long.

Male flowers in fascicled spikes sometimes in the axils of leaves but more particularly on special leafless branches which attain 3D cm. in length, the upper spikes on these special branches are not much shorter than the lower; they are up to *22* mm. long with the basal 2—5 mm. sterile and the upper part densely beset with about 2D flowers SD that the whole is bng-clavate and they stand out from the axis conspicuously at an angle of between $7D^{D}$ and $11D^{D}$: the axis pubescent, angled: bracts ovate, curved round the base of the flower, acuminate, dark chestnut in colour, glabrous within but pubescent without, just exceeding 1 mm. in length : bracteole ovate, acute, small and difficult to see among the hairs of the outside of the flower. *Sepals* orbicularly Dvate, pubescent without scarcely 1 mm. long. *Petals* obovate, much thicker than the sepals, shorter, glabrous' *Stamens* 5, on very short filaments, in all under D.5 mm. long. *Gynoedum* a very small three-pointed cone.

female flowers in rather bng spikes to the number of about 18, the spikes about 2D cm. bng, their axes tomentose with tawny hairs, rather straight: bracts densely pubescent Dvate, acute, 2 mm. bng : bracteoles Dvate, 1 mm. long, densely pubescent. *Sepals* broadly Dvate, densely pubescent outside, D.75 mm. bng. *Petals* similar in shape, Dne-half as large, glabrous. *Staminodes* 6, minute. *Ovary* about 2 mm. bng at flowering. *Capsules* pubescent at first, but after losing the hair appearing polished, tawny brown : the stipe is 5 mm. bng and widens to a diameter of 4 mm. where the wings spring out at an angle which

¶s fully a right angle and often rather more than a right angle, after which the margins curve evenly to a retuse apex, the greatest width Df the wings about 2[) mm. and their length along the placenta up tD 25 mm. *Seeds* deep chestnut in colour with a wing all round somewhat unevenly but conform ta the bculus.

WESTERN MALAYSIA or SUNDALAND, more or less throughout, and ' apparently in the extreme south Df Anam.

The Did est specimens Df this species seem to be those of Kuhl and van Hiissi-li, which HIT unlncalized : ths next are ZDllinger's : when Zollinger's were examined by Moritzi, he identified them with Rumpf's *Ubium nummularium* and gave to them the name *Dioscorea nummularia.* Spach wrote the same determination upon sheets in the Herbarium Df the Jar din des Plantes in Paris. In 18!)2 Sir Joseph Hooker published his new name for the species, having studied specimens both from Java and the Malay Peninsula,.

Its occurrence in Anam is uncertain, because the specimens collected there are female only. Search should be made for the characteristic male spikes.

In the Malay Peninsula it is chiefly found close tD streams ; and though not always, yet SD frequently aa to indicate that it requires much water. It flowers in Malaya at the height Df the rains in December and in the first part of January.

Father Schebesta collected specimens Df it at Baling in Kedah as a food-plant of the Pagan tribes. One a ecimen he labelled as " tiiuii " and " hubi baneh ", the other as " kedel" or " hubi seluh ". It has p not transpired, if these names belong tD the yams at different ages Dr are due to some difference unknown to the writers.' A name from Java which has been recorded is " chanar babi " or pig's Sinilax.

EASTERN INDD-CHINA. **9 d. Anam.** Province of N h a -1 r a n g. At 5D kilom. from Ninh-hoa towards MuDiig Drack (doubtful), *Poilane* 5158 !

MALAYSIA. **11** & **Malaya.** State of K e d a h. Baling, *Schebesta* ! State of P er ak. Without precise locality, *Scortechini* 153 b ! Larut, in open jungle between 3DD and 8DD ft., *Kunstler* 298 D ! Taiping, at the foot of the hills, *Burkill and Mohamed Haniffl* Gunong Arang Para (miswritten G. Horam Dn the label), *Scortechini* 725 ! Grik, by the Kendrong river, *Burkill and Mohamed Haniff* 13839 ! Ampang near Ipoh, under the limestone cliffs, *Burkill and Mohamed Haniff* 13942 ! In Kinta, near limestone cliffs, and upon Gunong Malaka, *Kunstler* 71 Bl ! Near Tapah towards Jor, by a stream, *Burkill and Mohamed Haniff* 13428 ! State of K B 1 a n t a n. Sungai Ketch, *Mohamed Nur* 11948 ! State of P a h a n g. Sungai Merapoh Dn the north border, *Mohamed Nur* 11925 ! Kuala Lipis, *Burkill I* Dhegar Perah, *Henderson I* Sungai Sat in the Ulu Tembeling, *Henderson I* Kota Glanggi, *Henderson* ! Bentong, *Burkill and Mohamed Haniff* 1BBS3 ! State Df S e 1 a n g o r. Near Ulu Kerling, in dense bambDD forest, *King's collector* 8716 ! Between Kuala Lumpur and Rawang, at the 11th mile-post, *Burkill*! Ulu Gombak forest reserve *Burkill* 9969 ! Weld Hill in Kuala Lumpur, *Burkill* 44D4 ! [3338 ! States of the N'e g r i - S e m b i l a n. Bukit Tangga, *Mohamed Nur* 11815! Tebong forest reserve, *Holttum* 9539 ! State of J o h o r e. Kluang, in a thicket at 3DD ft., *Holttum* 9698! ' S i n g a p o r e island. Sungai Pandan, *Ridley* 154G! Kranji road., at nine miles from Singapore, *Burkill* 1DDD4 ! Bukit Panjang, *Ridley* 11842 ! Bukit Timah on the summit, *Mohamed Nur* 23D! 232! **11 f. Sumatra.** Without any locality, *Korthals* ! Residency of the E a s t C o a s t. Simpang Toba in Asahan, *Yatss,* 1273 ! Ack Kanipan on the Loendoet concession, *Barthtt* B935 ! Sibolangit in the " Nature rpscrvc " of the Garden not uncommon, *Urzing* 834D ! Residency of L a m p o n g H. Si-bDsi island, at 3DD m, *Coders van Leeuwen* 5275 ! **11** g. **Northern Borneo.** State of S a r a w a k. Path to Tegura, *Haviland* 2D23 ! Puak, on the path to Jambusa, *Ridley* 12351) ! B r i t i s h N o r t h B o r n e D. Jesselton, *Clemens* 9714! **11 h. Dutch Borneo.** Residency of the E a s t a n d S o u t h. Sanggouw, *Hallier* B. 802 ! 11 j. **Java.** Without locality,

Kuhl and van Hasselt! *Nagler* ! Residency of B a t a v i a. Kampong sawah near Batavia, common, *Hallier* ! Tjilodong on the east Df Depok, among bamboos, *Backer* 31237 ! BuitenzDrg Botanic Garden, *Tzijsmann* 23912 ! Wanajasa, near Poerwakarta, in scrub at 7DD m., *Backer* 1411D ! Residency of P r e a n g e r. Palaboean RatDe, *Kuntze*! Between Rambai and Sagararten towards Soekaboemi, *Kuntze* 5249 ! Ngalinding near Soekaboemi, *Kuntze* 5297! Residency of B a n j o e m a s. Banjoe Besi, PringombD, *Koorders* 39D21 b ! Residency o f P a s D e r o e a n. Tangkil, at 400—530 m., *Koorders* 23515 b ! Mount Smeroe, between Ampelgading and Kali Glidik at 7DD m., in scrub, *Backer* 35B8 ! Tjikoya (type Df *D. polyclades* var. *oblongifolia,* R. Knuth), *Zollingzr* 283 ! 1418 ! Between Bodjing Lopang and Lengkong, in scrub, *Backer* 15991.

PLATE 144. Dioscorea polyclades, *Hooker fil.* |1) A branch with rather small male inflorescences from Scortechini's specimens, nat. size : |2) a male flower, X12: 13) the same dissected, X15 : |4) stamens, X3D : |5) the gynoecium of a male flower : (B) a bract and bracteole, : X15 : |7) female flowers and young capsules nat. size : |8) capsules from a specimen collected by Teijsmann, no. 25912, nat. size: |9) a capsule with a seed, nat. size : |1D) a seed : |11) a large leaf from Mohamed Nur's no. 23D, nat. size.

Group of D. orbiculata (species 145-145). Hairs distributed uver the plant, but nat densely. The male flowers not densely crowded.

145. DIDSDDREA PLATYCARPA, Prain and Burkill in Kew Bull., 1925 p. 65.

Underground parts unknown. *Stems* attaining IB metres in length (Koorders), in their upper parts at least unarmed, smooth, with minute hairs about the bases of the axillary branches and extending alsoto the bases of the adjoining petioles, probably more extensively hairy when young. *Bulbils,* none observed. *Leaves* exactly ovate, with an abrupt short mucronate apex, opposite, up to 8 cm. long by 5 Dm. in width, 5-nerved: the nerves of the first pair diverge from the midrib at an angle of less than 3D°, bend a little outwards, and then curve round to the apex to enclose a broadly Dblanceolate area : the nerves of the second pair diverge from the midrib at an angle of about 6D° to approach the margin and end in the upper half of the blade : the secondary nerves cross the interspaces obliquely and fairly regularly with only an occasional elbow, and are easily distinguished from the network : the upper surface glabrous, though perhaps pubescent when young, with the nerves distinct: the lower surface with fairly abundant rather tawny or reddish hair chiefly upon the nerves when they are old, no doubt more evenly distributed when fhe leaves are young, with the primary nerves prominent and the others distinct: petiole about 2 cm. long.

MaU plant unknown.

Female flowers only inadequately known from their remains upon the capsules. *Capsules* with stipes about 4 mm. bng expanding upwards to a diameter of 2 mm. where the wings arise in a curve which runs through a right angle, the wings not as in most •species of the section *Enantiophyllum* curved in a semicircular way, but more conical, and a little oblique, ending above in an apex to the capsule which is just retuse, the maximum width of the wing *22* mm. and the measurement along the placenta about 21 mm. *Seed* winged all round with a wing which is more or less conform to the loculus.

EASTERN JAVA.

This species is inadequately known. The hair upon, its stems and leaves indicates its affinity to be with auch spcsies as *D. pubera* and *D.polyclades,* which occur in Java : but search through all the available material of thesp. two, fails to reveal leaves matching those of *D. platycarpa,* nor are capsules to be found with the same shape. Another and apparently closer ally is *D. orbiculata* which is not known to occur in Java : it is closer because of its leaves being entire at the base. Influenced by this we place it as apparently the Javanese representative of *D. orbiculata.*

The width of the wings of the capsule bears to their length, measured along the placenta, the proportion Df lD5tol[)D.

MALAYSIA. **11 j. Java.** Residency of B e s D e k i. Forest of Rogodjambi-Balak, above Ginting, *Koorders* 28931 b !

PLATE 92, left side. Dioscorea platycarpa, *Prain and Burkill.* A collotype figure Df the type plant, reduced to one-third.

146. DIDSDDREA ORBIDULATA, Hooker fil., Flora Brit. Ind., 5, 1892, p. 292 : Curtis in Journ. Roy. As. Soc. Straits branch, 25, 1894, p. 149 : Ridley, Mat. Flora Mai. Penins. Mono cot., 2, 1907, p. 82, and in Journ. F. M. S., Mus., 4, 19D9, p. 81 : Ridley and Winkler in Engl. Bot. Jahrb., 44, 1913, p. 528 : Prain and Burkill in JDUHI. AS. SDC. Bengal, N. S. 10, 1914, p. 31* : Merrill in Journ. Roy. As. Soc. Straits branch, special no., 1919, p. 118 : R. Knuth in Engl. Pflanzenreich, iv-43, 1924, p. 281 : Prain and Burkill in Hew Bull., 1927, p. 245, and in Lecomte, Flore gén. de 1' IndDch., 6, 1934, p. 744 : Merrill in Dontrib. Arnold Arb., 8, 1934, p. 20 : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 822.

Dioscorea glabra, Ridley and Curtis in Journ. Roy. As. SDD. Straits branch, 38S 1902, p. 55, in part; not of Roxburgh.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3, 1924, p. 115, in part; not Df Linnaeus.

Dioscorza sativa, Wallich in Cat. lith., 1830, no. 5108 D ; but of no one else.

Tubers deeply penetrating into the soil, but spreading considerably, sometimes, it ia said, to a distance of 6 feet on their long stalks which arise from a woody knot, thin-skinned, edible, delicate, but only to be dug with much labour. *Stems* wiry, up to 10 m. long, rather sparingly covered with rusty-red hair when young and later glabrescent unless at the nodes where the hairs always persist longest, with scattered prickles near the soil but unarmed in the upper parts, dark purple-brown, with slight longitudinal ridges. *Bulbils,* none observed. *Leaves* alternate or opposite, orbicular-ovate or ovate-cor date, acuminate, up to 18 cm. long by 14 cm. in width, the acumen about 2 cm. long, 7-nerved : the nerves of the first pair diverge from the midrib at about 30° to enclose a narrowly obovate area: the nerves of the second pair diverge from the midrib at about 90° to approach the margin very gradually and to run submarginally through the upper half of the length Df the blade : the nerves of the third pair are weak and submarginal in the lower half Df the length Df the blade : the secondary nerves cross the interspaces with one or more elbows : the upper surface glabrous, dull in colour, with the primary nerves distinct and the secondary nerves rather indistinct: the lower surface with floccose pubescence which becomes sparse with age, of a brighter green

than the upper surface, the primary nerves puce-coloured and prominent, the secondary nerves rather prominent and the reticulation distinct: petiole relatively long, up to 10 cm. in length, with puce pulvini.

M ah flowers on spikes which are sometimes in the leaf-axils, but much more commonly Dn long leafless inflorescences which project forwards and hang downwards by their weight so as to expose the flowers very adequately : the spikes upon these inflorescences diverge in a characteristic way from the axis at about 45° and are curved: the axis coated with stellate brown hairs and the bracts on it densely brown-tomentose : the axis of the spikes up to 4 cm. long, angled, minutely scabrid, with up to 5D flowers : buds ellipsoid from a very broad base, facing a little forward : bract repressed against the axis, rather small, often slightly auriculate at the base, ovate-acuminate with some stellate hairs : bracteoles smaller, subtriangular. *Szpals* broadly ovate, very obtuse above, 1 mm. long, with pale margins. *Petals* with parallel sides and a triangular apical part, 0-75 mm. long. *Stamens* B, scarcely 0 • 5 mm. long, the filaments Df the same length as the anthers. *Gynoecium* a low cone.

Female flowers on solitary axillary spikes : axes of the spikes with a brown tomentum, up to 15 cm. long and with upwards of 3D flowers. *Sepals* broadly ovate, densely tomentose outside. *Petals* similar, smaller. *Staminodes* minute. *Ovary* densely tomentose. *Capsules* large, chestnut in colour, the stipe 8—9 mm. long, expanding tD a diameter of 4 mm. at the point where the wings break away with a curve which does not quite run through 9D°, then with evenly curving margins contracted to an apex which is just truncate, the maximum width 26 mm. and the length along the placenta about 3D mm. *Seeds* with a dull chestnut wing all round, not quite evenly, but more or less conform to the loculus.

SUMATRA, the MALAY PENINSULA and BORNEO.

Phillips, who was Governor of Penang from 1819 tD 1825, and Wallich who was his guest in Penang during his Governorship, were the first tD collect this species which is easy to find in the island. Maingay muuh later obtained it in Malacca, where it may have been plentiful, as in Penang, in the years before the sudden awakening in the seventies of agricultural activity. It ia now known to occur right through the Peninsula from the' Siam-Kedah border to the centre of the state of Johore. Its Sumatran localities are more orlesa opposite to Selangor, except one in the islands off the western coast, and the specimen from thence is not typical: perhaps when more material is available, it will be found reasonable to call the last a variety. Its Bomean localities are not yet very fully established, and again more material is desired.

The authors know it as a species of banks and steep slopes, where the forest air is very moist, but the excessive rain is drained away. It flowers in Malaya between the tw_D periods of heavy rainfall, in May and June and in October.

The tubers are edible : but it is laborious to procure them because they spread, so that a very large hole must be excavated. The forest-dwelling Sakai say that they spread sometimes to two metres from the place where they find the stem ; and tD make a hole four metres in diameter with their simple instruments is a serious undertaking.

The Malays are scarcely conversant with such yams as this is, and make no use Df them : but thu Sakai and Dther Pagan tribes of the Malay Peninsula have names for it, though not very precisely applied. Five have been obtained from them :—"takob", "kakap", "kedek" "kud" and "waiih", but the last seems scarcely to belong to it. It was applied to it by Malay-speaking Sakai of western Pahang, but ia used to indicate other Dioscoreas a3 well. Father Schebesta obtained the name "kud" at Baling on the Kedah-Perak boundary among the negrito Semang. "Takob" is used from the Siam-Kedah boundary at least to Raub in Pahang; this is where the Northern Sakai dwell. "Kakap" was received from Malacca, and " kedak" fram thu Central Sakai above Tapah. "Takob" is a word often known to Malays wh_D use it as "akar takob", and moreover it is the widest spread of the above names.

"Akarmenujan" and "akarsebiak" have been recorded as Malay names ; but no stress can be laid in them. Dne name means a creeper connected with rain, either that drips or grows in dripping forest; the other might mean the creeper which has something to da with prolificness, but no explanation is obvious : and Alvins who collected the name wrote it "akar sebiat."

Before proceeding to the enumeration of the material examined, it may be appropriate to mention the authorities for the eating of the tubers. Alvins, calling the vine "akar kakap" stated in 1885 that the country-folk of Malacca and Negri Sembilan sometimes boil and eat them. Schebesta ascertained that the Sakai pf northern Perak, i.e., the Northern Sakai, eat it under the name "hubi akob." Skeat and Blagden *Pagan races of the. Malay Pminsula,* 1, 1DD8, p. 115) wrote of the Semang Df Kedah that they eat "ubitakob", by which this species is likely to be meant: the name they use is, of course, uf common origin with " akob " which Schebesta used. Herr, when collecting plants just a few miles further north, in country where Semang live, learned that it is eaten ; and to him the name "ta-yong" was given.

MALAYSIA. **11 d. Peninsular Siam.** Circle of P u k e t. Ranawng, at Jaun in evergreen forest, *Kerr* 15514 ! Betong, cl̈Dseto the Kedah boundary, at 2DD m., *Kerr* 7485 ! 11 **B. Malaya.** K e d a h state. Ġrunong Raya in Langkawi, *Mohamed Haniff and Mohamed Nur* ! 71K4 ! Kedah peak, at 1,DDD and at 1,5DD ft., *Mohamed Haniff and Mohamed Nur* 4181 ! 4182 ! P e n a n g island. Without precise locality, *Phillips* ! *Wallich* 51D8 ! 51D8 D ! Government hill road, at 5DD ft., *Curtis* ! and at 7DD ft., *Burkill* 580 ! 2564 ! and at 1,DDD ft., *Curtis* 91D! 19DD ! Moniot's road, at 1,5DD ft., *Mohamed Haniff* 24D8 ! *Mohamed Nur* 2422 ! P e r a k state. Larut, in dense and in open jungle, *Kunstler* 3421 ! 5DB8 ! Ayer Larut, *Wray* 1999 ! Sungai Larut, *Wray* 2351 ! Temengok, *Schzbesta* 5 ! Grik, *Burkill and Mohamed Haniff* 12392 ! Lubok Merbau, *Burkill and Mohamed Haniff* 13589! TanJDng Pondok, *Burkill and Mohamed Haniff* 13245! Kuala Kangsar, *Mohamed Haniff* 14930 ! Sungai Siput, *Burkill* 531B ! Kc-ta on the plains, *Wray 3251* ! Gopeng, *Kunstler* 514 ! Tapah, *Wray* 1255 ! *Burkill and Mohamed Haniff* 13502 ! 13533 ! 13538 ! 1354D ! Towards JDT, *Mohamed Haniff,* 1425D ! Tebm region, *Ridhy* 138D4 ! K el a n t an state. Bukit Papan, *Mohamed Haniff and Mohamed Nur* 1D215 ! P a h a n g state. Between Mesah and Bukit Jelateh, *Mohamed Nur* 11905 ! Kuala Lipis, *Burkill and Mohamed Haniff* 15B78 ! Sungai Tahan, at 4DD ft., *Holttum* 2D828 ! Jerantut, *Burkill and Mohamed Haniff* 1BD28 ! 15D7B ! 15077 ! Kota Glanggi, *Henderson* ! Dong, *Burkill and Mohamed Haniff* 1B7B9 a ! Raub, *Burkill and Mohamed Haniff* 16b"45 ! 1B841 a ! Batu Talam, *Burkill and Mohamed Haniff* 17D24 ! Six miles north DfBentong, *Burkill and Mohamed Haniff* 15493! 1B494 ! 1B71D ! Benua valley, *Burkill and Mohamed Haniff* 15447 ! 1B451 ! S e 1 a n g D r state. Dhangkat Asah, *Burkill and Mohamed Haniff* 13491 ! Ulu Gombak, *Burkill and Mohamed Haniff* 1B387 ! Weld Hill in Kuala Lumpur, *H amid* 2899 ! States Df the N e g r i S e m b i l a n. Sungai Ujong, *Alvins* 2120 ! Tampin, *Mohamed Nur* ! Selaru forest reserve, *Holttum* 9638 ! Tebong forest reserve, *Holttum* 9635 ! Gemas, *Burkill* 4485 ! B378 ! B399 ! M a l a c c a territory. Without precise locality, *Maingay* 1706! Sungai Udang, *Goodenough* 1642! Selandar forest, towards Batu Bekarat, *Burkill* 530 ! Bukit Sedanan forest reserve, *Holttum* 9587! Jus, *Alvins* 4D1 ! B93! Bukit Bemban, at 5DD ft., *Burkill* 3197 ! J D h o r B state. Between Kluang and Mersing at the seventh mile from Kluang, *Holttum* 9295 ! **11 f. Sumatra.** Simaloer island |a glabrous condition), *Achmad* 894 ! Residency of A c h e h (Achin). On the Deli-Acheh boundary at sea-level, *Bangham* 539. Residency of the E a s t C o a s t. Asahan, at Kwala Masihi, *Yates 2211* ! Between Hoeta Padang and Dobk Maradja, *Hamel* 1134 ! Between Bangaen Dolok and Dobk Maradja, *Rahmat* 1217! 11 **h. Dutch Borneo.** Residency Df the E a s t and S o u t h. Lampeong and PatDeng, *Winkier* 3344 !

PLATE 145. Dioscorea orbiculata, *Hooker fil.* (1) and |la) Branches with male flowers from Kunstler's no. 3421, nat. size : \2) a male flower dissected, x ID: |3) a bract • |4) a female inflorescence from Curtis' specimen, nat. size : |5) capsules from Wray's nD. 2351, nat. size: |B) a seed from the same, nat. size.

Group of D. tBiniifolia (aperies 147). With positively geotropic male flower-spikes, but requiring to be studied further.

147. DIDSDOREA TENUIFDLIA, Ridley in Journ. Roy. As. SOD. Straits branch, 41, 19D4, p. 34 : R. Hnuth in Engl. Pflanzenreich, iv-43, 1924, p. 289.

Dioscorea oppositifolia, Backer, Handb. Flora van Java, 3,1924, p. 115, in part.

Dioscorea"! repanda, Blume, Enum. plant. Javae, 1, 1827, p. 22: Kunth, Enum. plant., 5, 185D, p. 40D.

DiosooreaZollingeriana, Miquel, Flora Ind. Bat. Suppl., 1830, p. 511 : Ridley, Mat. Flora Mai. Penins., Monocot., 2, 19D7, p. 82: Ridley, Flora Mai. Penins., 4, 1924, p. 317, in part; not of Kunth.

Tubers several, each consisting of a long stalk with a more or less sphaeroidal terminal swelling, descending into the soil under a woody abbreviated knot of tissue, flesh edible. *Stems* wide climbing and attaining a length of 13 metres or more, armed sparingly near the base, but unarmed above, dark straw-coloured when dry, 5 mm. thick at the base. *Bulbils,* none seen. *Leaves* opposite or alternate, elliptic or ovate-elliptic, acuminate above, at the base obtuse or when well grown somewhat rounded, up to 15 cm. long by 7 cm. in width and, if very large, up to IB cm. in length >y 11 -5 cm. in width, 7-nerved : the nerves of the first pair diverge from the midrib at a 'lery small angle then curve outwards and soon inwards to enclose a rather narrowly obovate area : the nerves of the second pair running submarginally almost to the acumination at the apes : the nerves of the third pair very weak, running only for a very short distance close within the margin near the base of the blade: the secondary nerves relatively few, oblique and rather indistinctly crossing the interspaces : the upper surface dull green, with the primary nerves just prominent and the others just visible : the lower surface dull green, when dry like the upper surface, but in life sometimes bronzed, the primary nerves prominent, the others just prominent or distinct: the margin thin : the petiole up to 7 cm. long.

Male flowers in spikes which are grouped 2 - 3 together in the leaf-axils or may be produced Dn the stem-endings from the axils of bracts : the axes showing a strongly marked positive geotropism whereby they bend earthwards and this probably brings them parallel to the pendulous Dr erect thin stem on which they are produced, the axis slender, angled, very minutely scaberulous, up to 8 cm. in length with about 40 well-spaced flowers which are directed a little forwards so that they point obliquely downwards : bracts triangular-ovate, repressed against the axis by the bases of the flowers, 0-75 mm. bng, reddish brown: bracteoles similar, smaller. *Sepals* exactly ovate from a broad base, glabrous, D-5mm. long. *Petals* similar but smaller. *Stamens* B, filaments rather slender, shorter than the anthers. *Gynoecium* alow cone.

Female flowers well-spaced, on long simple axillary decurved spikes which when fruit is ripening may have attained a length Df as much as 50 cm., carrying 40 flowers or at least the indications of so many: axis markedly angled: bracts ovate, acuminate, red-brown, about 1 mm. bng : bracteoles similar, shorter and broader. *Sepals* broad, thick, truncately obtuse above, with a minute mucro, red-brown, 0-75 mm. long. *Petals* thick] shorter than the sepals, lanceolate- clavate, red-brown. *Staminodes* 6, small. *Capsules* large' the stipe B mm. bng, expanding upwards SD as to be 5 mm. in diameter where the wings'

arise rather abruptly in a short curve which runs through 9D° and sometimes rather more, then evenly curve along the margin tD the retuse apex of the capsule, the maximum width, 3D mm. and the length measured along the placenta about 35 mm. *Szzds* with a smoky brown slightly uneven wing all round.

SUMATRA and the MALAY PENINSULA.

In the yBarlB5DKunth described a specimen *ot D.pyrifolia,* collected by Zollinger in Java, as a new species, giving it the name *D.Zollingeriana.* Itwassiiiit D be preserved in Luca'a herbarium, and his specimens passed after his death tD the University Df Kiel, where we sought for the type in vain when wo were preparing Diir W*no sis* of the genus. Others, perhaps, earlier had sought it likewise in vain. Whether Miguel did so, or did not, we are unaware; but in 1SBO he identified as nonspecific a Sumatran specimen collected by Teijsmaiin, but was wrong in mis. calling it *D. tenuifdia*; but in 191)7 ijuite correctly he identified it with *D. Zollingzriana,* Miq., Singapore however, in common with everyone else, not knowing that Miguel's plant wasnot the species described by Kunth. Dr. R. Kniith'3 monograph has disclosed the fact that Kunth 'a type of *D. Zollingzriana* ia preserved in thB *V.* herbarium where obviously it is far better placed than at Kiel; andfrom Berlin we have, by the kindness D / D T Diels, procured a photograph, which clearly indicates what it is—namely *D. pyrifolia.*

M- T rl t rrnination of Teijsmann's plant having been erroneous, the oldest and legitimate name for the plant above described is *D. tmuifdia,* Ridley.

We desire here to express Diir thanks to Dr. Pulle for allowing us to see Miguel's plant in order to prove its name.

This DiDScorea is a curious one, demanding further study. We have some acquaintance with it alive, having found it with male flower-buds in the Mandai forest, Singapore. Study in flower was not possible then, but Mr. Flipp ance was so good as to visit the locality for us and take flowering branches at the proper time.

Several times on newly cleared land in Singapore island we have seen sterile plants of this species, and we think that in the past it must have beqn frequent. But it is certainly rare to obtain flowers and fruit.

MALAYSIA. **11 B- Malaya.** Singapore island. Ponggol, *Burkill* 4333 1 Mandai road *Burkill* 5105! *Flippancs* 7DD5 ! Bukit Timah, *Ridley* 4595 ! *Mohamzd* Mandai road, Reservoir woods, *Ridhy* 13319 ! *Burkill* 2229 ! 2878 ! *N ! B r 'll* T Tlin lr/the Botanic Gardens, *Ridḥy* 8D59 ! *Burkill* 38DD ! Tanah Merah, *Burkill* S^f^Mgi, *Ridhy*[1]- **11 f- Sumatra.** Residency of the East D0ast. Asahan, Tf 1 M s "hi' *Yates 2211* ! Nari ĠrDenoeng, Dn the KarD plateau at 8DD m., *without JkdoJs'narm* ! Resid.ncy of Palembang. Moera Enim, *Teijsmann* 4021 !

p 145 DioscDrea tenuifolia, *Ridhy* |1) A pendant branch showing the male s ikes^araUel to the axis, from Flippance's no. 7DD5, nat. size : |2) a male apike, x ID : |3, male flowers, XlO: (4) capsules from Ridley's no. 8D59, nat. size: |5) a seed, nat. size.

Addenda and Corrigenda to Part I.

p. IB. D. PYRENAIDA:

additional references :—BubaniinNuov. Griom. bot. Ital. 5,1873, p. 313 : Rouxin Ann. Soc. bot. LyDn, 31,19DS p. xxvii: Pitard in Bull. SDC. bot. France, 54,19D7, p. lxi: Focetin Bull. Soc. Linn. Normandie, 7th ser., 7, 1924, p. 33.

Most writers, abb tD afford information regarding this interesting plant, have recorded its places of growth as just over the crest of the Pyrenees on the Spanish side : Pitard indicates one of its habitats on the French side. He states that it occurs where the Grave de Pail, descending from the glaciers of the Cirque de Gavarnie and having cut the gorge Df CaDUSselet, traverses a short and nearly level area at an elevation of 15DD to 153D metres. FDcet says that it is partial to a rubbly soil and has very long lateral roots. Roux gives its occurrence near thB crests of the mountains between the Port de Gavarnie and the Breche de Roland.

p. 24. D. DAUDASIDA :

additional references :—Lipsky in Zop. Kievsk Dbhsch. Est. Ispint, 12, 1893 no. 9, as *Dioscorsa sp.* Lipsky in the same, 13,1894 p. 143, as *D. caucasica* : Alboff in Bull. Herb. Boiss., 1, 1893, p. 263, and Dans les coins perdus du Caucase, 1894, with a figure, and again in Arb. Petersb. Naturf. Ges. 23, 1894 p. B5.

p. 2B. D. DELTDIDEA:

additional reference :—Prain and Burkill in Lecomte, Fbre gen. t'e l'lndoch., 6, 1934, p. 7DB.

p. 29. D.PRAZERI:

additional reference :—Prain and Burkill in Lecomte, Fbre gen. de l'lndoch., 5, I934, p. 7DB.

p. 33. D. SEPTEMLDBA:

Mueller-Beeck, Verzeichn. d. essbar. Pflanzen Japans, 188B, states that the rhizome is eaten ; but this is unlikely.

p. 34. D. ZINGIBERENSIS :

additional reference :—Pampanini, Piante vascolari raccolte dal Rev. P. D. Silvestri nell Hupeh, 1911 p. 25.

p. 35, linB 15, from the bottom, *for* 2DD m. *read* 2D5D m. as the height of Wu-tan hsien.

p. 39. D. DOLLETTII:

additional references :—YamamotD, Suppl. Ic. Plant. Formos., 3, 1927, p. 6 : Syun'iti Sasaki, List Plants Formosa, 1928, p. 114.

p. 41, line, 8, for Kaun-yin shan *read* Haun-ying shan.

p. 45. D. CHINGII:

additional reference :—Prain and Burkill in Lecomte, Flare gen. de l'lndoch., 5, 1934, p. 709.

p. 47. D. TENUIPES:

additional references :—MakinD and NemotD, Flora Jap., ed. of 1931, p. 1587 : Masumune in Mem. Fac. Sci. Taihoku Imp. Univ., 11, 1934, p. 5BB.

Masumune records this plant as in the islands of Tanega shima, Yaku shima and Dkinawa, which are islands in the Liu-kiu chain—a considerable extension of known range.

p. 49. D. TDKDRD:

additional references :—Yabein Tokyo Bot. Mag., 17, 19D3, p. 142 : Makino and NemotD, Flora Jap., ed. of 1931, p. 1587 ; Hara in Journ Jap. Bot., 10, 1934, p. 527 : Masumune in Mem. Fac. Sci. Taihoku Imp. Univ., 11, 1934, p. 535.

Yabe records this species for the islands of Tsu shima : Hara for the Japanese province Df Shinano, Dn the mountains Yagasaki and AtagD and in the Usui pass ; Masumune records it for the islands of Yaku shima and Amani 0-shima in the Liu-kiu chain.

p. 53. D. QUINQUELDBA:

additional references :—Yabe in Tokyo Bot. Mag., 17, 19D3, p. 142 : Makino and NemDtD, Flora Jap., ed. of 1931, p. 1587 : Masumune in Mem. Fac. Sci. Taihoku Jap. Univ., 11, 1934, p. 565.

Yabe records this species for the islands of Tsu shima : Masumune for the island Df Yaku shima which is towards the northern end of the Liu-kiu chain.

Mueller-Beeck, Verzeichn. d. essbaren Pflanzen Japans, 1886, made the statement that *D. quinqueloba,* is eaten in Japan. As it was customary, at the date of his writing, to misapply the name he USBS/D *D. nipponica,* he probably meant that species. But whether he did or did not, his statement is questionable.

p. 57. D. TENTADULIGERA :

an additional reference :—Prain and Burkill in Lecomte, Flare gen. de l'lndoch., B, 1934, p. 70S.

p. 58. D.RDDKII:

an additional reference :—Prain and Burkill in the same, p. 710.

p. 59. D. MEMBRANADEA :

an additional reference :—Prain and Burkill in the same, p. 7D9.

p. bl. D.NIPPDNIDA:

additional references :—As *D. nipponica,* Kung H. W. and Wang T. P. in Dontrib. Instit. BDt. Nat. Acad. Peiping, 2, 1934, p. 264: Hiyamain Journ. Jap. Bot., ID, 1934, p. 95 • Hara in the same, p. 527. Under the synonym *D. Giraldii,* KoniDrDv and Kbbukova AlisDra, Key forplants Df the east region of theU.S.S.R., 1, 1931, pp. 385 and 387. Under the name *D. quinqueloba,* Moellendorf in Zeitschrift Gesellsch. Erdkunde Berlin, IB, 1881, p 91 • Mueller-Beeck, Verzeichn. d. essbaren Pflanzen Japans, 1883 ; possibly this species, but see above : Rein, Japan nach Reisen, 1886, probably this species : Yabe, Enum. Plants South Manchuria, 1912, p. 3D : Pampanini, Piantevascolari raccolte dal Rev. P. D. Silvestri nell Hupeh, 1911, PP- 25 and 218 : Kung H. W. and Wang T. P., loc. cit. Under the name *D. polystachya,* but not of Turcazninow, Komarov, Flora U.S.S.R., 4, 1935, p. 497.

The following information is added by these authors :—Hara records it for the province of Shinano, Dn the mountain of AtagD and in the Usui pass : Hiyama records it for the Tanigawadake range, in the same part of Japan. Pampanini adds to those localities already known two in the Chinese province of Hu-peh, namely" Mount Triora " at 1950 m. and Si-liD Mount *Silvestri* 2913 and 2913a).

p. 65, line 14 from the bottom, for HsiaD-lou-tai shan *read* Hsiao-wu-tai shan, and for Tieh-ling-szu *read* Tieh-lin-sze. Both localities are in the new Dhahar Province in lat. 4D°N. and bng. 115^{D}E.

p. 63. D. BIRMANIDA:

an additional reference :—Prain and Burkill in Lecomte, Fbre gén. de l'lndoch., 5,1934, p. **711.**

and an additional locality:—**ID e. Lower Burma.** Hanthawaddy district, Insein, *Parkinson* 14347 !

p. 73. D. DAUNAEA:

an additional reference :—Prain and Burkill in Lecomte, More gén. de l'lndoch., 6,1934, p. 711.

p. 74, line 24. The record of the occurrence of this species in the Circle of Puket is misplaced : it should be four lines lower down, as the circle is in Peninsular Siam.

p. 74. The following additional species follows *D. daunaea.*

31a. DIOSCDREA GARRETTII, Prain and Burkill in Kew Bull., 1935, p. 493.

Underground parts unknown. *Stem* unarmed at bast in its upper parts and probably unarmed throughout, glabrous, with many slightly raised longitudinal lines, its thickness where flowers are produced upto2mm. Leamsimple, alternate, very long-cordate, shortly acuminate, up to 12 cm. long by 6 cm. in width, very thin in texture, 7-nerved : the first pair of nerves diverge from the midrib at 3D-4D^{0} and enclose a lanceolate or oblanceolate area by meeting the midrib in the apex : the second pair diverge from the midrib at 9D_95° and become submarginal about the mid-length of the blade and SD embrace an ovate area : the nerves of the third pair curve from the midrib at an angle of about 1DD_H[)^{D} and passing a short distance into the lobes reach the margin : secondary nerves cross the interspaces, but are only a little more cDnspicDUS than the network, rather far apart: upper surface of the blade bright green, glabrous, somewhat shining, after drying with the larger nerves just raised : lower surface paler, shining, with the primary nerves raised as arB also the larger of the secondary nerves : petiole in length to about 3 cm.

Male flowers arranged along the axes of spikB-like racemes to the number of about 5D, spaced 2—5 mm. apart : axes up to 21) cm. long, sometimes branched at the base, glabrous, very thin, with slight angles : flowers Dn pedicels which are D"25—D-5 mm. bng, projecting at a right angle tD the axis, opening so wide that the limbs Df the perianth-bbes extend Dn the sides of the axis or, recurving a little, partially fold Dn to it, pals green. *Bracts* more or less lanceolate, 1 mm. bng, glabrous or rather transparent, not embracing the pedicel at all: bracteDle Dvate, slightly acuminate, D-5-D-75 mm. bng, more Dr less transparent. *Perianth-tube* very shortly infundibuliform, 0 -5 mm. deep. *Sepals* ovate, broadly obtuse at

the apex, in anthesis horizontal or slightly recurved, 1-nerved, 1 -5mm. long. *Petals* similar in size and position to the sepals, or slightly upturned and the apex somewhat morB rounded. *Stamens* 5, the filaments inserted at the edge of the disc, erect to the anthers, then incurved abruptly so as to cause the anthers to face each other at a small distance apart : thB anther-lobes almost as broad as long, *Gynoecium* a low conB with three apices.

Female plant unknown.

SIAM.

The affinity of this species is closest with *D. daunaea* but the stem is conspicuously more slender ; the foliage is smaller, as are the flowers. It has been found as yet only in the north of Siam, flowering in July and August. *D. daunaea* has not been found as far north : and it flowers from January to March.

WESTERN INDD-CHINA. **ID g. Siam, excluding the Peninsula.** Circle of P a y a p. Doi Chieng-dao, on a steep hillside above Ban Tarn, at about 550 m., *Garrett* 972 ! Circle of M a h a r a t. Lampang, at Muang NgaD, *Put* 40D7 !

p. 76. D. PARADDXA:

an additional reference :—Prain and Burkill in Lecomte, Flare gen. de l'lndoch., 5, 1934, p. 712.

p. 78. D. CAMBODIANA :

an additional reference :—Prain and Burkill in the same, p. 713.

p. 8D. D. ESDULENTA:

additional references :—Prain and Burkill in Lecomte, Floregen. de l'lndoch., 6, 1934, p. 713 : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 818 : Merrill in Trans. Amer. Phil. SDC, N.S. 24, part 2,1935, p. 113. As *D. aculeata,* Glaumc-nt in Bull. SDC. Nat. d' Acclimat. France, 1897, p. 375. As *D. fasrimlata,* Willis and Gardiner in Ann. Roy. Bot. Gard. Peradeniya, 1,1901, p. 101. As *D. papuana,* Warburg, Pflanzenkleidu. NutzpflanzenNeu-Guineas, 1899 : Kolbe in Tropenpflanzer, 7, 19D3, p. 211 : Kanehira in Journ. Dep. Agric. Kyushu Imp. Univ. Fukuoka, Japan, 4, 1935, p. 291. As *D.* <spi7LDsa, Syun'iti Sasaki, List plants Formosa, 1928, p. 113.

p. 85, line 7, for Khaoi *read* Khoai.

p. 89, line 9, Merrill, by enquiry in Barlin, has ascertained that it was Sprengel who mis-applied the name *Dncus esculentus* to *Tiliacora.* It is, therefore, fortunately impossible to advance a claim for invali dating ths name *Dioscorza escuhnta* on account of this confusion.

p. 90. To the known localities for *D. esoulenta,* the MaldivB Islands should be added. It is extremely probable that its presence in those islands was due to the interest which a former prime-minister, Ibrahim Didi, took in acclimatizing plants through a herb-garden which he maintained at Funada. A specimen preserved in the herbarium of the Royal Botanic Garden, Peradeniya, came from him in the year 1895. If he could keep it in cultivation for a time, so might others.

p. 91, line 13 from the bottom, for RaveDn *read* RancDn.

p. 92, line 12 from the bottom, The words—B u t o n, Rumpf.—should be three lines higher and immediately after the figure 1B725 b. !

Kanehira has collected this plant in the PalaD island of Saipan, no. 1DD7.

p. 92, line 8 from the bottom, for 21 Dl read21D91.

p. 98. D. PIS CAT DRUM:

an additional reference :-Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 823 Mr. H. B. Keith, Conservator of Forests, British North Borneo, in a communication to us' states that the large root-thorns of this plant sometimes project above the soil so close are the tubers to the surface. He adds that locally the tubers are considered to remain inedible even after cooking.

p. 1[>2. D. HEMSLEYI:

an additional reference :-Prain and Burkill in Lecomte, Flore gen. de 1'Indo ch 6 1934, p. 715. inao-cn., D,

Dr. E. Knuth figured a fbwer of this planti» his monograph g^, PflanzBMBich|{ v-43, 1824, p. 318 figs H- and C)-, wlùch, as he suggests, appBara to ke hermaphrodite : he doe s not comment further on it.

Among the localities we give one near Wei-ning, where Pottinger collected it on hi8 ezpecut.on through Yun-nan , ,t may he that he had passed out of that province into the provmce of KwBLchow when he collected the plant, for the well-known city of Wri-nim; is beyond the border. J " lum e

p. 1D B. D. PSEUD D-NITENS :

an additional reference :-Prain and Burkill in Lecomte, Flore gen. de 1'Indoch 5 1934 p. 71[0: and additional specimens **:-5iam, excluding the Peninsula** rir i f T>" ' ' Doi Hua Mot, on a ridge at about 144D m., *Qarrett* 781 ! 786 ! ^ a y a p .

p. 108. D. VELUTIPES :

An additional reference :-Prain and Burkill in LeCDmte, Flore Egn- dB]ln d l'T.H ^ K 1934, p. 716. doch., 5,

p. 111. D. BULBIFERA :

additional references :—Eckhardt in Home, A year in Fiii laai DR Roy. Bot. Sard. Peradeniya, 1, 19D1, p. 43 : Prain in Jo 1, P u V Willis TM Ann, 1893, p. B3 : Dunn and Tutcher, Flora of Kwang- 2 andHon K ? I* ^ SoC" 8, se, ID., 1912, p. 275: Schinz and Guillaumin n S a r a l ^ ^ ^ S**" ^ a**it. 192D,p.l28: Yamamoto, Suppl. I, Plant. V ^ ^ * TM ? * va Caledonia, 1, 7, p. 6 : Syun'iti Sasaki, List Plants Formosa, 1928, p. 113 : Merrill in Lingnan Sci. J^ 6 1930, P" 274 : Prain and Burkill in Lecomte, Flore gen. de 1'Indoch., B 1934, T, 79a V ne Mem. Fac. Sci. Taihoku Imp. Univ., 11, 1934, p. 5B4 : BurU Di't Econ 77 M^ p. 913 : Kanehira in Joum. Dep. Agric. Kyusiu Imp Z *Tl* ^^^ 1935, p. 291. As *D. saUva,* Aschers.n in Zeitschr.fur Erdkunde ^ ^ ' / ^ Berl

Japan nach Reisen, 1B85 : Hcimerl in Dcsterreich. BDt. Zeitschr., 37, 1887, p. 58, F. v. Mueller in Proc. Linn. Soc. N. S. Wales, 1891, p. 457 : Holtze in Trans Roy. Soc' S.Australia, 15,1892, p. 120 : GlaumontinBull. Soc.Nat. d'Acclimatat. France, 1897 p 375 '. K. Schumann and Lauterbach, Flora Deutsch Schutzgeb. in d. Sud-see, 19D1' p. 223.

Some of the above references have added to the known range of this species, or have confirmed its occurrence in parts where it seems to be bss common than usual. Fleming in 1891, and J. S. Gardiner, later, collected it in the island of Minikoi, an island now crowned with a lighthouse which lies a day's steaming west of Ceylon. Heimerl mentioned it as a plant of Pondicherry : as far as our material goes, it is not a common plant in the parts of India near this French settlement. Masumune records it as found in the islands of Yakushima and Okinawa, in the Liu-Kiu chain. As the province of Kiang-su has furnished its northernmost localities in Cathay, it is interesting to be able to add to them another •— Summit of the Hua-ling shan, Kao-an, at 85D m., in light woods, *Y. Ts'iang* 1047D \

Additional localities in Formosa are :—Mai shan in the province of Taihoku, *Yamamoto* • and Kuraru, Hoshum, *Linsley Gressitt* 475 ! And from Hai-nan :-Shan Tong-to *Ts'an' Wai-tak* 1B2D4 ! In light woods at Yai-chow, *H. Y. Liang* 52852 ! It flowers in Hai-nan in September.

As in north-eastern New Guinea Warburg records it as at Hatzfeldhafen |his no 21093) and Lauterbach as on the Gogol river. Karl Schumann and Holloing record it as in the Louisiade islands.

Von Mueller obtained it in the Kimberley division of Western Australia some three hundred miles beyond the range indicated by us on p. 131.

Towards proving it universal in the Pacific a few new facts are to hand. Schinz and Guillaumin record its presence in the Loyalty islands : Kanehira in the islands of Aneuar and Kusai of the Palau group : and Finsch in the island of Ponape of the Carolin group.

A. D. Smith had collected it in the Fiji islands on Vanua Levu, between 150 and 38D m on the Natewa Peninsula (his no. 82D !); and Mrs. Tothill on the island onMakonzi - Thi' flowers of male plants produced in Fiji are of peculiarly small size.

Rechinger says its bulbils in Samoa are at times as large as a child's head!

From the Hawaiian islands we have recently seen the following —island of H " Kailua, *Dtgenar and WzibU* 211! Mani in the Keamae valley, *Degener* 55B9 ' island nf n T ' Punaluu, *Dtgemr, K. K. Park and Y. Nitta55S5* ! Aiea valley! Z^ner XiKKP^

It is BvidBnt that Kein was rrfBring to *D. bulbiftra* whBn hB stBtBd that *D. satim* furnishBS material for the manufacture of starch in Japan. The " Useful Plants of T » the same statement. Mueller-Beeck, who, like Rein, wrote in 1885, said that T " f " " ^ eaten in Japan ; the presumption is that he too was referring to *D. bulbifera,* ^ "^ W&S

p. 125, line 3 from the bottom, for J. Campbell *read* A. Campbell,

p. 134, D. INDPINATA:

An additional reference :-Prain and Burkill in Lecomte, Flore gBn. de l'Indoch., B, 1934 p. 729.

The Circle of Rachaburi in which it occurs should be assigned tD **Peninsular Siam** in the list of localities on p. 135, i.e., **11** d. instead of ID g.

p. 138. D. KERRII:

an additional reference :—Prain and Burkillin Lecomte, Flare gen. de 1'Indoch., B, 1934, p. 717.

p. 139. D. PSEUDO-TOMENTDSA :

an additional reference :—Prain and Burkill in the same, p. 718.

p. 14D. D.ARACHIDNA:

an additional reference :—Prain and Burkill in the same, p. 719.

p. 142. D. FILIDAULIS :

an additional reference :—Prain and Burkill in the same, p. 718.

p. 142. D. DRAIBIANA :

an additional reference :—Prain and Burkill in the same, p. 720.

p. 146. D. KAMODNENSIS:

additional references :—Prain and Burkill in the same, p. 720. As *D. Fargesii*, Jumelle in Rev. Cult. Col. 14, 1904, p. 258.

an additional locality : N a g a H i l l s Paona, at 55DD ft. |var. *straminea), Bor* 5255 !

p. 152, linB 5. The locality Pan-long-tse is in Yun-nan and should have been on p. 151.

p. 153. D. TAMARISDIFLDRA:

an additional reference :—Prain and Burkill in Lecomte, Flore g6n. de l'lndoch., 6,1934, p. 723.

p. 154. D. PIERREI:

an additional reference :—Prain and Burkill in tha same, p. **723.**

p. 15D. D. PENTAPHYLLA :

additional references :—Heimerl in Oesterreich. Bot. Zeitschr., 37,1887, p. 58 : Tschirch, **Ind.** Heil-u. Nutzpflanzen, 1892, p. 185 : K. Schumann in Notizblatt Bot. Gart. Berlin, 2, no. 13,1898, p. 1D1: K. Schumann and Lauterbach, Flora Deutsch Schutzgeb.in d. Sudsee, 19D1, p. 223 : Willis and Gardiner in Ann. Roy. Bot. Gard. Peradeniya, **1, 1901,** p. 1D0 but excluding the note : Grofi, Ding and E. Groff, in Lingnaam Agric. Rev. 2, 1923, p. 53 : Prain and Burkill in Lecomte, Fbre gen. de l'lndoch., 5, 1934, p. 724 : Burkill, Diet. Econ. Prod. Mai. Penins., 1935, p. 822 : Kanehira in Journ. Dep. Agric. Kyushu Imp. Univ. Fukuoka, Japan, 4, 1935, p. 291.

TD our account of this species we are able to add, partly as a result Df new material from Tahiti and Rapa, which Dr. Herbert Gregory of the BernicB Pauahi Museum in Honolulu has put into Dur hands, some facts concerning its cultivation in the Pacific. Seemann, who visited Fiji in 18BD, took with him as an assistant a young Australian named Jakob Storck, and left him there, where he wished tD remain as a planter. After Seemann's return to Britain, Storck continued tD collect plants and to transmit his collections to Seemann. HB seems to have been one of the first tD observe that *D. pmtaphylla* is a cultivated plant of the Pacific. Seemann published tliB fact, and gave its Fijian name as " kaile tokatolu." The French Surgeon Df Marine, Nadeaud, was sent tD Tahiti about 185B and observed it, cultivated there. The record is tD be found in his *Plantes usuelhs ties Tahitiens,* 18B4. Tschirch in an account Df the medicinal and food plants of the East referred to the plant, without adding any new information. In 1922 Professor Harrison Smith sent us two tubers Df *D. pmtaphylla* from Tahiti: they were figured in the *Gardens Bulletin, Straits Settlements,* 3, 1923, on the plate opposite p. 4 with the numbers 7 and 8. An attempt to raise plants from them in the Botanic Gardens, Singapore, met with indifferent success. But newer material in spirit from Tahiti has supplied identical tubers, and gDDd leafy specimens : similar specimens have reached us from the island of Rapa, 7DD milea to the southward. WBSBB in these a cultivated race requiring further study alive, if possible sidebyside with what the Fijians cultivate. Nadeaud says that the Tahiti an plant has angular bulbils : these we have not seen.

Dahl, itisrecDrded, collected *D.pentaphylla* at Ralum in New Britain. Kanehira records it from the island DfYap |hisnos. 1123 and 11B1). Degenerhas collected it in the Hawaiian island of MDlDkai, to the west of Ualapue (his no. 55B2 !).

p. 182. DIOSDDREA HEPTAPHYLLA, Syun'iti Sasaki in Trana. Nat. Hist. SDC. Formosa, 21, 1931, p. 147.

The author's description of this species is difficult to follow. He describes it aa a climber attaining 15 m. in length with male panicles 35 cm. in length. The latter are canescent. The axis of the female inflorescence above the base and the ovary are described as with brownish pubescence. The plant itself is described as glabrous. The probability is that it is glabrescent. The leaves are built up of seven leaflets 8—11 cm. long and 3-5-4.5 cm. wide on petiolules 5—7 mm. long : their upper surface is shining : in venation they are penninerved. The capsules are relatively large, being 3-5^t cm. long and2-5—2-7 cm. across : they are said tD be reflexed. The dimensions ascribed to the seed—9 mm. in length by 4-5 mm. in width—would seem tD be those at a stage before maturity and do not assist the enquirer. The inflorescences Df both sexes are described as pendulous ; the petiDlB as 9—10 cm. long ; the outline of the leaflets as " obovate or obliquely long ovate, entire, caudate attheapex, cuneate at the base ": the bracts of the male flowers as up to 2-5 mm. in length: the sepals and petals purplish, triangular, incurved, up to 2 mm. in length ; the bract of the female flower to 3 mm. in length.

The species was obtained by the author Dnthe island of KotD-sho or Botel Tobago, at Taito, with flowers in June ; subsequently fruit was obtained at the same place by Kokiti Segawa.

Regarding the affinity Df this species there is no doubt : its compound leaves indicate that it belongs to one of two sections, *Lasiophyton* Dr *llligzrastrum;* the incurved perianth pf the male flowers assigns it to *Lasiophyton,* wherein the large size of the capsules places it among the species which we have numbered 64—70. But Mr. Syun'iti Sasaki's description contains nothing whereby his species can be distinguished from no. 55, *D. inaequifolia,* Elmer.

The island Df Koto-sho is to the Bast of the South Cape of Formosa and half a degree north Df the Batan islands in which the Philippine *D. inaequifolia* has been obtained. Other species of the same group are known to occur in the island of Hai-nan and the Chinese provinces, of Kwang-si and Kwei-chow : and therefore its extension to KotD-sho is but little whether we seek its allies in the south-west Dr in the south.

p. 1B6. D. SDORTEDHINII:

an additional reference :—Prain and Burkill in Lecomte, Fbre gen. de 1' Indoch., 6, 1934, p. 725.

The type of *D. Scorkchinii* is a specimen collected by Father Scortechini in Perak : it carries mature fruit. Identical with it and identified with it by us, is Balansa's specimen from Mount Bavi in Tonkin. It too carries ripe capsules. We ourselves were at pains tD get the male plant from Scortechini's locality : and male plants are now coming to hand from Indo-China. The latter differ from the former in the size of the male flower and the colour of the indumentum. Observing this we have recently described the IndD-Chinese plant as *V&T. parviflora [Kew Bull,* 1935, p. 494). The sepals and petals in this variety are 0-75 mm. long ; and the hairs are grey, not rufous. The type-specimen of the variety is C. Wang's unlocalized Hai-nan specimen, no. 33578 ; and his no. 33325 agrees in all points. We have seen as yet no male flowering plants from Tonkin : and until collections are made towards the mountains where Balansa worked, it will be doubtful whether the Tonkin plant agrees with the variety or with the plant as found in Malaya : but the geographical position suggests that the Tonkin plant is more likely to be var. *parviflora* than typical.

Female plants have been collected in Hai-nan | *U. Wang* 34279 and H. Y. Liang B3347) which if not ideal are nevertheless obvious representatives of *D. Scorkchinii.*

p. 188. D. HISPIDA:

additional references :— Grofi, Ding and E. aroff in Lingnaam Agric. Rev., 2, 1923, 53 : Prain and Burkill in Lecomte, Flore gen. de l'lndoch., 5,1934, p. 725: Burkill, Diet. **p.** Econ. Prod. Mai. Penins., 1935, p. 818. As *D. daemona,* Pottinger and Prain in Rec. Bot. Survey Ind., 1, 1898, p. 223. As *D. triphylla,* Syun'iti Sasaki, List Plants Formosa, 1928, p. 114.

A few additional localities have reached us and may be enumerated. **4 e. Sub-subregion Df Rain from the Bay of Bengal.** (Western Bengal). District of M i d n a p u r. Chandrakona, *R. K. Das* 354BD. **9 b. the HwangS.** H a i - n a n . Without locality, C. *Wang* 33348 iVai-chow, in thickets, *H. Y. Liang* 62252 ! Kachek, Wong Chuk, *Me Vlure* 9798 : Pak-fan-shue-leung, Ngau-ma-woh, in the district of Taam-chau, *Ts'ang Wai-tak* 17162 !

Observing the poisonousness of this plant, an attempt has been made to kill leeches •with it |de Jesus in *Philipp. Journ. Sci.,* 1934, p. 49); but contact lasting a week did not kill them.

p. 198, last line but Dne, for Kagi, *Tikutochi* and *Shimada read* Kagi, Tikutochi, *Kawakami and Shimada.*

p. 199, tha second line, for Luang *read* Liang.

p. 203. D. POILANEI:

an additional reference:—Prain and Burkill in Lecomte, More gén. de l'lndoch., 5, 1934, p. 70S.

p. 207. D. SIMULANTS :

A fruiting specimen has been seen. It was collected tD the south of Lin-chow in thB Yang-shan district of the Province of K w a n g -1 u n g, by *Tsui T. M.* |no. 479). The capsules are shaped like those of *D. dissimulans* and similarly reflexed. The stipB is 2 mm. long. The wings along the placenta are 12 mm. long, their maximum width 9 mm. in tha upper one-third.

p. 2D9. D. LEDERMANNII:

additional references :—Kanehira in Journ. Dep. Agric. Kyushu Imp. Univ. Fukuoka, Japan, 4, 1935, p. 291 : and as *D. flabellifolia,* Kanehira in Bot. Mag. Tokyo, 49, 1935, p. 271.

Kanehira gives the island of Babel-thaop as the locality for his no. 231B.

By some inadvertence Dr. R. Knuth in his monograph (Engler, *Pflanzznreich,* DiDScoreaceae, iv-43, 1924, p. 13) has labelled a figure of bulbils of a species of the sention *Lasiophyton* as those Df this species. These bulbils are such as *D. dumetorum* is known to produce.

Distribution Tables.

TABLE J. All the Eastern species by subregions. The sequence of the table is that adopted in the enumeration above, section by section and group by group. The occurrence is indicated by a serial number, running through each subregion : e.g., there are 14 species in the Himalaya and they are numbered 1 to 14.

	Balkans.	India.	Himalaya.	Cathay.	Australia.	Pacific.	Uni'Drileil altitiules.
BDRDEREA, whirh is CDnfintJ tn the 1"yrcnees							
1. *pyrenaica*							At 15DD m. ani a little higher
STENDPHDltA, extends from nD rtli(TII ivarm-tt mperat me pant into Ehe trap ics.							
Group ul D. dBltoilaa.							
2. *balcnnirn*	1						At2G0m.
3. *vdJjcasira*		1					BO to 081)0 m.
4. *deltoideti*			1	1	1		In the Himalaya at!)0D—33DDm. in Yun-nan at 3 Ei Il in.
5. *Prazeri*		1	2		1	1	20—17DDm.
5a. *Poilanei*				2			At4DUm.
Group ol D. coraana.							
6. *coreana*				1			
Group ol D. siplBmloba.							
7. *septemloba*				1			
Group ol D. panlhaica.							
8. *zingiberensis*				2	2		T[i.i)DDm.
9. *panthaica*					3		To 3051) m.
10. *biserialis*					4		At28D0m.
Group ul D. CollBttii.							
11. *Hutii*				3			
12. *Collettii*				4	5	3 2	In Yun-nan to 3 Do Dm.
13. *hypoglauca*				5	li	4	Hecoriled D to lQDOm.
14. *gracillima*				2	5		In Japan to lDDDm.
14a. *Zentarvana*				3			
Group ol D. asclepiaiUa.							
15. *asdepiailed*				4			
Group ol D. Cllingii.							
15. *Chingii*						5	At 1300 m.
Group DlD.tDkoro.							
17. *ennenncura*				7			At ODDm.
18. *tenuipes*				5			
19. *tokoro*				li	B	8	
Group DI D. palawana.							
20. *palawana*						2	At sea level.
Group ol D. quinqUBlobi.							
21. *quinqueloba*				7	D		In N. China tu 500 in.
Group ol D. althaBoidDi.							
22. *althaeoides*					7		2DD1—32DDm.
Group olD.lulsthaUBnsis.							
23. *futschauensis*				ID			D—DDOm.
Group ol D. tBntaculieara.							
24. *tentaculigera*						3	
Group oi D. mBinbranacBa.							
25. *Rockii*						4	
26. *membranacea*						5 "a	D—4DDin.
Group Dl D. nipponica.							
27. *nipponica*				B	11	S	D—20DD m.
Group ol D. birmanica.							
28. *birmanica*						li 4	0—12DDm.
Section uncertain.							
29. *Ridleyi*						5	
Scarcity known.							
29a. *mindanaensis*						*	

	Pyrenees.	Balkans.	Caucasus.	India.	Himalaya.	Japan.	Cathay.	S.-W. China.	E. Indo-China.	W. Indo-China.	Malaysia.	Papuasia.	Australia.	Pacific.	Recorded altitudes.
STEN 0 C DREA, restricted tD three tropical subregions.															
Group ol D. ilenDnnriBora.															
30. *itenomeriflvrti*											6				0–BODm.
31. *daunaea*										7	7				0–IBODm.
31a. *UaTrettii*										8					
32. *kedutnsil*											8				At 12DD in.
group ol D. lumalrana.															
33. *sumatrana*											9				At 75 m.
group ol D. paralua.															
35. *camboii<*na*									7	9	ID				0—12D0 m.
C DMBILIUM, wide in cultivation.															
3B. *aaiUria*				2	3	9			8	ID	11	1		1	D—BDDm.
ILLIGEEASTRUM, only in East IniD- China.															
3Ba. *limulani*									9						At55Dm.
3Bb. *diuimulam*									10						At120D m.
PAKAMECDCAEPA, EastlndD-China tD edge DfPacinc.															
37. *flabdlifulia*											12				0—75D m.
38. *bullata*											13				AtSDDm.
3 Ha *PMotii*									11						At14DDm.
39. *piicatvT-um*											14				0—BDDm.
3Ba. *Leiermannii*														2	
SHANNI CDBEA, South-West China and just over the borders.															
4D. *yunnaneniti*								9							14DD—15DDm.
41. *Hmekvi*								10	12	11					12DD—3050 m.
42. aubcolus								11							At150Dm.
43. nitens								12							120D—2450 m.
44. *jmudo-niteni*										12					AtlODDm.
45. 5/artini								13							
46. velulipei								14		13					**1BDB—iiuom.**
DPSaPHYTDN.wide In Did World Tropics.															
Group ol D. bultilin.															
47. *hllbifera*				3	4	10	12	15	13	14	15	2	1	3	To lBDDm. in Himalaya ; to 275D in Yunnan.
4B. Braniiiii										15					
49. *punctata*													2		
Sroup p| D. ingpinala.															
5D, *inopinata*											IB				Sea-level.
LASIDPHYT DN, wide in **Old World Tropics.**															
Broup ol D. arichidna.															
51. *Ktrrii*										16					At47Dm.
ii. pieuio-tomvtoit										17					
&3. *artuhiina*				4					14	18	17				D—12DDm.
54. jUic-uIii										19					Near sea-level.
55. *Cruibiana*									15	20					
Broup ol D lumDomniii.															
5S. *mdano'phyma*					5			16		21					BOD—305Dm.
57. *kamoomnsiB*					6		13	17	IS	22					BDD—42D)m.
is. *limmtiana*								18							
Broup DID. lamariicinnrs.															
59. *tamariedflon.*											18				
BD. *Piemi*									17	23	19				Nearsea-ievel.
UroupDlD.tomBiilDiB.															
61. *tumenima*				5											D—1350 m.
Group ol D. pgntaphylla.															
t'l. *psnt&phyllu*				6	7	11		19	18	24	20	3	3	4	TD 17DDm. in Himalaya ; lSOUm.inKha.-sia Hills; 15DD m. in Yun-nan; 165Dm. in Shan Hills.
63. *Kalkapershadii*				7											
Group ol D. ScortBChinii.															
04. Bran											21				
a5. ijiiBjiii/ohil											22				
B 3. *Cumingii*											23				
g5a. sp. near last															
B7 £«iu:**rdii**								20	19						
(ja *polyptiyUa*											24				BDD—lDDDm.
69 • JJtaiei											25				To 15JU m.
70 *Stntechitdi*									20		26				TBl2DI)m.

	Pyrenees.	Balkan^.	Gcincasus.	India.	Himalaya.	Tupan.	Cathay.	S.-W. China.	E. Indo-C'hina.	W. Indo-China.	Malaysia.	Fapuasia.	Australia.	Pacific.	Recorded altitudes.
Group of D. hispida.															
71.	..	..	..	..	..	..	..	21	..	5	7	..	..	..	Sea-level to 1200 m.
EN. ANTIDPHYLLTJM, wiie in the old World Tropics.															
Group ol D. laurilolia.															
72. HBDiJun *dii*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
73.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
74. *laurifolia*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
75. *Vanvuurenii*	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1—90
[illegible]															
75. *P* [illegible]	..	..	..	..	..	..	..	..	..	..	3	..	..	..	To
[illegible] arboreE a.															
77.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]															
[illegible]	..	..	..	..	..	..	..	..	..	..	3	..	..	..	
[illegible]	..	..	..	..	..	..	..	..	..	..	3	..	..	..	
[illegible]															
[illegible]	..	..	..	..	..	..	..	..	..	..	3	..	..	..	To
[illegible]	..	..	..	..	..	..	..	..	..	..	3	..	..	..	
[illegible]															
Group ol D. bi-color.															
82.	..	..	..	..	..	..	..	2	..	..	..	..	..	..	
grgup ol D. aipiria.															
[illegible]	..	..	..	..	..	..	..	3	..	..	..	..	..	..	21—4
group gl D. opicali.															
84.	..	..	..	9	..	..	..	..	..	..	..	..	..	..	Pro 300
85.	..	..	..	10	..	..	..	..	..	..	..	..	..	..	
86.	..	..	..	11	..	..	..	..	..	..	..	..	..	..	1—1200
[illegible]															
[illegible]	..	..	..	..	..	..	..	24	23	..	..	..	..	..	1—1200 m.
[illegible]	..	..	..	..	..	..	..	25	..	..	..	..	..	..	550—1300 m
[illegible]	..	..	..	..	..	..	..	26	24	..	..	..	..	5	To 1950 in chuan.
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]	..	..	..	..	..	13	1	7	..	..	..	..	..	..	To 140 China.
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Bmup DI D. BBnlhamii.															
83. *Benthamii*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]															
94.	..	..	..	..	..	..	..	..	..	..	..	5	..	..	1—700
[illegible]															
95.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]															
96.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]															
97.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]															
98.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	N.
Group ol D. cirrhoia.															
[illegible]	..	..	..	1	..	..	1	..	9	7	..	..	..	..	
100.	..	..	..	..	..	..	..	..	8	8	..	..	..	..	
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
[illegible]	..	..	..	..	..	..	..	..	30	..	..	..	..	..	
[illegible]	..	..	..	..	..	..	..	..	31	..	..	..	..	..	
Group ol D. Bonii.															
102. *Bonii*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Group ol D. Wallichii.															
103. *Wallichii*	..	..	..	1	..	..	..	..	..	..	10	..	..	..	0—900 m.
104. *pulverea*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	At 1400 m.

	Pyrenees.	Balkans.	Caucasus.	India.	Himalaya.	[illegible]	Cathay.	[illegible]	[illegible]	[illegible]	Malaysia.	rt.	Australia.	Paciflo.	Rpcnriei altitudes.
Group Dl D. alalfl.															
lDfi. *brevipetiylata*										3D	41				0—3DD m.
106. [illegible]									33						....
107. *kratica*										31					0—1550 m.
108. *Fordii*									34						....
109. *gibbiflora*											42				n—25D m.
110. *myriantha*										32	43	П			D—25D m,
111. *depauperata*										33					1DD—5DD m.
112. *persimilis*								2D	35	34					D—2D0 m.
113. *Ilamiltonii*				14	0					35	44				0—12D0 m.
113a. *W.*										*					....
114. *alata*				15	11)	15	19	3D	33	3 Li	45	7	B	9	Cultivated widely
Group ol D. npaca.															
115. *opaca*												B			At BUD m.
Group Dl D. lamprDCBUla.															
116. *lamprocaula*											41!				0—125D m.
Broup D! D. itBinonDidBi.															
117. *stemonoides*										37					300—4DD Dl.
Group ol D. glabra.															
11B. *belophylla*				13	11					3B					L'limninn at 13JD —15DD m.
119. *lepcharum*				17	12					3D					TD29D0 m.
119a. *By.*				*	•										....
12D. *glalra*				IB	13			31	37	4D	47				D—13DD m.
120a. *sp.*															....
121. *vexans*											48				....
122. *oryzetorum*										41	49				Sea-level.
123. *gracilipes*											5D				Sea-level.
124. *calcicola*											51				D—5DD m.
125. *nummularia*											52	D		"t	....
125a. *sp.*											•				....
126. *Sitamiana*											53				....
127. *Nieuwenhuisii*											54				....
128. *gedensis*											55				....
129. *salicifolia*											51)				D—1DDD m.
130. *ovata*											57				....
130a. *Wilkesii*											•				....
131. *Loheri*											58				....
132. *divaricata*											59				D—2DD m.
133. *Foxworthyi*											BD				....
134. *Merrillii*											61				At 70D m.
135. *Kingii*											32				D—ODD m.
136. *pyrifolia*											93				D—15 DD m.
Group gl D. oppoiililglii.															
137. *intermedia*				19											....
13B. *oppoiitifolia*				29											D—1B0D m.
139. *trinervia*				21						42					0—DDD m.
140. *obcuneata*				22	•										....
14Da. *tp.*															....
Broup ol D. dgcipiing.															
141. *decipwm*								32	••	43	54				D—BOD m.
Broup Dl D. pubara.															
142. *pvpera*				23	14					44	B5				0—105D m.
143. *Lilteri*										45					....
144. *pulydaiet*									3B		US				0—70D m.
14B. *platycarpa*											B7				....
Group ol D. grbiculalB.															
148. *orbiculata*											OS				D—45D m.
Broup gl D. linuilolii.															
147. *tenuifolia*											BB				D—BDD m.
Total	1	1	1	23	14	15	19	32	38	45	9B	9	B	7	

Summary.

PyrenBES, 1 speciES, eniEmic ani very distinct, of African affinity.
Balkans, 1 species, enilcTuic, with allies in Asia.
Caucasue, 1 species, endemic, wibh close allies in Asia.
India, 23 species Df which 44 per cent. Endemic.
Himalaya, 14 species DF which nunu endemic.
Japan, 15 species of which 27 per cent. Endemic.
Cathay, ID species of which 21 per cent, endemic.
SDuth-West China, 32 species of which 37 *pa* cent, endemic.
Eastern IniD-China, 38 species of which 31 per cent, endemic.
Western Indo-China 45 species uf which 29 per cent, eniemic.
Malaysia, B9 species of which 69 per cent, endemic.
Papuasia, D species of which 22 per cent, endemic.
Australia B species of which 5D per Lent, endemic.
Pacillc, 7 species Df which 14 per cent, endemic.

TABLE 2. The genus in Malabwia, distiict by district from the north to the south. The Kaira district has b&cn added by way Df contrast, but does not belong to Malabaria.

	Surat.	Kulalja.	Malajar.	Cochin.	Travancure.	Coimbatore.	Uva, Ceylon.	Maldives.
[a) wild **ipp.**								
85. *Trimenii*	..	..	..	..	..	x	..	..
140. *obcuneata*	..	..	..	..	..	y	x	..
142. *pubera*	..	..	..	..	x	..	..	..
86. *spicata*	..	..	..	x	x	x	x	..
137. *intermedia*	..	..	x	..	x	x	x	..
61. *tomentosa*	..	..	x	x	x	x	..	..
118. *betophylla*	..	..	..	x	..	..	..	..
113. *Hamiltonii*	..	..	x	x	x	..	..	..
13B. *oppositifolia*	..	x	x	x	x	x	x	..
1D3. *Wallkhii*	..	x	x	..	x	..	..	..
71. *hisjiiia-*	..	x	x	..	x	..	..	..
47. *bulbifera* (1)	..	X	x	x	x	xx	7	x
B2. *pentaphylla* (2)	..	x	x	..	x	..	..	x
(b) cullivgltd **ipp.**								
9. *el-uknta*	..	x	x	x	x	xx	7	x
114. *alata* (3)	..	x	x	x	x	x	x	x
Total no. wild (4)	3	5	8	5	11	8	4	1

(1) *D. bulbifera* meets with some cultivation in the four Districts anil twii States iuilicatiMl l)y italiu *"X "*.
(2) *D. penttiphylla* is rccnrileil as having bfeii rultivateil nt one timi! in the District nf Malalmr.
(3) *D. alata* is known ti) run wilil and persist iineari'il for in the District of Malabar anil the State nf TravancorB.
(4) tile luw figures fQr th; Districts uf KDluba anil LbDR ate clearly Llue to inailciiuate cxulurntion.

TABLE 3. The genus in CoromandBlia, district by district from south to north. The Districts Df Madura, NellDre and Kistna are by the boundaries which they had before 19D7.

	Tinnevclly.	Madura.	Tanjure.	Coimliatare.	Salem.	S. Arcot.	Pondicherry.	Nell • u.	Kistna.	
Elevation In metric.	1,9=0.	40.	Little.	60.		70.	Very littie.	60.	Little.	Little.	
[•) will **ipp.**										
12D *glabra*	..	..	..	..	..	..	..	..	..	x	Spreads in from the north. Apparently the same.
71. *hitpiia*	..	x	x	..	x	..	..	..	..	..	
84. *Wightii*	x	..	..	..	..	..	..	..	..	..	
B9. *ipieata*	x	x	..	..	x	..	..	..	..	..	
47. *bulbifera*	x	..	x	..	x	..	x	..	..	..	
91. *timentosa*	x	x	..	..	x	x	..	..	..		
138. *oppositifolia*	x	x	x	x	x	x	..	x	x	x	..
82. *pentaphylla*	x	x	x	x	x	x	x	x	x	..	..
63. *Kalkapershadii*	..	..	..	..	..	x	..	..	..	..	..
(b) cullivalid ipp.											
39. *emulenta*	x	x	x	x	..	x	..	..	x	..	x
114. *alata*	x	x	x	x	x	x	x	x	x	x	x
Total no. will	3	D	5	4	2	R	4	2	2	2	2	1	1	

It is not known that any species of DioscDrea occur in the North Province and the North-Central Province of Ceylon except *D. alata* in cultivation. The two provinces have therefore no place in the table.

TABLE 4. The genus in the Deccan, district by district, as far as it occurs (1).

	Mysore.			Malabar above the ghats.		Nizam's Dominions.		Bombay above the ghats.					
(i) will ipp.													
71. *hiipiia*	..	..	..	X	..	X	X	..	..	..	X	..	X
HI. *tomentoia*	..	..	X	X	..	..	..	..	X	..	..	..	..
118. *belophylla*	..	..	..	..	..	..	..	..	X	..	..	..	..
103. *Wallichii*	..	X	..	..	..	..	..	..	X	..	..	..	X
138. *opfoiitifolia*	..	..	X	X	X	..	..	..	X	X	X	..	X
BZ. *pentaphylla* (Z)	?	?	?	X	X	..	..	X	X	X	X	..	X
47. *butbifera* \3)	X	..	X	..	..	X	..	X	X	X	X	X	X
(b) cullivilid ipp.													
38. siculenfs	..	..	..	..	X	..	..	..	..	..	..	..	..
114. slsfs	..	..	..	..	X	X	..	..	..	..	X	..	..
Total no. wlli ..	1	1	3	4	Z	2	1	2	B	3	4	1	5

(1) The following Districts arc not known to produce any wild species *ol Dwscorea* :—in the State of Mysore, Hassan, KDUT ani Chittalirug- in Madras above the Hhats; Anantapur ani Bcllary: in the Nizam's Dominions; Lingsugur, Ilaichur, Mahbubnagar, Qulbargah, Nalgundah, Eljiinial, Meiak, Bliar, Akalkot, Usmanabad, Bir, Nanier, Indur, Sirpnr, Taniur, Aurungabai and Parbhani: ani iu Bombay above the Hhats- Bijapur, Kolhupur, Sholapur, Ahmcinagar and East Khaniesh.

(2) *D. pentaphylla* occurs In Mysore, but the exact localities are unrecoricd.

(3) *D. bulbifera* has been observed in cultivation in the District of Nasik.

TABLE 5. The genus through the Central Provinces of India, district by district from west tD east.

Name of District.	Nimar.	Buldana.	Akola.	Amraoti.	Betul.	Hosliungabad.	Narsinghpur.	Seoni.	Chanda.	Bhandara.	Seoni.	Nasik.	Jufatulg.	Yeotmal.	Ealaghat.	Nagpur and Wardha.	Baipur.
if with hills rising above CDD m.	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	Yes.	No.	Yes.	Yes.	Yes.	Yes.	Yes.
(i) will ipp.																	
Dl. *tumintisa*	..	X	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..
IDS. *Wallichii*	..	..	..	X	X	..	..	..	..	..	X	X	..	..	..	X	X
142. *pubera*	..	..	..	X	..	X	..	..	..	..	X	X	X	..	X	..	X
11B. *belophylla*	..	X	..	X	X	X	X	X	..	..	X	X	X	..	X	X	X
138. *appositifalia*	..	X	X	X	X	X	..	X	X	..	X	X	..	X	X	X	X
B2. *pentaphylld*	..	..	..	X	X	X	X	..	X	..	X	X	X	X	X	X	X
71. *hitpiia*	..	X	X	..	X	X	X	X	..	..	..	X	X	X	X	X	X
47. *bulbifera* \1)	..	X	X	X	X	X	X	X	J:	..	X	X	X	X	X	X	X
(b) Eultivaiad ipp.																	
3B. *eimlenta*	..	X	..	X	X	..	..	X	..	X	..	..	..	X	X	..	..
114. *alata*	..	..	..	X	X	X	X	..	X	..	..	..	..	X	X	..	X
TotalnD. wild (Z)	4	4	2	7	0	B	4	4	4	..	2	S	7	2	B	5	5	4	3	9	7

II) *D. bulbifera* h»9 been observed in cultivation in the Districts of Betul, Nagpur, Yeotmal ani Baipur.

(Z) It is unlikely that the District of Wardha is entirely without will species Df *Dio,<m<, :* it lies alongside the District of NaBPur and is climatically very similar.

TABLE 5. The genus to the north-west of the Bay of Bengal, district by district from the south tD the north.

Name Df the district (1).	Diicare.			Drissa.						CllDta Xagpur.					
	Oo avcri.	Vk ag.llat 6	Ganjam.	Puc.	Cuttauk.	A I	1 rc.	a 1 lhanja.	mbalpur.	Ia bhuE.	llanchi.	Mar a.	1 agh.	1 P3	S ah.
height *to* which hills rise in metres.	1,350.	1,500.	1,100.	L i	750.	950.	L≡w.	1,150.	900.	1,0 50.	1,100.	S.	1,350.	g 10.	S 0.
(i) wild ipp.															
113. ***Hamiltonii***	..	..	..	..	..	x	x	x	..	x	x	x	x	..	x
51. *tomentoia*	x	x	x	..	x	x	..	..	..	..	x	..	..	..	..
1D3. *Wallichii*	x	x	x	x	x	x	x	x	..	x	x	x	x	x	..
142. *pubera*	x	..	x	..	..	x	x	x	..	x	x	x	x	x	x
118. *belaphylla*	x	x	x	..	..	x	..	..	..	x	x	..	x	x	x
13B. *oppoiitifalia*	x	x	x	x	x	x	..	x	..	..	..	..	..	..	..
129. *glabra*	x	x	x	..	x	x	x	x	..	x	x	x	x	..	x
52. *pentaphylla* (Z) ..	x	x	x	x	x	x	x	x	..	x	x	..	x	x	X
53. ***Kalkapershadii*** ..	..	..	..	..	..	..	x	x	..	..	x	..	..	..	..
71. *hitpida*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
17. liutti/erii (J)	X	x	x	x	x	x	x	x	x	x	x	..	x	X	X
(b) cultivated ipp.															
3S. *eiculenta* \4)	..	x	x	..	..	..	x	..	..	..	..	..	x	..	X
114. *alala*	x	x	x	x	x	x	x	..	x	x	..	..	x	..	x
Total nD. wild	S	B	19	5	7	ID	B	9	2	B	ID	5	B	0	8

(1) In this table the States ol Denkanal, Baud, and Narsingpur are incluilcil with the District DI Angul, anil tile StatB Df Nilgirl ia lnclulei with the State of Mayarbhanji.

(2) *D. peMaphylla* is sparingly cultivated in several districts, notably in that Df Qanjam anil in the Sontal Fergunnahs.

(3) *D. bulbifera* has beBU ubscrved in cultivation in the District D! Uoiavcri, tna State 3f Mayuibhunja, the District Df Palamau and tho Sontal Pergunnahs.

(4) *D. etailenta* has been ulia erved wild in the Huntal Fcrgunnahs.

(5) *D. alula* aomBtiinea runa wild in the District of Gaujam.

TABLE 7. The line at which the genus Diascarea is arrested towards the north-western plains Df India. TD the west Df this line *D. bulbifera* appears on Mount Abu in the State of Sirohi (lat. 24° 3B' N. and bng. 72° 45' E., *i.z.*, due north of Kaira): otherwise the genus is absent.

Name i)f place.	1 W	Ali I ur	Barwani.	Indare.	Bh a 3	E har.	Eatah.	1	1	i a	S Si	Budaun.	Delhi.	Bareilly.	Filibhit.	M I a	Saharanpur.	
Its latitude N.	22° tn	22° 11'	22° 30'	SI° 44'	23° 1&'	n° 5# 4'	3° 10'	29° 14'	27° 10'	27° 28'	5° n5'	28° 02'	28° 39'	2°° SI'	3° U'	28° 51'	N° m3'	
Its lnngitude E.	7° 45'	74° 24'	74° 57'	7U3° 0'	77° k	77° S'	75° 52'	78° S'	78° S'	77° 41'	7n° 40'	701° 10'	7r-° 12'	7en° 27'	7S3° 51'	7·0° 4S3'	7t~° IN5'	
(B) wild ipp.																		
118. *belophylla*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	Intrudes from the Himalaya.
13S. *opporitifolia*	..	x	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Intrudes frDm the Deccan.
142. *pubera*	..	x	x	x	x	x		..	..	..	..	..	..	..	..	..	..	Ditto.
S2. *pentaphylla*	..	x	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..	
71. *hispida*	..	x	..	..	..	x	x	x	..	..	..	..	..	..	..	..	x	
47. *bulbifera* (J)	..	x	..	..	x	X	x	x	..	..	x	..	..	..	..	x	x	
(b) cullivalid ipp.																		
3B. *esculenta*	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	..	
114. alula	x	..	..	..	..	..	..	..	x	x	x	x	x	x	x	x	x	
Total no. wild ..	D	5	3	1	Z	4	2	2	D	D	1	0	D	1l	It	1	3	

(1) *D. bulbifera* has been seen in eultivatin11 at Narsiiigliai.

TABLE 7a. The Rainfall at the limit of the genus in north-western India, month by month, in inches, from the Memoirs of the Meteorological Department of India, *22*, 1914.

	Jan.	Feb.	Men.	Apr.	May.	JUD.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total for the year.	Total from May to Dctubsr
Kaila	0-03	0-11	D -113	0-D3	D-15	4-DD	15·01	8-97	4-75	D-35	D-24	D-D3	33-70	33-23
AliRaJlJiir	D-DB	I)-23	D-4IB	u - in	<I-]B	4-51	11-57	»-4D	B-D3	0-7S	DDB	D-D7	32-94	32-45
Barwani	D-DB	D-DB	I) • 1)4	D-D5	[MB	3-9B	B-77	4-44	4-35	D-95	D-DB	D-D4	2D-71	2D-38
:[nJorr;	3·1 4	U-17	D-D4	D-14	D-47	5·Ii4	9-B4	7- 37	7-D5	1-08	D-3D	D-25	32-79	31-75
BhDIial	D-34	D-21	D-14	D-D5	0-2D	B-2D	15-BJ	12-74	7-58	D-SB	0-36	D-35	44-79	43-34
Narsinghur	D-51	II-3D	D-32	0-17	D-22	Ii • B8	14-29	14-B8	8-81	0-42	D-45	D-55	47-B9	45-3D
Kotah	I) -23	11-24	Il-0d	D-43	11-43	2-7D	1D-15	B-2D	5-D4	D-31	0Đ2	D-29	2B-12	2B-B3
QwaliDT	OS2	D-49	O-DB	D-3D	D-29	2-95	D-DQ	12 -DB	4-91!	D-59	D-14	D-32	31-B3	29 -»3
Agra	D-54	D-37	0-23	D-25	D-48	2-51	B-57	8-2B	3-B5	0-83	D-D7	0-33	27-32	25-5D
Muttn	D-58	D-37	D-23	D-18	D-53	2-39	S-1B	8-D3	4 1 1	D-53	O-D7	Q-3B	25-53	23-75
Etiih	D-51	D-4D	D-44	11-15	11-42	2-89	8-91	8-22	4-46	1-D1	U-D4	D-28	27-73	25-91
Budauo	D-8B	D-B9	D-45	D-27	D-42	3-94	11-21	9-31	B-19	1-22	D-D9	D-34	34-99	32-29
Delhi	1-D7	0 • 33	D-47	ti • a H	U- B3	3-10	a-Dts	7-BB	4-4D	D'29	D-1D	0-4B	27-52	24-3B
Bareilly	1-D5	0-77	B-B2	0-2D	D-7D	5'42	14-D2	13-2D	6-9]	1-3B	D-23	0-3S	44-96	41-B2
Pilibhit	1·1 2	1-D9	0-B3	(1-32	1Đ2	B-35	1B-71	15-76	8-24	1-2D	D-11	D-44	51-D5	41-28
MDiadahad	1-2B	1-1B	n-73	D-25	D-95	4-95	13-53	11-51	5-51	1-D7	D-12	0-4B	41-53	37-52
Saharaspur	1-5D	1-43	D-93	D-35	D-73	4-D7	11-47	11-D4	5-25	D-43	D-1B	D-S2	37-98	33-DD

TABLE 8. The genus in and on the edges of the Upper and Mid Gangetic Plains; each, district by district, from west to east.

	NDithern Edge.									Plains.		Southen1 Edge					
		Bijnor.		Pillibhit.								Jhansi.	Jalaun.				
(a) wild ipp.																	
120. *glabra*	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..
142. *pubera*	..	..	..	..	..	..	X	..	X	..	..	X	..	..	X	..	..
118. *belophylla*	X	..	..	..	X	..	X	..	X	..	..	X	..	..	X	..	X
71. *hispida*	X	..	..	..	X	X	..	..	X	..	..	X	..	..	X	X	X
62. *pmt'lphyUtl*	..	..	X	..	..	..	X	..	X	..	X	X	..	..	X	X	X
47 *bulbifera\2)*	X	..	X	..	..	X	X	..	X	X	X	X	..	..	X	X	X
|b) cultivated ipp.																	
36. *esmlenta*	..	..	..	..	..	..	..	X	..	..	X	X	..	..	..	..	..
11*. iifata P)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	..	..	X
Total no. wild	3	D	3	D	2	2	4	0	3	1	2	5	0	D	5	3	4

Only two of the Plains Districts are named here ; but *D. alata* is cultivated in all the other Districts of the United Provinces Df Agra and Dudh ; and *D. esculenta* is cultivated in the Districts Df Dawnpur and Hardoi (which are towards the centre of the plains) and in the Districts of Sultanpur, Fyzabad, Partabgarh, Allahabad, Jaunpur, Azamgarh, Benares, Ghazipur and Ballia (which are towards the eastern end). When no species occur wild in a Plains District it is excluded from the table.

{") *D. bnlbifsm* has bcDii observed in cultivation in the District Df Jhansi.
|3) *D. alata* is able to survive in ft mote or less wild condition in the submontane parts of the Xaini Tal District.

TABLE 9. The genus in Tirhut and Behar. The annual rainfall is in general IJCIDW 5D inches : in the districts of Table 10, it is above 5D inches.

	Xnrth iirtlu- lf;tiiB.-s ITirlmt).						Soinh nl' tlu• UauKi-s (l!ili;u).				
	I'liaJii-li-.ir.ui.	Saran	.Mnzuir-iTiuir.	7)ar-bhauga.	Xnrth Di.Mllll-ghyr.	Xnrth nrillla S!-alimr.	Slialia-Ir.lii.	I'atna	.aya.	Smith iirMmi-Rhyr.	Smith ..fUliiig-aliiur.
(a) wild spp.											
5. *rrnzeri*	X	..	..	..	..	..	..	..	..	..	..
120. *glabra*	..	..	..	..	..	X	..	..	..	..	..
142. *pubera*	..	..	..	..	X	..	..	..	..	..	..
51. *tomsntosa*	..	..	..	..	..	..	X	..	..	..	..
71. *Mspida*	..	..	..	..	..	..	..	..	..	X	..
113. *llamiltonii*	..	..	..	..	..	..	..	..	..	X	..
G2. *pentaphylla*	..	..	..	..	..	..	..	..	X	X	..
47. birfbi/ern (1)	X	..	..	X	..	..	*X*	..	..	X	..
(b) cultivated spp.											
3B. *escuhnta*	X	X	*X*	X	X	X	X	X	*X*	X	**X**
114. *alata*	X	X	X	X	X	X	X	X	X	X	X
Total no. will	**2**	U	**1)**	1	1	1	2	**D**	1	4	I)

(0 *D butbifera* has been ohservel in cultivation in the District ot Shaliiliatl, whcri;-.ilsu it is wilil.

TABLE ID. The genus in the Lower Gangetic Plains where the annual rainfall exceeds 5D inches, district by district, from the north-west to the south-east.

	Nnitk Lcngiil.									Wrat Ei'iigal.						Central Bi'ngal.							Bast Bengal.				
	ne I. S L,	H be Jjerla u	s 5	3 &E 1 5 l-s	Ran(:p u	Bogra.	P 3	is SH	Malda.	airlJhuS a	e is urdJs =	B id	au ll. a	a h.	fi:5 jut.	M rsld(3	•3 ^5	24-Parganas.	•5*	. sorr.	Khulna.	1 m	1 i	Dacca.	Hip 8 H	U. 0 >5	ylhet K
(a) wild .pp.																											
1D3. *Wallivhii* ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X
61. *tomentosa* ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..
IIS. *btfophutta* ..	..	X	..		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
119. *lepcharum* ..	..	X	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5. *Prazeri* ..	..	X	..		..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
112. *Hamiltonii* . •	..	X	..	X	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	X	..	..	..	..
71. *hispitla* ..	..	X	..	X	X	..	..	..	X	..	..	..	X	..	X	..	..	..	..	..	..	..	..	..	..	..	X
142. *pubera* ..		X	..	X	..	..	..	..	X	X	..	..	..	X	..	..	..	X	..	..	..	..	..	X	..	..	X
12D. *glubm* ..	..	X	X	X	..	X	X	..	X	X	X	X	X	X	..	X	..	X	..	..	X	X	X	X	..	..	X
Bl. *pGiitaphyila* \l).	X	X	X	X	X	X		X	X	X	X		X	X	X	*X*	..		..	..	..	..	X	X	..	X	X
47. *bulbifern* (2)	X		X	X	X	X	..	X		X	X	X	X	X	X	X	..	A"	X	..	..	..	..		..	..	X
(4) cullivalsd spp.		X							X															X			
3D. *cscuknta* (3)	X	..	X	**A'**	X	X	..	..	..	X	X	X	X	X	X	..	..	X	..	..	..	..	X	..	..	..	X
114. *alata* ..	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Tutal nil. wild	3		**3**	10	•i	3	2	**2**	li	4	;i	3	4	4	4		1)	4	1	J	*I*	**1**	3	-	IJ	**1**	1;
		X							X															X			

(2) /). *pentiipliijHa,* has bi^L'u si'f.u in cultivntimi in tin- Distrids *nl* I'aluia, Biililmm, Hankura ami Murslmlnhail : also in the iSniital rci-uiinihs

(2) *B. bulbifera* is fumul in cultivati m in thi' Districts nl[1] 1'urnrali anil 1'ariilpur.

[3) B. esailenta has IJITII 1'HUIL1 wilJ in tin; District i>l' .Talpai^nri.

TABLE 11. The genus along the North-western Himalaya from west to east, the species found at the greatest altitudes in the upper lines Df the table.

	W	R	Chit rill.	[illegible]	[illegible]	Kashmir (valel.	[illegible]	[illegible]	[illegible]	[illegible]	Simla Hill States.	[illegible]	British Garhwal.	Naini Tal.	[illegible]	[illegible]	Central Nepal.	
la) wild app.																		
4 deltmiea	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	AscBnds to 3D5D m.
6. melanophyma	..	..	..	..	..	x	..	x	x	x	x	x	x	..	x	..	x	21DI) m.
47. bulbifera (1)	..	..	..	..	..	..	..	x	..	..	x	x	x	X	X	..	x	1800 m.
57. kumaonensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	x	1900 in.
B2. pentaphylla	..	..	..	..	..	..	..	..	..	..	x	x	X	X	x	x	x	16B0m.
118. belophylfo P) ..	..	..	..	..	..	X	X	X	X	..	x	x	..	..	x	x	x	1300 m.
6. Prazeri	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	lDDDm
71. hiipida	..	..	..	..	..	..	..	..	..	..	X	X	X	..	X	..	x	mm.
120. slaira	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	In fDDt-hills.
142. pubera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	In foot-hilla.
(b) cultivated app.																		
114. alula (3)	..	..	..	..	..	..	..	..	X	..	x	X	..	X	..	..	x	Ascends to 1DDD m.
	1	1	1	1	1	3	B2	4	3	2	8	5	5	4	7	2	ID	

(1) D bulbiftrais cultivated as well as will at thB foot DfthB Himalaya in thB Districts of Almora and Naini Tal.

(2) D bilophylla which is iBcarilcd here as having its western limit in Kashmir, is fDuni yet a little further west on thslillaapur of the Salt Range In tho District ot Jhelum. at an altitudB which is probably 1DD0 m.

(3) D alala his beon found in a will cDDdition in thB bhabur or sub-Himalayan tract of the District ol Naini Tal.

TABLE 12. The genus along the Eastern Himalaya from west to east, the species found at the greatest altitudes in the upper lines of the table.

	Central Nepal.	Eastern Nepal.	Darjeeling District.	Sikkim State.	Bhutan	Duphla Hilh.	Abm Hills.	Mishmi Hills.	
(a) will ipp.									
4. deltoidea	x	..	..	..	..	..	..	..	..
56. mdanaphyma	x	..	..	..	..	..	..	..	..
57. kamomtmii	x	..	x	x	..	..	..	..	Ascends tD lH60m.
47. bulbijera, (1)	x	..	X	x	x	..	x	..	15DD m.
62. pentttphyUa	x	x	x	x	x	..	x	x	15D0 m.
118. bdophylla	x	..	x	x	..	..	..	..	15DD m.
5. Prazeri	x	..	x	x	x	..	x	..	1400 m.
9. Wattii	..	..	x	..	..	..	x	..	1150 m.
12D. glabra	x	..	x	..	..	..	x	..	1D50 m.
119. lepchamm	..	..	x	..	..	..	x	..	9DDm.
142. juiwri	x	..	x	x	x	..	..	..	90Dm.
113. ffomitonii	..	..	x	..	..	..	..	..	750 m.
71. hiipida	x	..	x	x	x	..	..	..	BOO m.
143. iirteri	..	..	..	..	..	x	..	..	..
(b) cultivatid ipp.									
35. iicidinta	..	..	x	..	..	..	..	..	BDDm.
ni aZo/a 12)	x	x	x	x	..	..	x	..	277D m.
Total no. wild ..	1J	1	12	7	5	1	6	1	

(1) D. bulbifera is .ultivatBd to some eitsnt in thB District of Darkling and doubtless also in the State of Sikkim.

(2) D. alata is reported to occur at a very unexpected elevation in the District of Darjeeling, SBB ths Cgmments Dn p. 312.

TABLE 13. The genus in the Provinces of Japan, which lie to the north of Lat. 36° N. arranged from north to south \1).

	nokkniiD.					NDrthorn Nippon.													
	Isi ari.	Kushiro.	Iburi.	Shiribeshi.	Oshima.	Mutsu.	1 u.	U o.	Uzen.	Echiga.	Iwashira.	Hitachi.	Shimotsuke.	Ivutsuke.	1 a 5 w	Etchu.	Kaga.	Hida.	tiki islands.
fa) wild spp.																			
7. *septemloba* ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	X	..	..	..
18. *tenuipes* ..	..	..	..	..	..	..	..	..	..	..	..	..	X	X	..	..	..	..	..
21. *quinqueloba* ..	..	..	..	..	..	..	..	..	..	X	..	..	X	..	..	..	X	..	X
31. *japonica* ..	..	..	..	..	..	X	..	X	..	X	..	..	X	..	X	..	..	..	X
1!). *tokora*	..	X	X	..	X	X	..	X	X	..	X	X	X	..	X	..	..	X	X
14. *qrarillima* ..	X	..	..	..	..	..	..	..	X	..	..	..	X	..	..	..	..	..	..
27. *nipponica* ..	X	..	..	X	..	..	X	..	X	X	..	X	X	X	X	..	..	..	..
|b) cultivatsd spp.																			
47. *bulhifera* \2) ..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	7
£!). *opposite*	X	X	..	X	X	X	X	X	..	..	..	..	X	..	X	..	..	..	..
Total no. wild ..	3	2	1	2	2	3	2	3	3	3	1	2	8	2	5	1	1	l	3 Dr 4

\|J) There ar3 no records for the five Provinces of Hokkaido which are not named here, nor for the Provinces in Nippon of Rikuzeu, Iwaki and >'oto.

\2) *D. bulbijera* at ibs northern limits seems to occur only as a cultivated plant.

TABLE 14. The genus in the Provinces of Japan, which lie to the south of Lat. 36° N., arranged from east tD west \1).

	Southern part of Xippon.											Shikoku.	Kiushiu.							
	g usaslii.	Sagami.	Suiruga.	o wari.	Ise.	1 C sl	ii.	Izumo.	H	Hagi.	Na 1	Huaa.	Chikuzen.	Hizcn.	Bungo.	Higo.	Hyuga.	Satsuma.	Hizen Shima.	Goto Islands.
|a) wild spp.																				
7. *septemloba*	X	X	X	..	..	..	..	..	..	..	X	X	..	..	X	..	..	..	..	..
IS. *triiuipei* ..	X	X	X	..	..	..	..	..	..	X	..	X	..	X	..	..	X	..	..	..
21. *quinqudoba*	X	..	..	..	..	..	X	..	..	..	X	X	X	X	..	X	..	..	..	..
1)1. *japonicn* ..	X	X	X	..	..	..	..	..	X	..	..	X	..	X	..	X	..	X	X	..
1!). *Ittkoro* ..	X	X	X	..	X	X	..	X	..	..	X	X	X	X	X	..	..	X	X	X
14. *ijracUlima,* ..	..	..	X	X	..	..	X	..	..	..	..	X	..	X	..	..	..	..	..	..
11. *iiipponica* ..	X	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13. *asrlepititlea*	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..
|b) cultivated spp.																				
47. *bulbifera* \2)	..	X	..	..	..	..	..	..	..	..	..	X	..	X	..	..	..	..	..	..
8;). *opposiUl*	X	X	..	..	..	..	..	..	..	..	..	X	..	X	..	..	..	..	..	..
Total no. wild	7	li	li	1	1	1	2	1	1	1	3	8	2	8	!	2	1	2	2	1

ID The record Df distribution in Japan is extremely impeirecb anil there are UD records for the following Provinn™ •__ii" v- Shimi i Kazuka, Awa, Izu, Kai, Totomi, .Mikawa, Mino, Shima, Dini, Wakasi, YamotD, Kawachi, Setsu, Tajima, Inaba Hāriin! MV. 11JPDn, llizcn,"Biteliu, HDki, Izumo, BingD, Aki, Iwami, and Suo ; \|in Sikoku) Sanuki, Awa, and Ujo ; \|iu Kiushiu) Buzeu, Chikigo'and Oumi iasaka,

\2) *B. bulbiftra* seems tD occur in an uniDubtedly wild state in the island Df Kiushiu.

TABLE 15. The gonus from Japan to Formosa, along the Liu-kiu islands.

	Jiljlilil.		Liu-kiu islands.					
	Hok-kaido.	Nippon mid Kiu.shiu.	Tanega shima.	Yaku-shima.	Dshima.	Oki-nawa.	Yayp-yama k IriD-moto.	Formosa
|a) wild spp.								
27. *nipjivniza* ..	X	X	..	..	..	..	..	..
14. *gracillima* ..	X	X	..	..	..	..	..	..
10. *tnlcoro* 17) ..	X	X	..	X	..	..	..	..
91. *japonica* ..	..	X	X	X	X	X	..	X
21. *quinqudoba* ..	..	X	X	..	..	..	..	..
47. *Inilbifera* \2) ..	..	X	..	X	X	X	X	X
18. *tmuip&s* ..	..	X	..	X	..	..	..	..
15. *asdepiadea* ..	..	X	..	..	..	..	..	..
14a. *Zi'Jitaroana* ..	..	..	..	..	X	..	..	..
[J2. *p&ntaphylla* ..	..	..	..	..	..	X	..	..
II) D. *cirrhosa*	..	..	..	..	..	..	X	X
VI. *ColMii*	..	..	..	..	..	..	..	X
13. *hypogluuca* ..	..	..	..	..	..	..	..	X
87. *doryphora* ..	..	..	..	..	..	..	..	X
93. *Bmthamii* ..	..	..	..	..	..	..	..	X
112. *parsimilis* ..	..	..	..	..	..	..	..	X
71. *hispida*	..	..	..	..	..	..	..	X
|b) cultivated spp. (3)								
Total nu. wild ..	3	8	2	5	3	3	2	9

\1) *D. talc ro* lms bi'i-n ri'conli'd as FoirnDsun, but almost ncrtainly in error.

\2) *D. hvlbifera* ia tultivuti-il lit iis nurthurn limit.

\3) *D.oppixilu* is ciiltivatirl, appurcntly all ilown thn Liu-kiu Islands anil in rnril, ... cultivalrJ from the soulh almost *to* southern Japan. *D.* ^*uhnta* is Wn tA ... nDWntD havD bken cultivated in the Liu-kiu Islanil.s, but thn luutility ia not ITLOFIIIMI.

TABLE lli. ThB g.nus from the Amurland to thB Island of QuBlpart at thB South of Corea \1).

	Ussuri.	Priamur.	Manchuria.	Kirin.	[illegible]	[illegible]	[illegible]	Hwang-hai-da.	[illegible]	[illegible]	Chhing-cheng-da	Kyeng-sang-da.	Chel-la-da.	Quulpart.
|a) wild spp.														
27. *nippoiiica* ..	X	X	X	X	X	X	X	..	X	..	..	X	..	X
91. *japonica* ..	..	..	..	..	X	..	..	..	..	..	..	..	..	X
6. *coreana* ..	..	..	..	..	..	..	..	..	X	X	..	..	..	..
89. *opposita* |2) ..	..	..	..	..	..	..	..	..	..	X	..	..	..	X
19. *tokoro* ..	..	..	..	..	..	..	..	..	..	..	..	..	..	X
21. *quinquelobа* ..	..	..	..	..	..	..	..	..	..	..	..	..	..	X
|b) cultivated sp.														
8U. *opposita* |2) ..														
Total no. wild ..	1	1	1	1	2	1	1	D	2	2	0	1	0	5

\|j) All the Provinces Df CoiDa liavu bEBn named : the reader may be told that inniciuute expbration appears tu explain tlic scanty records for thum.

\|Z) *D. oppaBita* is cultivated in Corca, probably in many parts.

TABLE 17. The genus in f'athay, the spucies placed in order SD that the more northern :iB first and the muri: southorn List.

	Ho-pei.	Shan-si.	Sze-chuan.	Shen-si.	Kan-su.	Shan-tung.	Ho-nan.	Kiang-su.	Ngan-hwei.	Hu-peh.	Hii-nan.	Kiang-si.	[illegible]	[illegible]
(a) wild spp.														
27. *nipponica*	X	X	X	X	X	X	..	..	X	X	••	..	X	X
21. *quinqueloba*	X	..	..	..	..	..	..	..	..	..	••	..	..	..
83. *opposita* (1)		..	X	X	X	X	X	X	X	X	X	X	X	X
87. *doryphora*	..	..	..	..	..	..	..	..	..	X	••	X	..	..
12. *Collettii* (2)	..	..	..	..	X	..	..	..	..	..	••	..	X	X
91. *japonica*.	..	..	..	..	X	..	X	..	X	X	••	X	X	X
88. *Potanini*	..	..	..	..	..	..	X	..	..	X	••	..	..	..
23. *futschauensis* (3)	..	..	..	..	..	..	X	..	..	..	••	..	..	..
47. *bulbifera*	..	..	..	..	..	..	..	X	X	X	••	X	X	X
19. *tokoro* (4)	..	..	..	..	..	..	..	X	..	..	ll	..	X	..
8. *zingiberensis*	..	..	..	..	..	..	..	..	..	X	..	X	..	X
17. *enneaneura*	..	..	..	..	..	..	..	..	..	X	..	..	X	..
57. *kamoonensis* (5)	..	..	..	..	..	..	..	..	..	X	..	..	..	..
90. *lineari-cordata* (6)	..	..	..	..	..	..	..	..	..	..	..	X	..	..
13. *hypoglauca*	..	..	..	..	..	..	..	..	..	..	..	X	X	X
14. *gracillima*	..	..	..	..	..	..	..	..	..	..	..	..	X	..
11. *#imi*	..	..	..	..	..	..	..	..	..	..	..	..	X	X
HID. *cirrhosa*	..	..	..	..	..	..	..	..	..	..	..	..	X	X
(b) cultivated spp.														
89. *opposita*	Z	..	..	..	..	..	..	X	..	..	..	X	..	X
114. *alata* (7)	..	..	..	..	..	..	..	..	..	..	..	X	..	X
Total no. wild	3	3	2	2	4	2	4	3	4	9	1	7	12	D

(1) *D. opposita* is known to *be* cultivati-d in tho Provinces of Ho-pei, Kiang-su, Kiivug-ai anil Fu-kii-n, unil is possibly cultivated in all.

(2) *D. Collettii* only just rntnra Kan-su from tho aouth.

(3) *D. futschauensis* is known from Ho-nan in leafy specimens only and is therefore somewhat doubtful.

(4) *D. tokoro* is reported from two Provinces of China, but no authenticating specimens huve been seer..

(5) *D. kamoonensis* enters Hu-peh from the weat.

(6) *D. lineari-cordata* is doubtful in the Province uf Kiang-si.

(7) *D. alata* is iloubtful in the Province of Kiung-si.

TABLE 18. The genus in South-West China, the Provinces divided roughly into parts and these arranged from the most mountainous to the warmest parts.

	…chuan …ards …	Yun-nan t… …ibet.	… Yun…	…uan.	…	…	…uan.	Kwei-…	…	…	…
(a) wild spp.											
4. *ddloidea* ..	X	X	..	..	..	..	..	..	..	..	..
27. *nipponica* ..	..	..	..	..	X	X	..	..	..	..	..
12. *Colkttii* ..	..	X	X	..	X	X	X	..	..	..	..
13. *hypoglauca* ..	..	..	..	..	..	..	X	X	X	X	X
91. *japonica* ..	..	..	..	..	X	..	X	..	..	..	..
87. *doryphora* ..	..	..	..	..	..	..	X	X	..	..	..
88. *Potanini* ..	..	..	X	..	X	..	..	X	..	..	..
5fi. *mdanophyma* ..	..	..	X	..	X	..	..	..	..	..	..
57. *lcamoonznsis* ..	..	..	X	..	X	X	X	X	X	X	X
8. *zingibzrmsis* ..	..	..	X	X	X	..	..	X	X	X	..
9. *panthaica* ..	..	..	X	..	X	X	..	..	..	..	..
41. *Hemshyi* ..	..	..	X	..	X	..	..	..	X	X	..
22. *althaeoides* ..	..	..	X	..	..	..	..	X	X	X	..
82. *bicolor* ..	..	..	X	..	..	..	..	..	X	..	..
83. *aspersa* ..	..	..	..	..	..	..	..	..	X	..	..
ID. *biszrialis* ..	..	..	..	..	..	..	..	X	..	X	..
49. *yunnamnsis* ..	..	..	X	..	..	..	..	..	X	..	..
43. ra&enj ..	..	..	X	..	..	..	..	..	..	X	..
42. sii&cafoa ..	..	..	X	..	X	..	..	..	X	X	X
45. *Martini* ..	..	..	X	..	..	..	..	..	X	..	..
46. *velutipes* ..	..	..	..	..	..	..	..	X	..	..	..
47. *bulbifera* ..	..	..	X	..	X	..	X	..	X	..	..
71. *hispida* ..	..	..	..	..	..	..	..	X	X	X	X
52. *pentaphylla* ..	..	..	..	..	..	..	..	..	..	..	X
11. *persimilis* ..	..	..	..	..	..	m	..	..	..	..	X
12D. pJa&m ..	..	..	..	..	..	..	..	X	..	..	X
141. *dzcipitns* ..	..	..	..	..	..	..	..	..	..	..	X
								..	..	..	X
(t) cultivated spp.											
B9. *oppusita* |2) ..	..	..	X	..	X	*X*	X	*X*	..	X	..
114. a ^ a |3) ..	..	..	*X*	..	X	..	..	..	*X*	..	..
Total nD. wild ..	1	2	**15**	1	11	3	6	11	**14**	9	9

\|1) It is necessary to explain how we have divided the Provinces of Sze-chuan and Yun-nan for th• table. Culumns 1 and 2 indicate the species which occur in the parts on the Tibetan edge where thD deac… thia cut enormous gorg. s : some phytogeographers add these parts to Eastern Tibet. Column 3 indicates the … Delttvay, FDrr, st and others in thi- mountainous but less intensely rugged western parts of Yun-nan towards th… of Burma. Dulumn -1 Indicates thnan which havn boen fouml in the adjacent parts of Sze-chuan Column … spnciis su far found in that characteristic belt of Central Sze-chuan between long. 1 D3° and 11)8°E wherein I;, … Cheng-tu—a brlt explor. d by several collectors and particularly by Mr. F. T. Wang. Columns G and 7 … of further to the Bast, in broken country traversed by the Yang tse kiàng. Column S indicates the species found in … of Kwei-chuw. Columns !) and 1 D tliose found In the bordering parts of Yunnan, no. U in the country with Yun … centre and no. ID with Meng-tzi; as Its cent™. Lastly column 11 indicates the apecies found around Sze m… Yun-nan wliich bulges towards the Shan plateau. The area Df Szu-chuan and Yun-nan is so great that botanical … has only touched it in patches. …ation

\|2) The cultivation of *D. opposita* in Kwei-chow is recorded.

\|3) *D. alata* is said to occur in a wild condition in three localities.

TABLE 19. The genus from Formosa to Anam, omitting such details regarding the Provinces Df Tonkin and Anam as are in the next table.

|a) wild spp.									
19.	*tokoro*	1)	..	..	?	..	..	..	..	..	..
12.	*Colhttii*		..	..	X	..	..	..	..	..	..
13.	*hypoglauca*		..	..	X	..	..	..	..	..	..
87.	*doryphora*		..	..	X	..	X	..	..	..	..
91.	*japonica*		..	..	X	..	X	..	..	..	..
90.	*lineari-cordata*		..	..	..	..	X	X	..	..	..
15.	*Chingii*		..	..	..	..	..	X	..	..	..
57.	*kamoonensis*		..	..	..	..	..	X	..	..	..
41.	*H&msl&yi*		..	..	..	..	..	X	..	..	..
93.	*Benthamii*		..	..	X	X	X	..	..	..	..
57.	*Esquirolii*		..	..	..	..	..	X	..	..	..
70.	*Scortechinii*		..	..	..	..	..	X	X	X	X
36a.	*simulans*		..	..	..	..	..	X	..	..	..
1D8.	*Fordii*		..	..	..	X	X	..	X	..	..
lD7a.	*hainanensis*		..	..	..	..	..	..	X	..	..
10D.	*cirrhosa*		..	..	X	X	X	X	X	X	X
112.	*persimilis*		..	..	X	X	X	X	X	X	X
120.	*glabra*		..	..	..	..	..	X	..	..	..
47.	*bulbifera*		..	..	X	X	X	X	X	X	X
62.	*pentaphylla*		..	..	..	..	X	..	X	X	X
71.	*hispida*		..	..	X	X	X	..	X	..	X
125.	*nummularia*		..	..	..	..	..	..	X	..	..
38a.	*Petelotii*		..	..	..	..	..	..	..	X	..
4.	*deltoidea*		..	..	..	..	..	..	..	X	..
80.	*pzperoides*		..	..	..	..	..	..	..	X	..
1D2.	*Bonii*		..	..	..	..	..	..	..	X	..
1D1.	*intempestiva*		..	..	..	..	..	..		..	X
5a.	*Poilanei*		..	..	..	..	..	..	..	..	X
35b.	*dissimulans*		..	..	..	..	..	..	..	..	y
34.	*paradoxa*		..	..	..	..	..	..	..	..	X
53.	*arachidna*		..	..	..	..	..	..	..	..	X
BO.	*Pierrei*		..	..	..	..	..	..	..	..	X
105.	*brevipetiolata*		..	..	..	..	..	..	..	..	X
107.	*kratica*		..	..	..	..	..	..	..	..	X
144.	*polyclades*		..	..	..	..	..	..	..	..	X
55.	*Craibiana*		..	..	..	..	..	. .	..	. .	X
|b) cultivatsd ipp.									
92.	*Owenii*		..	..	..	..	..	..	X	..	..
89.	*opposita*	2)	..	..	*X*	X	X	..	..	..	..
33.	*esculent a*		..	..	X	..	..	..	..	..	X
114.	*alata*	3)	..	..	*X*	..	X	..	X	*X*	X
	Total no. wild		..	..	**11**	**6**	**10**	**11**	**9**	**10**	**lii**

|1) *D. tokoro* is said to occur in Formosa, but the statement seems doubtful.

|2) *D, apposita* seema to persist from cultivation in Formosa and in South-eastern China.

|3) *D. alata is* rcpDrbed to run wild in Formosa aud Tonkin,

TABLE 2D. Ths genus in the Provincss of Tonkin and Anam, from north to south. The Provinces are as delimited in Brenier's Atlas Statistique, 1914 |1).

	TDiikin.													Anam.						
	Lao -kay.	3rd Milit. T.	Lang-son.	San-la.	Thai-nguyen.	B. kang.	Sun-tay.	Ha-dong.	Hai-dunug.	Hung-yen.	Hanoi.	Ba-ninh.	Ninh-binh.	Thanh-hoa.	Quang-tri.	Thua-thien.	Thuau-ao.	Cuang-nam.	Nh -trang.	Binh-thuan.
How rain falls.	Ab. Apr.-Sept.	,,	,,	,,	,,	Plentiful rain.	,,	,,	,,	,,	,,	,,	,,	Peak in ...	Autumn rain all.	,,	:	=	Plentiful rain.	Ab. rain.
|a) wild spp.																				
57. kamixnirnsis	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
41. llemsUyi	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
38a. retelotii	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Its. Chhwi{2)	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4. drltoidea	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1DD. ciTrhnsa	X	..	..	..	X	..	X	..	..	X	..	..	..	..	..	X	..	..	..	..
47. bitlbifera	X	..	X	..	..	..	..	..	X	X	X	X	..	..	X	..	..	..	X	X
112. peraimilis	X	..	..	..	..	X	X	X	..	X	X	..	X	X	..	..	..	..	..	..
120. fftabrn	X	..	X	..	..	..	..	..	..	X	..	..	..	..	..	X	..	..	X	X
ii2. penttiphylla	..	..	X	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	X
70. Scortechinii	..	..	..	..	..	..	X	..	..	..	..	..	..	X	..	..	..	..	..	..
80. peperoides	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..
1112. Jftwiii	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..
101. intempestiva	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	X
5a. Poilanei	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..
71. hispida	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	X
36b. dissimulans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..
34. paradoxa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	X
511. arttrhitlna	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	X
61). I'ierrei	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..
105. brevipetiolata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	X
11)7. kratirti	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..
144. poli/rlades	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..
55. Craibiana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X
|b) cultivated spp.																				
36. esculenta (3)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	X
114. aJain																				
Total no. wiltl	7	1	3	1	1	1	3	1	1	5	4	1	1	2	4	4	D	1	8	9

|1) This table oimtains thi; names nf but little more than half the I'rDvincL's : there arc no records for those which arc not named in it. The new iirnvinre of llsiut Dinni is nut eppnTiiteil from that uf Binh-thuan.
|2) J). Vhiiiuii. The Incality fur this in Tnnkin WIIB unt pri'rimiy rccurded.
l.'j) D. esa'lenta has limn fnunil wild in the l'mvince nf Binh-thuan.
|4) I), alula is probably cultivated in every m-uvince.

TABLE 21. The genus in North-eastern India, in the parts where *Finns* occurs on the mountains.

	Brahmajiutra Valley.						Khaai-Naga Hills.					N. Burma.		
	[Joal-para.	Kam-rui).	Now-gong.	Dar-rang.	Sib-sagar.	Lakhim imr.	Gara Hills.	Khasia Hills.	Jaintfa HillK.	Cachar.	Naga Hills.	Mani-I>ur.	Hkamti-Sinjsplm Puuutry	Myit-kyina.
|a) wild spp.														
91. *japonica*	..	..	..	..	..	..	..	..	..	..	X	..	..	..
55. *melanophyma*	..	..	..	..	..	..	..	X	..	..	..	..	..	..
57. *kamaonensis*	..	..	..	..	..	..	..	..	..	..	X	..	X	..
28. *birmanica*	..	..	..	..	..	..	..	..	..	..	..	..	X	..
53. *arachidna*	..	..	X	..	..	..	..	X	..	..	..	..	..	..
5. *Prazeri*	..	..	..	..	..	..	..	..	..	..	X	..	..	..
13D. *trinervia*	..	..	X	..	..	..	..	X	..	X	..	..	..	..
118. *belophylla*	..	..	..	..	..	..	..	X	..	..	..	..	..	..
143. *Listen`*	..	..	..	..	X	..	..	..	..	X	..	..	..	..
142. *pubera*	X	..	X	X	X	X	X	X	..	X	..	..	..	..
141. *decipiens*	..	..	..	..	..	..	..	..	..	..	X	..	..	..
1D3. *Wallichii*	..	..	..	..	..	X	..	X	..	X	..	X	..	X
113. *hpcharum*	..	..	X	..	..	X	..	..	..	..	..	..	..	..
99. *Wattii*	..	..	X	..	X	X	..	X	..	..	X	..	..	..
71. *hispida*	..	..	..	..	..	X	..	X	..	..	..	..	..	X
121). *glabra*	X	..	X	X	X	X	..	X	..	..	..	..	..	..
113. *Humiltonii*	X	X	X	X	X	..	..	X	..	..	X	..	..	..
47. *bulb if era \1)*	X	X	X	..	..	X	..	*X*	X	X	X	..	..	X
B2. *pentaphytla* |2). .	X	X	X	*X*	X	X	X	X	X	X	X	..	..	..
|b) cultivated spp.														
36. *Boculsnta*	X	..	X	X	X	X	X	X	..	..	..	..	..	..
114. *alata* |3)	X	X	X	X	X	X	X	X	X	X	X	..	X	*X*
TDtul nD. wild.	5	3	9	4	B	8	2	12	0	8	7	1	2	4

(1) *D. Imlbifem* is euitivatcd in the Khasin Hiils ami alsD plentiful ivilil.
12) *D. pentnphiilla* is cultivateil in the Darning District, as well as wild.
|J) *D. alata* has been found in a inure or less will! state in the District of Myitkyina.

TABLE 22. The genus in the Districts of Northern and Dry Central Burma, from north to south |1).

	N. Uiirma.									Dry Central Burma.												
	Mr pur.	akamtl· mcoho · uctry.	Myitkyina.	Upper Chi lwia.	Gin Bll .	Pakokku Chin Hills.	Bl 1.	Katha.	Ruby Mines.	K c n	Shwelo	Lower Chinc	Sagai It	Kyauk.	Myingyan.	Pakokku.	a ia u.	Th vetmyp.	se.	Magwe.	Yam thin.	Mdktila.
(a) wild spp.																						
57. *fcamnonensiB*	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
119. ***lepcharum***	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
113. ***Hamiltonii***	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
142. ***pubera***	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25. ***membranacea***	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5. *Prnzeri*	..	..	..	X	..	..	X	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1?() *alabra*	..	..	..	..	..	..	X	X	..	..	X	..	..	..	..	..	X	..	X	..	..	..
11)3. ***Wailichii***	X	..	X	..	..	..	X	..	..	..	..	..	..	..	..	..	..	X	X	..	..	..
28. ***birmtiniza***	..	X	..	..	..	X	X	X	..	..	..	..	..	..	..	..	X	X	X	..	..	..
141. ***ilecipiens***	..	..	..	X	X	X	X	X	..	..	X	X	..	X	X	X	X	..	X	X	X	X
B2. ***jtmtaphylla***	..	..	..	X	X	..	X	X	..	..	..	..	..	..	..	X	X	X	X	X	..	..
47. ***bulbifpra* |2)**	..	..	X	X	X	X	X	X	..	X	..	X	X	X	..	X	X	X	X	X	X	..
71. ***hispida***	..	..	X	X	X	X	..	..	..	X	X	X	..	X	..	..	X	X	X	X	X	X
\b) cullivatal spp.																X						
3 5. *escuknta* (3)	..	..	..	X	X	X	X	X	X	X	X	..	..	X	X		..	..	X K	..	..	..
114. (ifafa (4)	..	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Total nD. wild ..	1	3	4	5	4	5	11	7	1	2	4	3	1	3	3	X 5 X	7	B	*a*	5	4	3

II) EvLTy district of Dry Ci'ntral Burma, with thn cicnptiDn Df Sagaing, nxti'nds back from the ci>ntr> Df tin' valli^y tD hilly country, tliDsc Df Maniialay and Kyauksf I'vi'n Dn tQ *Win* Shan Plati'au. Tin: uplands of tin- Mamlalay District mnstituti- tin' MaymyD Riilidivision and we have traiisfiTird thrm ID Talili' 24: anil in that TaLln wi: haviMiicluilud also thr Districts of the llnliy Mini's and Kyauksc. TIIB [>ani!aw yallry which is tlm ci'ntri'. of the l'akokkv. Uhin Hills wi- have ditachi'd from the 1'akDkku District. But aa rcuanls most of thr Districts Df Dry Dentral Burma it has not IJIXII pDssibk' to detach thiir diinipL-r hilly parts from thiii drier plaius. Unfortunately thi'. alisL'nri' Df DiDscorcas in tin' plains caiiimt be madr vi'ry itviilcnt.

|2) *D. bnlbifsra* has bicn found in cultivation in tin: Districts cf Kj'auksr, PakDkku ani Magwc.

[A) I), etrulmtu has biin found in a wild condition on Mount Fopa in thu District of Myingyau.

14) *1). alata* ia said tD run wild on tilt samu mDuntain.

TABLE 23. The g3nus in Dhittagong, Arakan and Lower Burma, district by district, from north tD south (1).

	Chittagang-Arakan.							**Lower** Burma.									
	Chittagang.	Lushai Hills.	Chittagang Hill Tracts.	Akyab.	N. Arakan.	Kyaukpyu.	is ay.	Bassoin.	Myaungmya.	Pya on.	Maubin.	Henzada.	Tharrawaddy.	Pegu.	Hanthawaddy.	Toungu.	Salween.
|a) wild spp.																	
139. *trinervia* ..	X	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..
142. *pubera* ..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
113. *Hamiltonii* ..	X	..	X	X	K	..	..	..	..	..	..	..	..	..	..	..	..
141. *devipiens* ..	..	..	..	..	X	..	..	..	..	..	..	..	..	X	..	X	..
12D. *glabra* ..	X	X	X	X	X	..	..	*X*	..	..	..	..	..	X	X	..	..
1D3. *Wallichii* ..	X	..	X	X	X	X	X	..	..	..	..	..	X	X	X	..	X
B2. *pentaphylla* |2) ..	X	X	X	X	X	..	..	..	*X*	..	..	..	..	X	..	..	X
47. *btdbifera,* |3)	X	X	X	X	..	..	..	..	..	..	..	..	*X*	*X*	X	..	X
6. ***hispida*** ..	..	..	..	..	..	..	..	..	..	..	..	..	*X*	*X*	X	X	" "
28. ***birmanica*** ..	..	..	..	..	..	..	..	..	X	..	..	X	..	*X*	X	X	..
|b) cultivated spp.																	
36. escuZenia ..	X	..	..	..	..	X	..	..	..	..	..	..	*X*	*X*	..	X	X
114. aiato	X	X	X	X	X	X	X	*X*	X	X	X	X	X	X	X	X	X
TDtalno. wild ..	7	3	**5**	5	5	1	2	l	2	*0*	D	1	**3**	**7**	**5**	**3**	2

II) It has nni been passible to include *D. Brandisiiin* this Table, as it is nut known from what part of Burma it came.
|2) *1). pentafhylla* has been found in cultivation in the District of Myaungmya.
13) *D. bulbiferu* has beeD observed in cultivation iu tin: Districts of Akyab, Tharrawaddy and Pegu.

Table 24. The genus through the mountainous country between Burma and Tonkin, from west to east (1).

	Shan Plateau.																			Siam & Laos.				
	Ruby Mines.	Maymyo.	Kyaukse.	Mongmit.	North Hsenwi.	Hsi-paw.	Lawksawk.	Mongkung.	Yengan.	Pwe-hla.	Hsa-mongkham.	Lai hka.	Yawng hwe.	Ho-pong and Naungwarun.	Nam hkok.	Wan-yen.	Hsa-htung.	Kengtung.	Mongpan.	Payap Circle.	Luang Prabang.	Sam Neua.	Tran-ninh.	Vien-tiane.
(a) wild spp.																								
57. kamoonsnau (2) ..	×	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..	..	×	..
41. Hemsleyi ..	..	..	..	..	..	..	..	..	..	×	..	..	×	..	..	..	..	..	..	..	..	..	..	..
12. Collettii (3) ..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5. Prazeri ..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
53. arachidna ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
51. Kerrii ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
1DD. cirrkoaa ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	×	..
101. inUmpgrtiva ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	×
112. puaimilis ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..
113. HamiUmii (4) ..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..	..	×	..
44. pseudo-nitena ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
24. tentaculigem ..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..	..	..	..
4B. velulipes ..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..	..	..	..
28. birmaniza ..	..	×	..	..	×	×	..	×	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
141. dtxipiens ..	..	×	×	..	×	×	..	..	..	..	..	..	×	..	×	..	..	..	..	×	×	..	..	..
1D3. WaUichii ..	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12D. glabra ..	..	..	..	..	×	×	..	..	..	×	..	..	..	..	..	..	..	..	..	×	×	..	..	..
71. hispida ..	..	×	×	..	..	..	..	..	..	..	..	..	×	×	×	×	..	..	..	×	×	..	..	..
B2. pentaphylla	..	×	..	..	×	×	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..	×	..	..
47. bulbifera (5) ..	..	×	×	..	×	×	..	..	..	..	..	..	×	×	×	×	×	×	..	×	×	..	..	×
31a. barreltii ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
2B. 7nembranacea ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
25. liockii ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
1D7. kratica ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
(b) cultivated spp.																								
3B. esculmta (5) ..	×	×	×	..	..	×	×	..	..	..	..	×	×	×	×	×	×	×	×	×	..	..	..	..
114. alata (7) ..	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	..	..	..	..
Total no. wild. ..	1	6	3	0	5	7	0	1	0	3	0	0	9	2	3	2	1	2	0	13	5	1	5	2

(1) There are many more Stations in the Shan Hills than are named here … uncultivated botanically … survey.
(2) D. kamoonensis. … uncertain where this occurs in the Shan Hills.
(3) D. Collettii. … uncertain where this occurs in the Shan Hills.
(4) D. Hamiltonii. It is uncertain where this occurs in the Shan Hills.
(5) D. bulbifera is said to be cultivated in the State of Yawng-hwe.
(6) D. esculenta is recorded as wild in the State of Kengtung?
(7) D. alata occurs wild in the Circle of Payap, … as wild in other parts of the Shan Plateau, but without precise …

TABLE 25. The genus in Siam (excluding the Peninsula), circle by circle and in the provinces of Laos to the east of Siam.

	Siam.												Laos.				
	Payap.	[illegible]	[illegible]	[illegible]	Udawn.	[illegible]	[illegible]	[illegible]	[illegible]	Prachinburi.	Ayuthia.	Kningtep.	N"akawu Chaisi.	Savannakhet.	[illegible]	Pakae and Baasac	[illegible]ranh-hca.
(a) will spp.																	
67. kamooneneit ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
31a. Garrdtii ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5. Prazeri ..	..	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..
53. arachidna ..	x	..	x	..	..	..	..	x	..	..	x	..	..	..	..	..	..
52. pseudo-iomsntoaa ..	..	..	..	..	..	..	..	..	..	x	x	x	x	..	..	..	..
54. filicaulia ..	..	..	..	..	..	..	..	x	..	..	x	..	..	..	..	..	..
55. Vraibiana ..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..
51. Kerrii ..	x	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..
1DD. cirrhoaa ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..
1D1. intempestiva ..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	..	..
112. persimilis ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
113. Hamiltonii ..	x	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	x
44. paeudo-mitens ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24. tmtamligera, ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4B. velutipee ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2B. birmanica ..	x	..	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..
141. dedpiena ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12[). glabra ..	x	..	..	..	..	..	..	x	x	x	..	..	..	x	..	..	..
71. hispida ..	x	..	..	..	..	..	..	x	x	x	x	..	..	..	..	..	..
B2. pentaphylla ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..
47. hulbijera ..	x	..	..	..	..	..	..	x	..	x	..	x	..	..	x	..	..
21. oryietarum ..	..	..	..	..	..	..	..	..	x	x	x	x	..	..	..	..	..
2B. membranacea ..	x	..	x	..	..	..	..	..	..	x	x	..	..	..	..	..	..
25. RocMi ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
31. daunasn ..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..	..
34. paradoxa ..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..
OS Piemi ..	..	..	..	..	..	..	..	x	..	x	..	..	..	..	..	..	..
1D5. brevipetiolata ..	..	..	..	..	..	..	..	x	x	x	..	..	..	..	x	..	..
111. depavperata ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..
117 ste?nonoides ..	..	..	..	..	..	..	..	x	..	x	x	..	..	..	..	..	..
107. kratica ..	x	..	..	..	..	..	..	..	x	x	..	..	..	..	..	..	..
11D. myrianlha ..	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..
(b) cultivated spp.																	
3B. wcuhrda ..	x	X	..	..	..	..	..	X	..	X	X	..	..	..	..	x	..
114. alata (2) ..	X	x	x	x	x	x	x	x	x	X	x	x	x	x	x	x	x
Total no. wild ..	15	1	3	1	1	0	0	10	[illegible]	13	10	3	2	1	5	0	1

(1) D. eindenta occurs wild in the Circles of Maharat, Hachaaima, Prachinburi and Ayuthia.
(2) D. alata occurs wild in the Circles of Payap and Prachinburi.

TABLE 25. The genus in Cambodia and Lower Cochin-China, province by province from north-west to south-east.

	CuinbDilia.							Lower Cochin 1'hina.							
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Kundal.	[illegible]	Thu-dau-mat.	[illegible]	Baria.	[illegible]	[illegible]	[illegible]	Poulo Condur.
|a) wild ipp.															
120. glabra	..	..	..	..	..	..	X	..	..	X	X	..	..	..	X
71. hispida	..	..	..	..	..	X	X	..	X	X	X	X	X	X	X
82. pentaphylla	X	..	..	X	..	..	..	..	..	X	..	..	..	..	..
47. bulbifera |1)	..	..	X	..	Z	X	..	..	..	X	..	X	..	X	..
121. uryzetorum	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25. membranacea	..	..	..	..	..	..	..	..	..	..	X	X	..	..	..
107. kratica	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..
35. rambodiana	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..
BO. Pierrei	..	..	..	..	..	..	..	X	X	X	..	..	..	X	..
1LJ5. brevipeliolaia	X	..	..	..	..	X	..	X	..	X	X	..	..	X	X
|b) cultivated ipp.															
36. esntlenta |2)	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..
114. aZa(» |3)	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..
Total no. wild	3	D	1	2	1	4	2	2	3	G	4	3	1	4	3

|1) D. *bulbifera* is recorded as cultivated in the PiDvince of Kompong Cham.
|2) D. *esculenta* was found wild by Pierre on Mount llancon in tiieProvi'iici) Df Knmrons Chhnini!
|3) B. *alata* is apparently generally cultivated and is recorded as running wild in the Pruvinci DfThu-dau-mot.

TABLE 27. The genus down the Malay Peninsula, from Tcnasserim to the Rhio Islands.

	Tcnasscrim.				Peninsular Siam.					Britisli Malaya.														fihJo.
	Thaton.	Amherst.	Tavoy.	Mergui.	Rachaburi.	Surat.	Puket.	Nakawn Sritamarat.	Pattani.	Perlis.	Kedah.	Penang.	Province Wellesley.	Perak.	Dindings.	Kelantan.	Trengganu.	Pahang.	Selangor.	Negri Sembilan.	Malacca.	Johore.	Singapore.	Rhio islands.
|a) wild ipp.																								
5. I'razeri	..	..	..	..	X	X	X	..	..	X	..	..	..	X	..	..	..	..	..	..	..	..	..	..
53. arachidna	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
113. Hamiltonii	..	..	X	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2B. birmanica	..	X	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
141. dmipiens	..	..	X	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
121). glabra	..	X	..	X	X	X	X	X	..	X	X	X	X	X	..	..	..	X	..	..	..	..	..	..
71. hisjiiia |1)	X	X	X	X	X	X	X	X	X	..	X	X	X	X	..	..	..	X	X	..	X	X	X	X
02. •pcntaphylla |2)	..	X	X	..	X	X	..	..	..	..	X	X	X	X	..	..	X	X	X	X	X	..	..	..
47. bulbifera |3)	..	X	X	..	X	X	..	..	..	..	X	X	..	X	..	X	X	X	X	X	X	X	X	..
1D3. Wttllichii	..	X	X	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
121. oryzetorum	..	..	..	..	X	X	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25. mrmbranacea	..	..	..	..	..	X	X	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
BD. I'ierrei	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
31. ilauwipu	..	X	..	..	..	..	X	X	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
144. •pdyrltidei	..	..	..	..	..	..	..	..	..	..	X	..	..	X	..	X	..	X	X	X	..	X	X	..
5D. in'tpinuta	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
111. dPpitiipuratti	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
II)!). l/ibbifloru	..	..	..	..	..	X	X	..	X	..	X	X	..	X	..	X	..	X	X	X	..	..	..	..
111). myriantha	..	..	..	..	..	X	..	X	..	X	X	..	..	..	..	..	..	..	..	..	..	..	..	..
124. calcicala	..	..	..	..	..	X	X	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..
122. gradlijies	..	..	..	..	..	X	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
141). orbiculata	..	..	..	..	..	..	X	..	..	..	X	X	..	X	..	X	..	X	X	X	X	X	..	..
59. tamtirisriflora	..	..	..	..	..	..	..	X	..	..	X	..	..	..	..	X	..	..	..	..	..	X	..	..
74. laurifolia |4)	..	..	..	..	..	X	..	..	..	..	..	X	..	X	X	..	..	X	X	X	X	X	X	..
120. Kingii	..	..	..	..	..	..	..	..	..	..	X	X	X	X	X	..	..	X	X	X	X	X	X	..
3D. stenvinerifl'JTa	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	X	..	..	X	X	..
3D. pisrnttirum	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	X	..	..	..	..	..	..
70. Atrfiiiiii	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	X	X	..	..
71). 1'rainiana	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	X	X	..	X	X	..	X	..
115. lampTocaula	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	X	..	..	X	..	..	..
13 S. pyrifolia	..	..	..	..	..	..	..	..	..	..	..	..	..	X	X	X	..	X	X	X	X	X	X	X
14. tenuifolia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..
|b) cultivated spp.																								
3B. escuhnta |5)	X	X	X	..	..	..	..	X	..	X	X	X	..	..	..	X	..	..	X	..	X	..	X	..
114. alata \S)..	X	X	X	X	..	..	..	..	..	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Total HD. wild ..	2	7	8	2	11	13	10	8	3	3	12	8	4	15	3	6	3	12	10	9	10	10	9	2

|1) D. *UspUla* is met with in fruit-ganlDiis in the Uirclc of Nakawn Sritainarat as if there encuurvnil to r,,,,,, i, tl the nianul'iicturers ol palm sugar ID grow abimt Malacca. Liicuur,iBM to grow. Iu the past it was encouraged by
12) B. *pMaphylla* receives cultivation at times in some parts of British Malaya, E.B., PB11ang, Proving Wc,,B,,cv alli ,y egri aemm^
|3) D. *bulbifera* has been observed in cultivation in the States of Selangor and Negri Siimhilan and must] m , h the Settlement of Singapore. I-KII aimoiun, nni must IIMD been at DnB time in cultivation In
|4) D. *laurifolia* is nDt yet fully proved to Dccur in Siam.
|5) D. *uctdtnta* has been found iu a wild condition in the CirclB ol Nakawn Sritaniarat and in the State of KBdah
|B) B. *alata* haa been found in a more or less wild condition in thB DisricC3 of Thaton and Tavoy and in the Btato of Pahang.

TABLE 28. The genus from the Andaman Islands to the Sunda Straits through Sumatra.

	Andaman islands.	Nicabar islands.	IslandH outside Sumatra.	o <!	Oast i 43 w cap?	Tal 1	West Coast	J 1	Palembang.	Lampongs.	1 Bangka.	B on.
(a) wild spp.												
121. *vexans*	X											
3D. *stemomeriflora* (1)					X							
33. *sumatrana*					^							
142. *pubera*							X					
12D. *glabra*	X	X			X							
71. *hispida*				X	X		X	X		X	X	X
B2. *pintaphylla*	X									X		
47. *bulbifera* (2)			X		X		X			X		
144. *polydades*					X					X		
10!). *gibbiflora*					X							
145. *orbiculata*			X		X							
39. *piscatorum*					X							
71. *Scortechinii*			X		X							
76. *Prainiana*					X							
115. *lamprocaula*					X							
120. *salidfolia*					X	*						
135. *pyrifolia*					X		X	X				X
147. *tenuifolia*					X				X			
73. *bancana*											x	
72. *Havilandii*												X
(b) cultivated spp.												
35, *esculenta* (3)	2	X										
114. alata	X	X										
Total no. wild	5	2	3	1	15	1	4	2	3	4	2	3

(1) *B. stenomiTiflora,* ia nDt fully proved tD occur in Sumatra.

(2) *D. bulbifera* is wild In the Andaman Islands and also cultivated o! recent years.

(3) *B. esculenta U* recoriel aa DCcuiritg in a will condition in the Andaman Islanda and in thB Niuobai Ialamia butit Beema to bu an escape from cultivation in tilth case.

TABLE 29. The genus in Java, residency by residency, from west to east (1).

	Bantam.	Datavia,	8 c	Preanger.	in 1 n	Pokalongan.	i m	R 1 ang.	D	Djokj 1	Kediri.	Mad in en.	P ean.	a o xn	? A	2 a 1 S	% a a 1	I
(a) wild spp.																		
142. *fUben*	X			X	X	X	X	X				X						
71. *hispiin U)*	X					X	X	X				X	X	X	X		X	
62. *pvntapriyua* (J)	Z	X				X	X	X		X	X	X	X	X	X		X	X
47. *tmlliifara* (4)						X	X	X	X		X	X					X	
144. *yulydades*	X	X			X								X		x			
110. *myriantha*	X	X				x	X	x			X		X				X	
124. *saticifoHa*	X	X		X											X			
136. *pi/rifulia*	X	X		X											X			
123. *gedMnip*		X																
7B. *filiformii*		X		X							x							
79. *mudiunenm*													*					
145. *platyi-arpa*																X		
89. **ijlumn**		X													X			
32. **isiuBii»i«**									X									
(b) CUltiVBtBD spp.																		
3B. *mvlenta.* (5)		Z		X	x		x	X	X	X		X	X	X	X	X	X	
114. ttltrfti	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tutalno. wild	7	13	1	8	4	0	6	7	3	2	5	6	5	2	3	5	5	1

in No wild spcciis are rccDrdEd for the HrşidiTcy of Surrakarta, but *D. alatn* is thers cultivated

k) JJ.AupitoiaMcourag.dtogrDWinfruit-gaid.nam Java, aa in the]ieaidenuiEB of Batavia, Madioin and Paseroean and the ialand

Oi ''m°TvWtavhvll™ cultivated in some puts of Java, cMtainly in the Seaidendta of Bantam, Batavia ani Madioen and in the island of

Mlli?«'*h *buVnJaa* is cultivat-d in the Rijuidencics Df Batavia, Pieang™ BaniDenjaa and Djokdjakarta and the island of Main™.

!0-!5.-B.C1.lenlBhaSbe™foundinaw1ldcondit.on in the aESid,nc,BB of Batavia, fomuang, Madiom and L^oeW and in the Xui«> islands.

TABLE 3D. The genus in and near Borneo.

	Anamba islands.	BDrneo.							Island of Balabac.	Island of Palawan.
		West Dutth Borneo.	South Dutch Borneo,	East Dutch Borneo.	Sarawak.	Brunei.	Labuan.	British North Borneo.		
|a) wild ipp.										
71. *hispida*	..	..	X	..	X	..	X	X	..	..
52. ***pentaphylla***	..	..	..	..	..	..	..	X	..	..
47. *bulbifera* |1)	X	X	X	..	X	..	X	X	..	..
144. *polycladzs*	..	..	X	..	X	..	..	X	..	..
110. ***myriantha***	..	..	..	..	..	..	..	X	..	X
146. *orbiculata*	..	..	X	..	..	..	..	..	..	..
39. *piszaturwm*	2)	..	..	X	..	..	..	X	..	..
1H. *Jullata*	..	..	..	..	..	..	..	X	..	..
129. *salicifolia*	..	..	X	X	X	..	..	..	..	..
135. *pyrifolia*	..	..	X	..	X	..	..	X	..	..
125. *nummularia*	..	..	..	..	..	..	..	X	X	..
29. *Bidkyi*	..	..	..	..	X	..	..	..	..	..
72. *Havilandii*	..	..	..	..	X	..	..	..	..	..
95. *Moultonii*	..	..	..	..	X	..	..	..	..	..
124. *Sitamiana*	..	..	..	..	X	..	..	..	..	..
125. *Nieuwmhuisii*	..	..	..	X	..	..	..	..	..	..
80. ***piperoides***	..	..	..	..	..	..	..	..	..	X
81. *JuzDuansis*	..	..	..	..	..	..	..	..	..	X
20. ***palawana***	..	..	..	..	..	..	..	..	..	X
|b) cultivated spp.										
3B. *esculenta,*	..	..	..	..	..	X	..	..	..	X
114. atoa	..	X	X	X	X	..	..	X	..	..
Total nD. wild	1	1	1)	3	9	1)	2	9	1	4

(1) *D, bulbifera* is known to bi' cultivated in tin[1] Kiirimata Islands DI[wi'strrn llDrnco.
|Z) *D.piicatorwn* is repnscnted by Duly ono iiidill'crcut snucinnil from Dutch Borni'0, which I1DI'3 not juitc amount to proof tliab It Dcc**urs there.**

TABLE 31. The genus in the northern half of the Philippine Archipelago, province by province, from north tD south.

	Batanes Islands.	Cagayan.	Isabela.	Kalinga-Apayao.	Ilocos Norte.	La Union.	Nueva Vizcaya.	Pangasinan.	Nueva Ecija.	Tarlac.	Zambales.	Pampanga.	Bataan.	Bulacan.	Rizal.	Cavite.	Laguna.	Batangas.	Albay.	Camarines S.	Polillo Island.
1)) wild ipp.																					
71. *hispida* ..	..	..	..	..	X	..	..	X	X	..	..	X	..	X	X	X	X	X	..	X	..	..	..
D2. *pentapliylla* (1)	..	..	..	..	..	..	..	..	..	..	..	..	X	..	X	..	Y	..	..	..	..	..	..
47. *bulbifera* ..	..	..	..	X	..	..	X	..	..	X	..	X	X	X	X	..	X	..	..	..	X	..	..
111). ***myriantha***	..	..	..	..	..	..	..	X	..	..	..	..	..	..	X	..	X	..	..	..	..	..	..
125. *nummularia*	..	..	..	..	..	X	X	..	..	..	..	X	..	X	X	X	X	..	..	X	X	X	..
65. *inaequifoUa*	X	..	..	..	..	..	..	..	..	..	..	..	..	^	..	..	X	..	..	..	X	..	..
HI. *luzonetisis*	..	X	..	..	..	..	..	X	..	..	..	..	X	X	X	X	X	..	..	X	..	..	..
133. *iivaricala*	..	X	..	X	..	X	..	..	X	..	..	X	X	X	X	..	..	..	..	..	..	..	..
r.s. *polyphylla*	..	..	..	X	X	..	..	X	..	..	..	X	X	..	X	..	X	..	..	..	..	..	..
80. ***piperoides***	..	..	..	..	X	..	..	X	..	..	..	X	..	..	X	..	..	..	..	..	..	..	..
37. *flabellifolia*	..	..	..	..	..	X	..	..	..	X	..	..	..	..	X	X	X	..	..	X	..	..	..
132. ***Loheri*** ..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	X	..	X	..	..	..	..	..	..
134. ***Forsworthyi***	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..
125. ***grafa*** ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..
125a. *Wittaii*	2)	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..
B4. *Elimri* ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	X	..	..	..	..	..	..
BB. ***Cumingii***	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..
ID) EUltiVBlad ipp.																					
36. *escutenta* (3)	X	X	X	..	X	..	X	X	X	..	X	..	..	X	X	X	J-	..	X	..	..	..	..
114. *idata*	4)																						
TDtalnD. wild	2	3	1	3	4	3	X	a	2	2	a	3	2	7	5	d	li	12	1)	u	2	4	1

11) *D. pwtaphyUa* is sometimes cultivated in the Provinces of Batann and Lugu na.
12) *J). Wilkaii* is au ill-f DUinlid uaino, haspd nn a most inadctiuatc sprap.
13) 2I. HciiteiKri runs wild readily in parts of the Philippine Archipelago uni is si rrcurded for tho llatan islands auj tilt- p,,,,;., , T, Dor tc, IIDBOS sur, Drncuit, LaUuion, Nucva Viscnya, liuluian, llizul, Tiiyabas and Laguna. irovmcrs of IlDCi)3
14) *D. alata* sciinlB to *be* cultivated in all tho province.

TABLE 32. The genus in the southern half of the Philippine Archipelago, the provinces or islands from north to south.

	[illegible]	Busuanga and [illegible]	[illegible]	Capiz.	Ilo-ilo.	[illegible]	[illegible]	Camotes islands.	[illegible]	Bohcl.	Negros occiden-til.	Negro oriente.	Camiguin.	[illegible]	[illegible]	Misamis	[illegible]	[illegible]	Cotabato.	[illegible]	[illegible]	[illegible]	Sulu islands.
(a) wild spp.																							
71. *hispida*	x	..	x	..	..	[illegible]	x	..	..	..	..	..	..	..	x	x	..	x	..	..	..	..	..
52. *pentaphylla* (1)	..	x	..	x	..	..	[illegible]	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..	x
47. *bulbifera*	x	x	..	..	x	..	x	..	..	..	x	..	..	..	..	x	..	x	..	..	..	..	x
110. *myriantha*	..	x	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	x	..	x
125. *nummularia*	..	..	..	..	..	x	[illegible]	x	..	..	..	..	x	x	..	..	..	x	..	x	x	x	..
85. *ihaequifolia*	x	..	..	..	..	..	[illegible]	..	..	x	..	..	..	..	..	..	..	x	..	..	..	..	..
133. *divaricata*	..	..	..	..	x	..	[illegible]	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..
88. *polyphylla*	..	..	..	..	..	..	[illegible]	..	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..
80. *piperoides*	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
37. *flabellifolia*	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
134. *Merrillii*	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..
20a. mindanaensis (2)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..
(b) cultivated spp.																							
38. *esculenta* (3)	x	..	x	..	..	..	..	..	..	..	..	X	..	..	..	..	x	..	..	..	..	..	..
114. *alata* (4)																							
Total no. wild	B	3	1	1	2	1	[illegible]	1	1	3	1	1	1	1	1	2	0	7	0	1	2	1	3

(1) *D. pentaphylla* seen [illegible] at times in the Province of Davao.
(2) *D. mindanaensis* is a scrap of a plant altogether inadequate for the establishment of a species, but which seems to represent a plant of great interest [illegible] as well as in Eastern [illegible].
(4) [illegible] to be cultivated in all the provinces.

TABLE 33. The genus in the islands of eastern Malaysia, between Wallace's and Weber's lines.

	Celebes.					Ambuinese. Moluccas.				Lesser Sunda Islands.						
	[illegible]	[illegible]	Islands of Salayer.	Island nl Iluton.	Sula Islands.	[illegible]	Cerain.	[illegible]	[illegible]	Bali.	Lorabak.	[illegible]	[illegible]	Florcs.	Solcr.	Timor.
(a) wild spp.																
71. *hispida* (1)	x	x	x	..	..	..	x	x	..	..	..	x	x	..	..	X
82. *pentaphylla*	..	x	..	..	..	x	..	x	x	X	..	x	x	..	..	x
47. *bulbifera*	..	x	x	..	..	x	..	x	..	..	..	x	..	..	..	x
110. *myriantha*	x	..	x	..	..	..	..	x	..	..	x	..	..	..	x	x
125. *nummularia*	x	x	..	..	x	..	..	x	..	..	..	..	..	..	..	..
77. *Warburgiana*	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
86. iSarmin	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
32. *ksiuentis*	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..
75. *Vammrerm*	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..
(b) cultivated spp.																
38. *esculenta*	x	..	..	X	..	..	X	x	x	X	..	X	..	x	..	x
114. *alata* (2)																
Total no. wild	5	li	3	0	1	2	1	5	1	1	1	3	2	D	1	4

(1) *D. hispida* is recorded as found in gardens in Timur.
(2) *D. alata* is apparently of general cultivation.

TABLE 34. The genus in Papuasia and in the parts Df the Pacific immediately to •the eastward.

	[illegible]	Halmaheira.	New Guinea, W. of 135°.	Little Kei Islands.	Aru Islands.	New Guinea, W. of 141°.	North-east New Guinea.	South-east New Guinea.	Louisiade Islands.	New Britain (Neu Pommern.)	New Ireland (Neu Mecklenburg).	Bougainville Island.	Shortland Island.	San Christoval Island.	New Hebrides.	New Caledonia.	Isle of Pines.
(a) wild spp.																	
71. D. hispida ..	..	..	x	..	..	..	..	..	..	x	..	..	..	..	..	..	..
52. D. pentaphylla (1)	x	..	X	x	x	..	T	x	x	..	..	..	..	..	..	x	..
47. bulbifera (2)	x	X	..	x	..	..	x	X	..	x	..	x	x	..	x	x	..
125. nummularia ..	x	..	..	x	..	x	x	x	x	..	x	x	..	..	..	..	..
94. elegans	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	..
115. opaca	..	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..
(b) cultivated spp.																	
30. esculenta (3) ..	x	X	..	x	..	..	x	x	x	..	x	..	..	..	..	x	..
114. alata (4) ..	x															x	x
Total no. wild ..	3	2	2	3	1	2	5	3	2	2	1	2	1	D	1	3	a

(1) D. *pentaphllya* is recorded as cultivated sometimes in the Kci Islands anil in the north and south parts Df Eastern New Buincn.
(2) *D. bulbifera* is recorded as cultivated in the island Df Halmahcira and in south-eastern New Guinea.
(3) *D. esculmta* runs wild in the Islands of Halmaheira and New Caledonia and is recorded as wild in north-eastern New Buinea.
(4) *D. alata* is prohably cultivated throughout.

TABLE 35. The genus in the Pacific, from west tD east.

	Bonin Islands.	Pelew Islands.	Yap.	Guam.	Ponape.	Fijian Islands.	Savaii.	Tongatabu and Eua.	[illegible] Islands.	Cook Islands.	[illegible] Austral Islands.	[illegible] Islands.	Tahiti.	Makatea Island.	Marquesas Islands.	Mangareva Island.	Pitcairn Island.	Hawaiian Islands. Hawaii.	Oahu.	Kauai.	Niihau.	
Lat. E.	142°10′	134°45′	138°13′	144°50′	158°25′	178°	174°	175°	172°	160°	[illegible]	[illegible]	149°30′	148°15′	140°	134°55′	130°14′	155°30′	158°	159°30′	160°	Lat. W.
(i) wild spp.																						
52. pentaphylla (1), ..	..	..	x	..	..	x	..	..	x	x	..	..	x	x	x	..	..	x	x	..	..	
47. bulbifera (2) ..	..	x	x	x	x	x	x	x	x	..	..	x	x	x	..	x	x	x	x	x	x	
125. nummularia ..	..	x	..	..	x	x	..	..	x	..	..	..	x	..	..	..	..	..	..	..	..	
37a. Ledermannii ..	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
(k) cultivated spp.																						
99. opposita (3) ..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
30. esculenta ..	..	..	x	x	..	x	..	x	..	..	..	..	x	..	..	..	..	..	..	..	..	
111. alata (4) ..	..	x	x	x	x	x	X	x	x	x	..	..	x	x	X	..	X	.T	X	..	..	
Total no. wild ..	0	3	2	1	2	3	1	1	3	1	D	1	3	2	1	1	1	2	2	1	1	

(1) *D. ptntaphyUa* is recorded as cultivated in the islands of Fiji, Tahiti and Eapn.
(2) *D. bulbifera* secins to have been in general cultivation tliroughDUt the Pacific.
(3) *D. oppositifolia* has been carried out to the Eonin islands from Japan.
(4) *D. alata* is dDulitlcaa in every island, unless the Bonin islands arc exceptional.

THE MEANING OF THE WORD 'SPECIES'.

The word " species " has now no precision ; and it has become desirable in all monographic work oi a systematic nature to indicate the latitude allowed to it. For that reason, before any further statements are made, it should be explained that in these na.es a " species ' is anassembling ofindividuals which possess in commonmacroscopic characters sufficiently obvious not only for recognition in the field but for recognition in all carefully chosen and properly preserved herbarium material. Our species are neither " Jordanons » nor " Linnaeons "; but intermediate. We believe that the majority of systematic botamsts of today adopt a conformable standard ; and we hold that systematic work as the scaffolding for all progress, should be based on a majority standard. The " field " is inBvitablv the court of appeal, but judgments formed there need to be such as can be recorded in the Herbarium.

We think that Linnaeus, with such limited material as he could get from remote countries, might have united in " Linnaeons " any of the following :—

D. caucasica, D. deltoidea and *D. Poilanei,*

D. panthaica and *D. biserialis,*

D. Collettii and *D. hypoglauca,*

D. tenuipes and *D. tokoro,*

D. Bockii and *D. membranacea,*

D. daunaea and *D. keduensis,*

D. paradoxa and *D. cambodiana,*

D. bullata and *D. piscatorum,*

D. filicaulis, D. Graibiana and *D. arachidna,*

D. pentaphylla and *D. Kalkapershadii,*

D. Elmeri and *D. inaequifolia,*

D. hispida and the African *D. dumetorum,*

D. filiformis and *D. madiunmsis,*

D. Wightii and *D. Trimenii,*

D. Potanini, D. opposita and *D. japonica,*

D. Wallichii and *D. pulverea,*

D. hainanensis and *D. kratica,*

D. gibbiflora and *D. myriantha,*

D. persimilis and *D. alata,*

D. pubera and *D. Listeri,*

D. platycarpa and *D. orbiculata :*

and perhaps others. But progress lies more in the course of analysis than in synthesis. However not to neglect synthesis unduly, we have arranged the species with which we deal in small groups as the reader will find them in Table 1 (p. 427). Naturally we assume a not-remote common origin for the species which make a group ; and we find it convenient to refer to species which seem but recently to have commenced speciation as satellite species.

It is evident that the size of a genus is increased as they are recognized and this increase goes on *pari passu* with increase due to the botanical exploration of the Globe.

A RETRDSPECT.

It is possible to measure the progressive growth of knowledge by counting the number of species established at different dates.

Df the species which we recognize, only four carry names by which in 1753 Linnaeus knew them, i.e., by names used in the first edition of his *Species Plantarum* : they are *D. alata, D. bulbifera, D. oppositifolia* and *D. pentaphylla.* Linnaeus tried in that great work to establish three others, but was unsuccessful as a consequence Df confusing the somewhat indifferent materials available to him.

His pupil, Thunberg, as the result of a voyage to Japan, added four : his contemporaries, Lamarck and LoureirD each added another. Thunberg's were *D. japonica, D. opposita, D. quinqueloba* and *D. septemloba* : Lamarck's was *D.* mmmWaṅa and Loureiro's *D. cirrhosa.* Thus there were ID established names when the eighteenth century closed.

By thB labours of Robert Brown, Blume, Blanco, Schauer and others the number had been raised to 23 when 1850 was reached. Kunth in that year added four more. Then followed *D. intermedia* in 1854, *D. gracillima* in 1855, *D. doryphora* and *D. pyrenaica* in 1BBB, *D. tenuipes* in 1878, *D. tokoro* in 1889 and *D. nipponiza* in 1891 : thesemaking 34. In the year 1892 Sir Joseph Hooker added another ID and in 1893 Lipsky and AHJDW discovered *D. caucasica.* The nineteenth century closed with the total at 45. It was 57 in 19D8 ; 98 in 1914 ; 11D in 1924 ; 138 in 1928 ; and it now is 154.

As the genus is most at home among mountains, accessions have been largely due to the explorations of botanists in the tropics reaching high levels in the interiors D! large islands and continents.

Thz collection of information prior to Linnaeus.—Popular ideas of classification are based on utility and the older writers on plants naturally approached their subject from that point Df view : the idea of a classification based Dn other properties took its origin in the West and for the first time claimed serious attention as Man became conscious of a power to reach the limits of the Globe and comprehend its contents. Then it was that enquiring minds followed the explorer inquisitively and asked information from him on his return. In this quest because the power Df the West spread by sea, ths first contacts with the Floras of the East were with such as lined the coasts. The needs of the voyager fixed his attention Dn the useful among the newly found plants : and that which became least unfamiliar was the familiar of the ports.

The Portuguese, who led the way to the East, were little given to become schoolmen. It is true that Garcia da Orta was one of them and an ornament to his nation ; but with his Spanish education he was exceptional. The adventurers were in general rough men in command of crews largely impressed and partly of criminals under sentence : but it was not long before northern Europe exhibited its more scholarly interest and its keener wish to chronicle information.

There was born in 1526 at Atrecht (Arras) in the province Df Artois, onB Charles de l'Escluse, destined to be pre-eminent in this. A student at various universities, a traveller in several countries of Europe, a visitor to the busiest ports,—it is recorded that he crossed over to London on four occasions to satisfy his inquisitiveness, and he had been in Lisbon : in his later days (from 1592) he was in charge of a Botanic Garden in Leiden and in it was built for him a stove-house that he might cultivate exotics. He gave to the world the first printed description of the tuber D!ˊa *Dioscorea,* figuring *D. alata* in 16D1 (see p. 324)

There had been a passing mention of *D. esiuhnta in* Garcia da Orta's *Colloquks* |15B3)but no description ; |sBB p. 323), and out of sight in Chinese, Sanskrit, Arabic and Persian books were various references such as the West could not then use. The oldest of these was in Chinese and related to the use of a yam, such as *D. japonic* is, in medicine : legend says that it was written about 27DD B. C. |see p. 246). Much later another Chinese writer referred to yams as food |see p. 247) : this was in the sixth century A.D. ; having mentioned the medicinal use recorded earlier, he took the opportunity to state that in Sze-chuan. yams were dug for food, and that in southern Kiang-si a VBry large and ^^ kind was met with. ThB SzB-chuan plant would be *D. oppostia* : the Kiang-si plant may have been *D. alata.*

About the same period, in a great work on medicine, written in the Gangetic Plains mention .s made of the place of yams in the diet of the sick |see p. 85): the compiler of this work referred to *D. alata* and *D. Escuhnta.*

In the 11th century yet another Chinese writer, referred to yams as food a little more precisely than thosewho had gone before, and in the 14th century a fifth writer did so more precisely still. In the 16th century the Mogul Emperor Akbar caused a survey of the natural resources of his kingdom to be made—a Domesd h ook and ln rt *D. alata* and *D. uovltnta* are definitely mentioned as crops.

Theae stray shafts of light on cultivation and consumption M fDod in which substantiate thB use assumed from development and distribution of the species, were not available to Dlusius and his contemporaries, who found the whole of the* kn wledee in thB plants t.i ems elv es.

On p. 324 we have pointed out how greatly the Dutch, on their accession to power ln the tn.pnal seas, encouraged learning; and we have had cause to name as those who

To these may be added Hermann
Most of them were physicians and their work was
done in the immediate neighbourhood of the garrisons to which they were a t t J 7 .
close to the ports where the Dutch maintained troops Th 7 I . attacnB[i I-B.,
they met with and described, prove to be *D. alata, B^ulUf^B Z u f Z T l t*
D. nummularia, D. oppositifolia, D. pentaphylla and D WaLhi il I T 1' occur
levels near the coasts of southern India, Ceylon and M a l a y sia.

To make drawings of each species was at that time considered essential and unfortunately the cost of reproducing illustrations often hindered the publication of accompanying descriptive text: Clusius had figured the tuber of *D. alata* and Marcgraf figured this plant in 1B48 : Grimm's figure of *D. hirsuta* and Rheede's figures in 158B : Sherard caused Hermann's figures to be published in 1698: but the Hermann drawings were not printed until 1750. Ray was the first of those times to make *Historia Plantarum* of lB8B-17D4-which contained no illustrations

The anxiety of thB Dutch to possess tropical plants led Rheede to send tubers of several Dioscoreas from Ceylon to the Hortus Amsterdam,where Commelin grew them, SD that in 1588 he had *D. alata* and apparently also *D. bulbiftra,*: and the latter is so easily cultivated that it was grown in other gardens aleo [p. 117).

Rheede, aa an administrator Df no less rank than Governor, did not write his own work, but employed a staff of artists under the missionary CasDarius ; and to the staff the plants to be delineated were brought from no great distance. Hermann had the misfortune to commence his service in Ceylon at a time of crisis, when the Dutch were SD severely pressed that they had tD withdraw their garrisons from the east side of the island, and his explorations took him nowhere except along the south-west coast. Limited thus in means he did not obtain the montane species of Ceylon ; and Rhecde's staff failed to obtain *D. tommtosa* and *D. spicata* from the higher hills under which their work was done.

With the year 159D interest passes to the work of another physician—Engelbert Haempfer, who went tD Japan in the service of the Dutch East India Company. From soon after their first contact with foreigners the Japanese had tried to hinder their coming and even to prevent their own nationals from voyaging to other lands by forbidding the building of large sea-going boats. Not being able tD CIDSB the door entirely they confined trade with the Dutch to the island of HiradD shim a, a little tD the north of Nagasaki, and then to Nagasaki itself wherB the Dutch had a factory covering the islet of De shima *;* and within it they were required to stay except that Dnce a year it was incumbent on them tD gD tD the capital to pay a visit of respect at court. Haempfer suffered from these restraints ; but working through interpreters he got together much information, at that date of extreme interest. Among the plants to which he gives names, *D. quinqueloba* is recognizable, for he left a good drawing Df it : he seems also tD have known *D. tokoro*, *D. opposita* and perhaps *D. japonica.*

The activity of the Dutch in Natural History aroused a like activity in the corresponding British East India Company and in Britain. Mary, daughter of King James II of Britain had been married in 1577 to William, Prince of Orange : recalled to Britain in 1589, as, at her wish, joint-ruler with William, she appointed Leonard Plukenet—a Westminister physician—tD be " Queen's Botanist and Supervisor of the Royal Gardens at Hampton Court ". And at Hampton Court a plant which he cultivated was *D. bulbifera* |p. 117). He died in 1713- His publications were considerable, consisting for the most part of small illustrations, each with a brief description Df the plant illustrated. His herbarium becamB extensive and at his death passed into the possession of his contemporary, James Petiver, a London apothecary. Petiver made it yet more extensive, an " immensus thesaurus " in the words Df Ray, obtaining from British surgeons sent abroad such plants as they would collect : one of these surgeons was James Cunningham who went to southern China in the service of the East India Company and brought *D. hispida* back from PDUID Condor : another was Edward Bulkley who served the Company with distinction in Madras until 1714. Near Madras he collected; and he procured specimens from the neighbourhood of Syriam in Lower Burma. Charles Du Bois, then Treasurer of the Company, was able tD secure the better part of Bulkley's materials for his Dwn collection, now the property Dfthe University of Oxford: the rest Df these materials entered Petiver 'a herbarium, which passed through Sbane'fl hands to the British Museum. In 1583 a priest, GeDrg Joseph Hamel, went tD Manila and from Manila sent to England the oldest known specimens Df *D. luzonensis* : he addressed Petiver and Ray jointly ; and Ray appended to his *Historic Plantarum* an account of Kamel's plants ninety-six pages long.

The species to which Ray refers are all those which others had described, together with *D. birmanica* and *D. luzonensis.*

Another contemporary herbarium was that of Mary, Duchess of Beaufort, in which *D. alata* is preserved. It ia unrecorded how she obtained her specimen, but she appears to have corresponded with Commblin.

Linnaeus' attempt at co-ordinating knowledge.—Forty-nine years after Ray has issuedthe last of his three great volumes, Linnaeus essayed to catalogue the same material in a new order, by the use of definitions in a minimum number of words instead of descriptions. One admits his splendid services to science, yet observes that he succeeded in regard to the genus *Dioswrea* so meagrely as to establish no more than four names—*D. alata, D. bulbifzra, D. oppositifolia* and *D. pentaphylla.* He was baffled by the unconformable work of some of those who had gone before ; their descriptions and figures merely led to confusing him with regard to *D. esmlenta, D. hispida, D. nummularia* and *D. Walliihii,* and to his passing by *D. birmaniza, D. japonic, D. luzonensis, D. opposita D quin-qudoba* and *D. tokoro.* It is obvious that he was faced with great difficulties : but it is not in all cases obvious why he failed-see for instance his confusion of *D. escuhnta* |p 88) and ofD. *hispida* |p. 193).

The invrmse of knowledge during the mxt eighty years.-Th, reader will recollect that these pages are written with special reference to the genus *Dioscorea* and that the work of writers however eminent, if not pertinent to the subject, is passed over.

During the hfe of Linnaeus the first great scientific, sometimes politico-official, voyages took place, the first of all being those of Captain James Cook. Such of these Voyages a8 resulted in adding knowledge to what was known of *Dioswrea* may be enumerated.

Years.	The Captain and his ship.	The chief of his collectors.
1768-1771	James CoDk, "Endeavour"	Sir Joseph Banks and D. Solander.
1772-1775	James Cook, "Resolution"	J. R. Forster and his son George.
1776-1779	James Cook, "Resolution"	Cook himself.
17B9-1794	A. Malaspina, "Descubierta"	T. Haencke and L. Nee.
1791-1797	d'Entrecasteaux, "Recherche"	Lahaie.
1795-1798	BrDUghton, "Providence"	Christopher Smith.
1B17-182D	de Freycinet, "Uranie"	C. Gaudichaud-Beaupre.
1B1B-1826	King, "Mermaid"	Allan Cunningham
1822-1B25	Duperrey, "DDiiuillB"	Dumont d'Urville and Lesson.
1825-1B2B	Beechey, "Blossom"	G. T. Lay and A. Collie.
1825-1829	Dumont d'Urville, "Astrolabe"	Dumont d' Urville.
183D-1832	Wendt, "Prinzess Louise"	F. J. F. Meyen.
1835-1837	Vaillant, "La Bc-nite"	C. Gaudichaud-Beaupre.
1837-184D	Dumont d' Urville, "Astrolabe"	Dumont d'Urville.
1B35-1B41	Sir Edward Belcher, "Sulphur"	G. Barclay.
1838-1842	Wilkes, "Vincennes"	Rich, Pickering and Brackenridge.
1842	Dupetit-Thouars, "Venus"	Dupetit-ThDUars himself.
1853-1856	RingDld and Rogers, "Vincennes"	D. Wright.
1859-1861	Count Eulenburg, "Thetis"	Wichura and Schottmueller.

The number of voyages and above all their durations indicate that many coasts were explored. Many extensions of known range were proved. Df Solander brought *D. tranwersa* to light and found the still voyager brought back *D. lulbifera.*

From 175D to 1752 Linnaeus'friend Peter Dsbeckmadea voyage to Canton and recorded *D. alata* from that port and sent a letter t_D Linnaeus recording it as grown also in the Island of St Helena (see p. 338). In 1772 Linnaeus' pupil and ultimately successor in the Chair of Botany at Uppsala, Thunberg, took service as a surgeon with the Dutch, and repeated for a year (1775-1775) Kaempfer's experience Df a confined life in De shima. He collected in Ceylon and Java near the coasts on his way to Japan. In 1768 another pupil, J. G. Koenig, joined the Danish Mission at Tran^uebar. J. P. Bottler and J. G. Klein also joined that mission and Benjamin Heyne was engaged in missionary labours in the same neighbourhood. The four formed themselves into a scientific society "The United Brothers" for the pleasure of botanizing together (see King in *Journ. Bot.* 37,1899, p. 455). Their zeal led tD the first herborizatiDns in the hills of the interior of India beyond the narrow limits $_D$f South Arcot where Bulkley had been able to obtain wild yams as a food of the Irulais. Koenig, severing his connection with the Mission, first for service under the Nawab of Arcot, then under the East India Company in 178D, was sent on a voyage Df exploration as the Company's Botanist tD Malacca and Siam. Patrick Russell succeeded him in 1786 and, after his very short service, William Roxburgh succeeded Patrick Russell. He made contact with the United Brothers. At the same period the French appointed botanists to Pondicherry, such as Sonnerat and Leschenault : and later (in 1834) Perrottet.

The East India Company's Botanists, being Army surgeons, were only free tD botanize round their stations : but at that time the south Df India was suffering from an extreme state of unrest which demanded many military establishments and their number afforded a variety of conditions under which the Botanists found themselves. Finally the unrest ended with the battle of Seringapatam in 1799, and within a short space of time round about that went all the major species of .Dips core a natural to southern India hadbeen discoveredby one or bv another of the botanists named. HDW these men consulted and worked together is seen by what we have recorded regarding *D. tomzntosa* Dn p. 156.

The battle Df Seringapatam led to the deputing of another army surgeon, Francis Buchanan (Buchanan-Hamilton) of the Bengal Establishment, who had abeady collected plants in ChittagDng and elsewhere, to southern India "tD travel through and report upon the countries of Mysore, Canara and Malabar."

After this, interest was removed tD the north of India. Roxburgh had been called in **1793** to Calcutta tD superintend the building up of the Company's Botanic Garden at Shibpur ; and Buchanan was brought back tD Bengal in 18D2, first tD go to Nepal and then tD make a survey Df the condition Df the Presidency.

From various localities Roxburgh's friends sent plants to him, and these he put into cultivation that he might study them. When his health gave way in 1813 and he had tD leave India, the Sanskrit scholar, Thomas Colebrooke, for a short time controlled the Garden; then Buchanan did SD until his departure for Europe in 1815 : whereafter the Danish surgeon Nathaniel Wallich was appointed tD the vacant place.

Buchanan had collected in Bengal *D. alata, D. bulbifera, D. escuhnta, D. glabra, D. Hamiltonii, D. hispida, D. pmtaphylla* and *D. pubtra.* Roxburgh had obtained in one way Dr another, *D. alata* in five races which he called species, *D. bulbifera* in three forms which he called species, *D. escuhnta* in two varieties which he called species, *D. ylabra* in forms from two sources which he called species, *B. hispida* and *D. pentaphylla.*

While botanical investigations were thus extending knowledge in India, there was an intensification Df collecting in Malaysia. Christopher Smith, having done gDDd collecting in the Pacific, was employed in establishing the cultivation of nutmegs and cloves in Penang, which gave him the opportunity of collecting in Amboina. Roxburgh sent his son and assistant, William junior, tD Penang and this son brought back to Calcutta material of *D. bulbifzr*uvar. *heterophylla* |D. heterophylla, Roxb.) Thomas Horsfield, a physician of American birth, went tD Java in 18D2 and did excellent work there. Raffles in 1818 tDDk William Jack Df the Bengal Medical Establishment to Penang, Singapore and BencDolen.

Many contemporary administrators were imbued with the idea that experimental cultivation should be tried wherever possible ; and plots of land were laid out at their orders for the purpose. Something like a garden had been created in Penang as early as 1794 : Colonel J. A. Bannerman, the Governor, added to it in 1818. The Dutch East India Company having invited Reinwardt, then Professor at Amsterdam, to visit Java to organize "education, a medical service, agriculture, manufacturing and scientific research" set apart in 1817 at his suggestion, the land at Buitenzorg which became its celebrated garden; and they placed him in charge. Wallich arrived in Singapore in 1822 on a short visit and advocated with success an experimental garden ; and Raffles had made one in Bencoolen.

Ceylon's famous Garden at Peradeniya was founded in 1817, with Alexander Moon as its first Superintendent. He was succeeded by James Macrae who had already collected plants in the Pacific for the Horticultural Society.

New military establishments in India towards the Punjab led- to such surgeons as were available taking charge Df similar cultivation in Upper India; and J. F. R 1 oy_e was in 1823 set to build up the Saharanpur Botanic Garden. Though tied to his surgeryhe ™ able to send native collectors into the Himalayas: they ticketed their specimens in Hindustani sometimes rather strangely, as for instance "Jansiyana" for Gentiana. Royle was succeed-' ed in 1832 in both his posts by Hugh Falconer who continued the method of employing collectors writing labels in one of the vernaculars. He himself was attached to Burnes' mission to Kashmir.

Contemporaneously Robert Wight, having joined the Madras Medical Establishment in 1819 directed a BOtanical department from 1826 to 1828 and had some control over Spice gardens at Courtallam which lies in a gap in the Western Ghats of Travancore • he em_ID-__d native collectors on a considerable scale.

Such gardens as we have mentioned, served as foci for investigations on the floras of their neighbourhoods and led to the collection of Dioscoreas in new places especial' those among mountains and remote from the sea, such as Peradeniya and Buiten zorg. J. can scarely be ascribed tD accident that among them those in the hilla showed at it vitality than those in the plains, Calcutta excepted, fDr their utility as spear-points gr ^tlT attacks was evident. in

To Java the Dutch sent in 182D two young enthusiasts Kuhl and van Hasselt The y SDDn fell victims tD the climate ; both had died before the end of 1821. Inl822tii ey sent out Blume as a physician under a Board of Health, and Reinwardt came home • Bl ume remained in Java until 1825 doing a wonderful amount of work in that short time.

In **1822** George Porter, Head Overseer of the Botanic Garden, Calcutta h d accompanied Wallich to the Straits : he elected to remain in Penang, as the villa e s'h a 1 **master** and **was at** the same time given charge of some experimental cultivation. H g c oo- e

collected plants and sent his specimBns to Wallich. Meanwhile W. E. Phillips, the Governor from 1819, made a herbarium which passed from him by gift tD the Horticultural Society and from the Society tD the Royal Botanic Gardens, Kew.

TheDiDSCDreas collected by these botanists may now be enumerated: they were *D. Blumei, D. bulbifera, D. esculenta, D. filiformis, D. glabra, D. hispida, D. laurifolia, D. myriantha, D. orbiculata, D. pentaphylla, D. polydades, D.pubera, D.pyrifolianndD.salizifolia.*

A glance at table 29 (p. 445) shows that the collectors in Java had been remarkably assiduous, for they had by that early date obtained more than half Df the species Df the island : but a glance at table 27 |p. 445) shows that those in Malaya had brought tD light only a small proportion of such as occur. It may be said that the botanical investigation of the western end of Java, by this time, had been brought tD a stage similar to that already reached in southern India.

Phillips' successor as Governor Df Penang, seems to have suppressed the small Botanic Garden ; and the first little Garden in Singapore went out Df cultivation in 1829. The latter may have had a slight influence Dn local horticulture but had none Dn botanical investigation.

In 182B, Dn the departure Df Blume from Java, the Dutch abandoned botanical investigation at BuitenzDrg, but they maintained the institution on a very high horticultural level. They were fortunate in having E. J. Teijsmann in control from 1B3D, and in 1837 added J. K. Hasskarl tD the staff.

*

In India the Nepalese war of 181B led tD collecting in the north-western Himalaya. Someone, we do not know who, at this time sent rhizomes Df *D. deltoidea* tD Britain (see **p.** 27). After the war Wallich himself was able tD spend twelve months at Khatmandu and he was able to get plants from Kumaon by the agency of Robert Blinkworth. It was immediately after returning from Rhatmandu that he tDDk George Porter with him to the Straits: next we find him travelling through the submontane forests of Oudh |1825) and then on a mission tD Burma (1826-1S27) where he reached the edge Df the Shan Plateau east of Mandalay. This was followed by a visit tD the Amherst District and by thp despatch of a collector—W. Gomez to the TavDy District. Also he had at work on the edge Df Assam two collectors Henry Bruce and F. de Silva.

His own collecting and that of his employees resulted in the obtaining of herbarium material from the hills of northern India Df *D. bulbifera, D. deltoidea, D. hispida, D. pubera, D. trinervia* and *D. Wallichii:* and from Burma, Tavoy and Singapore of *D. lirmanka, D. laurifolia* and *D. pyrifolia.*

Wallich was invalided home in 1828, and while in London carried out a work of great scientific value, namely the casting of the extensive herbarium of dried plants in the possession of the East India Company into sets and their distribution : he had several volunteer assistants, one no other than George Bentham ; and the work occupied four years. The specimens of *Dioszorea* were distributed in 183D, when everything available was handled. The determinations were provisional, but the numbering Waa so thoroughly worked Dut by appending letters to the numbers as to make citation easy and reliable.

Taxonomic Botany had not till then had quite SD large a gift as this |c/. Hooker and Thomson's appreciation in their *Flora Indica,* 1835, p. 59). As regards ths Dioscoreaa reasonably gDDd specimens of nineteen of the species of India were distributed and **put within**

the reach of botanists in no fewer than eight countries and twice as many institutions, so that botanists by quoting numbers could aid each others' determinations. Of course the sets were unequal; they could not be otherwise : but the most complete contained *D. alata, D. birmanica, D. bulbifara, D. decipiens, D. ddtoidza, D. esculmta, D. gibbiflora, D. glabra, D. Hamiltonii, D. hispida, D. kamoonensis, D. laurifolia, D. melanophyma, D. oppositifolia, D. orbiculata, D. pmtaphylla, D. pubera, D. tomantosa,* and *D. trinervia.*

Beyond all doubt it is reasonable to take the date of the distribution of these specimens as the commencement of a new period : and to assure ourselves that India, despite its size, was already vastly better explored botanically than any other part of the East.

WKile Wallich was in London sorting and distributing the Company's Herbarium, Victor de Jacquemont was making his great exploring journey through the north-western Himalaya. Landing at Calcutta in 1829, he traversed the Gangetic valley as far as Saharanpur and then went into the Himalaya *via* Jaunsar, returning to the plains through JummDO, whence he journeyed southwards to die in 1831 at Poona when almost due to sail for France. His diary was published posthumously as *Voyages dans Vlnde* : his collections are in Paris. He had not added new Dioscoreas to those obtained by others, but had traced the range of *D. ddtoidza* and *D. kamoomsis* from their first known habitats towards the west.

JacquemDnt's last specimens were obtained in the hitherto neglected Bombay Presidency; and they included *D. pmtaphylla* var. *Jacqusmontii.*

When the study of the plants of Bombay commenced, it was not altogether through army medical officers, as in Madias and Bengal. The first Bombay botanist was John Graham, Deputy Postmaster from 1828 to 1839, whose *Catalogue of plants in Bombay* appealed posthumously. The work of studying the flora was next taken up by Alexander Gibson and Nicol A. Dalzell. It is true that Gibson began as an army surgeon and was then in control of a small Botanic Garden at Dapuri in the Ratnagiri District: but his work Dn the flora was done as a Conservator of Forests, 1847-18BD; and his CD-author in a *Bombay flora,* N. A. DalzBll, was likewise a Conservator of Forests. The results of their labours did not appear within the period of the first eighty years from the date of the *Species Plantarum.*

A compatriot of Jacquemont, Louis Hyacinthe Boivin, left in his collections specimens from Bombay, but they were obtained for him by others.

Hooker and Thomson in their *Flora Indica* |pp. 69-71) name other botanists of India of this period and tb.B reader may be referred to it for those who did not leave behind th.B materials connected with the gBnus *Dioscorea.*

Early work in ths remoter East.—The visits of Kasmpfer and Thunberg to Japan have besn mBntioned. Kaempfer stayed two years, Thunberg one. The latter tells us that he had recourse to turning over the fodder brought into the Dutch factory as a means of finding plants. He was able oncB to make the journey to Kyoto with the annual mission of ceremony; otherwise unless at the beginning Df his stay, he was under detsntion in DB shima. A curious and intsresting light on the success which attended the methods of thB Japanese rulers, is seen in the way Europe was than, and remained for a vsry bng time, completely misinformed as to the amount of rice-cultivation in Japan.

In 1823 F. P. von Sisbold occupisd ths post which Thunberg had once held, retaining it for ?ix years and making many friends among the Japanese, getting to know so much that he

fell under suspicion and suffered the confiscation of such collections as he had with him at DB shima at the time. He had gathered the same Dioscoreas as his predecessors and in addition *D. gracillima.* Hendrik Buerger followed him and then other surgeons who likewise collected plants, such as 0. Gr. T. Moehnicke and P. F. W. Gtoering. It was just those DiDScoreas which had been obtained already that they too obtained.

ErDering's plants were found in bundles at Buitenzorg by Zollinger when he visited Java in 1842, and in return for arranging them, he was allowed to distribute the duplicates to herbaria in Europe.

During Buerger's period of office in Japan, the first Russian botanist reached Pekin overland. This was Alexander von Bunge, who after four years of medical service in Siberia, was in 1830 attached to the Eleventh Russian Ecclesiatical Mission. He collected both in going and in returning, obtaining *D. nipponica* and *D. opposita;* but such was the condition of taxonomy at the time that he misnamed both.

The taxonomic position at 1830.—All the common species in the year 1830 were passing under more than one name. *D. bulbifzra* as a wild plant was well recognized; but when found in cultivation it was not recognized : yet botanists such as Blume must have seen it alive in both conditions. *D. alata* was passing in herbaria and books under no fewer than nine names mostly altogether obscure, though the name "alata" was never misapplied. *D. hispida* as a species was reasonably recognized, but owing to misdirection by Linnaeus, there was no agreement in regard to its name. *D. oppositifolia* was in some confusion among writers in India who had not isolated *D. spicata* from it, and the species of the further East were greatly confused.

D. deltoidea and *D. tommtosa* were satisfactorily established names, and *D. glabra* was on its way to recognition, as well as *D. pmtaphylla;* but efforts to understand why Linnaeus had made two species of the last, kept its outline hazy and caused what should have been excluded to be included.

The following species were not confused, for the names WBIB based on single gatherings, or almost so:—*D. filiformis, D. japonica, D. laurifolia, D. nummularia, D.punztata, D. transversa* and *D. salicifolia.* But it cannot be said that a species represented by so little material as these were was really known.

D. pubsra, was passing under two names. *D. birmanica,* which Buchanan, who segregated intensely, thought distinct, had been confused by Wallich; and *D. Hamiltonii* which was Buchanan's *D. incrassata,* Wallich had placed with a query alongside *D. esculmta*—-a very poor suggestion. *D. pyrifolia* had received a manuscript namB from Wallich and *D. trimrvia,* another from Roxburgh; but these names had not been distributed to botanical institutions. *D. bancana, D. gracillima, D. luzonensis, D. mzlanophyma, D. myriantha, D. orbiculata, D. polyolaies* and *D. tokoro* had been collected but had not yet received names.

Bunge's error of attaching the name *D. quivqwloba* to *D. nipponica* had appeared and has proved extremely tenacious |see p. 63). That greatly misused name "*D. sativa"* he had attached to *D. opposita. D. Wallichii* was confused with *D. esculmta,* which species itself was in the very greatest confusion |see p. BO); while *D. opposita* was in a like state.

The well-established species, out of the total number of 154, make a extremely poor showing Dn the above statement.

From 1830 to 1859.—The next period ends with the publication Df Kunth's great *Enumzratio Plantarum,* VDI. 5, which complete work, incidentally, has been the last attempt made by one man to compass the whole range Df the Flowering Plants. A preliminary paper shows that he closed what he had written regarding the genus *Dioscorea* in the year 1848, by which date various valuable collections adding considerably to the knowledge of 183D had reached Europe. Before the position in which Kunth left the genus can bE set down, the work of the field collectors must be dealt with.

In the first place the Spanish priest, Manuel Blanco, must be mentioned. He wrote a *Flora de, Filipinas* |1837) : but, untrained and isolated, he fell into many errors ; Merrill *Species BlancoanaE,* 1918, p. 33) shows that his was a Flora notsD much of the Philippines as of the Provinces near Manila, because his means of collecting were limited.

Wallich returned to India from leave in 1832 and found himself Secretary to a Committee appointed by the Governor-General to report on the possibility Df introducing tea-cultivation. It fell out that almost immediately after this the occurrence of the tea-tree in India was announed, and as it had been found towards the north-eastern borders, attention was directed to Assam.

William Griffith, a surgeon DII the Madras Establishment was summoned to Bengal and in 1837, in company with Wallich, crossed the Khasia Hills to Gauhati, and then, when Wallich retraced his steps, went to the head of the Brahmaputra valley, into the Mishmi Hills, and made his astonishing journey over the Patkoi southwards through Burma. Reported dead, he returned to India through RangDon,"and was SDDn engaged Dn further expeditions, one being with PembcrtDn through Bhutan. He was a most assiduous collector, outstanding enough as a botanist to have earned a place in F. W. Oliver's *Makers of British Botany* |1913, pp. 178-101), diligent in making notes; and his extensive papers were printed after his death under the editorship of the zoologist John McClelland, who with J. W. Masters, Head Gardener of the Botanic Garden, Calcutta, served like Griffith, Dn the Tea Commission.

Wallich, Griffith, McClelland and Masters during this investigation collected *D. bulbifera, D. glabra, D. hispida, D. hpcharum, D. melanophyma, D. pmtaphylla, D. Prazeri, D. pubzra, D. trinervia* and *D. Wattii—n* very good sampling of the Dioscoreas of north-eastern India. Griffith in a report to the Government thought it well to insist on the need of studying the vegetation which Nature produces with the purpose of knowing what Man can substitute, i.e., how and where the cultivation of the Tea-tree might be introduced.

With a market for sets of herbarium specimens developing among scientists, R. F. Hohenacker, who had collected himself in the nearer East, hit on the idea of employing a collector to go over the ground whence Rheede's plants had come and found in a missionary named Metz, of Mangalore, a willing agent. Metz began at the coast, but soon worked back into the mountains far beyond the range of the plants known to Rheede's staff. His earlier specimens, those of the years 1B45 or 1843, were indifferent: those from the Nilgiri Hills obtained later were better. Metz naturally obtained plants which Rheede had not seen, such as *D. Hamiltonii* and *D. tomentosa.*

The possibility of meeting the costs D! an expedition by the sale of duplicate material seems to have told with three good collectors. One was Hugh Cuming, who in 1835 fitted out a small schooner and sailed to the Philippine islands where he worked until 1839, visiting very many bays all down the west side of Luzon and the coast of the islands southwards t$_D$ the north side of Mindanao. In 1837 J. W. Heifer, a surgeon of Prague, went to

Tenasserim and collected in the Districts of Tavoy and Mergui, just getting into Siam and crossing over to the Andaman Islands. He died in 1840, his work unfinished, and left a herbarium mostly unlabelled. In 1842 H. Zollinger, the Swiss botanist who has already been mentioned in connection with the distribution Df Goering's Japanese plants, went to Java and began a long period of collecting in the Dutch Indies: his wanderings are indicated in the introduction to his *Systematisches Verzeichniss.* Some of his Javanese collections reached Kunth in time for study before thB account of the Dioscoreaceae was issued in the *Enumeratio Plantarum ;* and so did all those of Duming.

Ws are now in a position to weigh the results of work to the date of Kunth'a extremely laborious undertaking. Apart from an artificial dividing of the genus into *Dioscor&a* for a part only, and *Helmia* for the rest, he swept everything together in a convenient way; and what he could not sieve, he left as he found it, with the following result.

The cultivated species werB far from being understood. *D. alata* he mentioned but did not describe, and he was puzzled by Roxburgh's names *D. atropurpurea, D. globosa, D. purpurea* and *D. rubdla.* He could not place Loureiro's *D. eburina.* Having an actual specimen of *D. escuknta* he described it, but under the now name of *D. tiliifolia,* apart from the synonyms *D. saliva, D. aculeata* an d *D.fasriculata* which remained standing as for three other and independent species. HB did the same with *D. opposita:* having an actual specimen he described it as a new species under the name *D. Goeringiana,* while he left as he found jit the strange confusion of *D. opposita* with *D. oppositifolia. D. deltoidea, D. glabra* and *D. kamoonmsis* he described well, reaping the benefit of Wallich's distribution of the collections of the East India Company, picking out the last from among material of *D. pentaphylla.* Cuming's plants served him for material by which to define *D. myriantha* and *D. pyrifolia:* Zollinger's by which to define *D. nummularia* and *D. Zollingmana.* On another specimen of Zollinger's he described *D. cornifolia* but it is not a good species; and on yet a fourth he made *D. vilis* which is scarcely different from Blume's *D. filiformis.* The following species he took from books, not having specimens in Berlin, nor finding them elsewhere:—*D. cirrhosa, D. divaricata, D. filiformis, D. hastifolia, D. japonica, D. punctata, D. quinqueloba, D. salicifolia, D. septemloba, D. spicata* and *D. transversa* and (under the name *D. anguina* as well as its own) *D. pubera.* He recognized but could not quite circumscribe, *D. bulbiftra, D. oppositifolia* and *D. pentaphylla* and out of the last named he separated his *D. Kleiniana. D. hispida* so far defeated him that he had it under five names.

A circumstance to be noted with humility is that the more a species had attracted attention, the more difficult had its recognition become ; and that thB unconfused names were those based Dn individual gatherings.

The Himalaya from 1850 to 1909.—Relatively little was known to Kunth about Himalayan plants ; and the time for attention to the flora Df this great range actually set in while he was at work. A trigonometrial survey of Kumaon was in progress from 1846 under Captain (afterwards Lieut.-Gen. Sir) Richard Strachey and continued to 1849. During that survey he was joined in 1848 by Lieut. J. E. Winterbottom and at one time had Lieut.-Col. Edward Madden of the Bengal Artillery as a companion. The Survey collected botanical specimens and the data added to the labels deserve praise. All the Dioscoreas of the hills were obtained.

While Strachey and Winterbottom were occupied in Kumaon, Thomas Thomson, of the Bengal Medical Establishment, was on a mission of exploration (commenced in

1B47) which passed into the Upper Indus valley via Simla and returned to the Plains via JummDD |see his *Western Himalaya and Tibtt*, 1852).

At this time Sir Joseph Hooker, then a Naval Surgeon, sought an opportunity of travel in the Himalaya and selected, with the approbation of the Governor-General of India, the mountains of Sikkim. Arriving in Calcutta in January 1848, he went via Dhota Nagpur to Darjeeling and during the summer months organized a staff Df collectors by a reconnaisance of the Flora in the vegetation of the outer hill-faces ; then he made those remarkable explorations, first just within the edge of Nepal and then through Native Sikkim, which attracted SD much attention. Next, joined by Thomas Thomson, he sought permission to travel along the chain in Nepal, but this being withheld he turned his attention to the Hhasia Hills (1850). The travels, as all know, were described in the *Himalayan Journals*. The collections were widely distributed, usually with approximate localities, but in the Kew Herbarium is often to be found a record of the exact place at which the collecting was done. *D. bulbiftra, D. hispida, D. kamoonensis, D. pmtaphylla* and *D. Praziri* were obtained in the Sikkim Himalaya: the last named was not described but noted as possibly a new species. None Df the Sikkim *Enantiophylla* were preserved : perhaps they were lost by some such accident as caused the loss of most of the genus *Impatims,* namely the fall of a bundle of dried plants during transport into a river. *D. behphylla, D. glabra, D. Hamiltonii, D. hispida, D. pentaphylla, D. pubera* and *D. trinervia* were obtained in the Khasia Hills.

Hooker put the upward limit Df *D. bulbifzra* at 915 m. and of D! *pentaphylla* at 122D m. Both have been found a little higher since.

Thomas Thomson was back again in the Sikkim Himalaya in 1854.

The brothers Hermann, Adolph and Robert von Schlagintweit from 1854 tD 1858 explored the North-western Himalaya and the Khasia Hills. Their results were published under the name of the first of the three between 1BB5 and 1885 as *Reiszn in Indim und Hochasien*. Except two species collected in the Alaknanda valley of the District of Garhwal, no Dioscoreas of their gathering are known tD us.

Thenceforward the infinite attractiveness of these giant mountains was to draw many botanists, having a little leave to spend, to their hill-stations ; and the founding of the Cinchona Department in Sikkim led to the retention there of a permanent staff with an interest in plants. Sir Henry Collett's *Flora Simlmsis* was the result of work in leisure hours during periods of duty at Simla. J. L. Stewart, as Conservator of Forests, Punjab, enjoyed opportunities for collecting during the years immediately prior to 1872. C. B. Clarke in 187B travelled through parts of Kashmir. J. R. Drummond, during the years of his service in the Punjab Commission, 1874-1905, collected in various parts of the edge of the mountains.

Military operations in Afghanistan in 1878 enabled J. E. Aitchison to survey the Kurram valley botanically and in 1884-1885 he was naturalist on the Afghan Delimitation Commission. He had been at earlier dates a medical officer in the Jhelum District and had been sent to Leh, at the very back of Kashmir.

Sir George Watt in 1879, making a vacation trip to the sources of the Bhagra river, met J. H. Lace, then a Forest officer in Chamba and suggested that he should collect: the result was a list *oi* the Flora of that State.

J. F. Duthie travelled in the Himalaya near Saharanpur during the earlier years of his service in India, was in Kashmir in 1892 and 1893, reaching Gilgit and Skardu in the first Df these years and the DeDsai plains in the second. He sent collectors from Saharanpur through the Hazara District and into Pangi in 1899.

During the expedition for the relief of Chitral in 1895, a medical officer, lieutenant 'Stanley Arthur Harriss was found willing to direct the work of a native collector and General Sir William Gatacre, who was in command, occupied what leisure he had in collecting.

J. S. Gamble, as Assistant Inspector-General of Forests, was in Simla at intervals from 1877 tD 1879, then was at times in the Sikkim mountains between 1879 and 1882, and at Dehra Dun from 189D to 1899 ; and he collected in these parts Df the chain. He published a list of the *Trees, shrubs and climbers of the Darjeeling District* in 1877 and a revised edition of that list in 1895, and an excellent account of the aspects of the vegetation in the *Indian Forester* |1, 1875, p. 73). The Kingdom of Nepal was not quite neglected, for John Scully, a Medical Officer, collected a little and employed collectors near Khatmandu.

The Cinchona enterprise brought Thomas Anderson to the Darjeeling Hills in 18B4, and after him Sir George King and others. William John Treutler in 1874 made a bng holiday trip through the Sikkim Himalaya. The Daphla expedition of **1874-1875** enabled J. L. Lister, then of the Cinchona Department and attached to the expedition, to collect a little in a hitherto altogether unexplored part.

Hong Kong, the Botanists' gate into China.—Hong Kong was ceded to Britain in **1841** and almost immediately became a new centre for the study of plants, which in an interesting way brought into being considerable co-operation between Britain and the United States of America.

To Hong Kong in 1844 the scholarly Henry Fletcher Hance went and immediately started tD botanize in his leisure: his first botanical paper appeared in 1848 : his connection with China lasted until his death in 1885, and many, botanists by inclination or persuasion, (Bretschneider in his *History of European Botanical Discoveries in China,* 1898, mentions more than forty) formed his school, referring tD him for his opinion whatever was puzzling in their collections. A year before Hance's arrival in Hong Kong, Robert Fortune had passed through on his way to the Tea districts in search of horticultural plants. In March 1854, the United States exploring ship "Vincennes" brought Charles Wright to Hong Kong. Wright collected through the Warm season and Rains and returned in January of the next year for a second period of collecting which lasted until April. Herewith commenced the first CD-Dperation between Britain and the States, for the working up of Wright's plants was entrusted to Bentham at Kew, who with their aid wrote his *Flora Hongkongensis,* 1861.

The second case of co-operation may be mentioned at once : it was between Forbes and Hemsley and ended in the publication in the *Journal of the Linnean Society of London* |VD1S. 23, 25 and 33) of the *Index florae Sinensis.* F. B. Forbes had arrived in HDIIP Kon in **1857** attached to an American political mission and had remained there in busin ess ; after a time he came under Hance's influence ; and as a consequence when he found him If in London he elaborated the literature on Chinese plants and making his papers over t se committee which had been formed tD report on the knowledge of the Flora of Dh" f o a *Journ. Linn. Soc. Lond.,* Bot. 35., 1905, p. vi), and through them to W. B. H sley, entered into their joint publication.

The third co-operation was in the person of E. H. Wilson whose early explorations were done from Britain and whose later were done from the Arnold Arboretum, Boston, Mass.

In 1872 the Hong Kong Department of Gardens and Afforestation was created and thereby a permanent botanical investigation instituted. It has been carried Dn successively under Charles Ford, 18B2-19D2, S. T. Dunn, 1903-191D, J. W. Tutcher, 191D-1921 and Harold Green from 1922 all of whom have been named in our pages as collecting Dioscoreas. The addition to the colony of Hong Kong in 185D of the district of Kow-loon extended the area for their study and gave them mountains rising to 95D m.

In 1855, the missionary Rudolf Krone was sent to Canton where he remained until 1851. He collected there and Dn one occasion reached a hill recorded as 915 m. high, which would seem to have been a part of the Loh-fau shan |15DD in. high). Missionaries in Canton have carried forward work such as his, particularly those attached tD the Lingnam University. In the *Hong Kong Naturalist* |5, 1935, p. 187) may be found in considerable detail an account of the such exploration Df the Province of Kwang-tung as has been done from Canton.

A similar review exists for the Province of Fu-kien |H. H. Uhung in the *Lingnam Science Journal,* 7, 1928, p. 121) and another covering a wider field has been given in a paper by F. P. Metcalf |the same Journal, ID, 1931, p. 1D1).

Japanese, isolation ends.—In 1854 the Japanese opened to foreign commerce two Df their ports, Shimida and Hakodate: a few years later they opened also Niigata, Hyogo (Kobe), Nagasaki, Tokyo, Osaka and Kanagawa : at the same time they permitted foreign residents to travel within something like a day's journey on foot around the opened ports. The Russian botanist, Carl Johann Maximowicz who had already collected on the coasts near Vladivostock and along the Amur, was the first to use this new opportunity. In 18BD he took up his residence at Hakodate and collected within a radius of about 23 milea. Next he went to Nagasaki and then tD Yokohama and lastly tD Tokyo. A year after hia arrival Richard Dldham went tD Yokohama for horticultural plants Dn behalf of Kew : and three years later Louis Savatier, a French Naval surgeon, arrived on his first but short visit. He returned in 18BB and remained, chiefly at Yokosuka on Tokyo Bay, until 1875. About 1855, James Bisset went tD Japan and lived there as a merchant for a considerable time.

MaxiniDwicz's collections of lowland plants were extensive, but he was forbidden access to the mountains. He trained a Japanese assistant named Tchonoski, who, not being restricted in hia movements, was able, after Maximowicz had left, to collect further afield and remit his collections tD Maximowicz in St. Petersburg.

Liberty Df movement in Japan becoming free, J. J. Rein, in 1874, travelled about the country for twelve months, chiefly in the central and southern parts Df Nippon (see his map in *Petermanns Mittheil,* 25, 1879, p. 293) studying rural economy : and Charles Maries, seeking plants of horticultural value, tramped across Nippon, northwards to Hakodate and back. Textor, a Dutch horticulturist, visited Japan on a similar mission.

The Austrians sent a mission tD Japan in 1879, whereof the surgeon Emanuel Weiss collected a herbarium. The expedition went to Nagasaki, visitedHiradD shima, where the Dutch in early days had traded, and proceeded to Yokohama. In 1879 Kanitz published a list Df the plants collected by Weiss, and Franchet commenced to publish his *Enumzratio Plantarum in Japonia,* based chiefly on Savatier's collections and conjointly with Savatier.

The missionary Urbain Faurie began his collecting in Japan in 1885, chiefly about Hakodate, Nemuro, Otaru and Aomori ; and he continued tD collect through a long and diligent life, during which he visited Corea, Formosa and other places.

The Japanese love flowers and have long had their own literature Dn them. It was now time to connect this literature with the knowledge Df the West. Franchet and Savatier's *Enumeratio* gave them what was needed and they were [juick to make use of it. One of their botanists Mr. Tomitaro Makino became particularly interested in the genus *Dioscorea,* and in 1888 demonstrated that the commonest of the Japanese species needed a new name—his *D. tokoro*—and in 1889 that a montane plant passing in books as *D. quinqueloba* being in like case, might be called *D. nipponica.* He has since done very much towards bringing the names of western science to his countrymen.

Augustine Henry's work and his stimulus.—Henry went tD China in 1881 as a physician in the Chinese Customs Service. After four years, when posted to the river-port of I-chang Dn the Yang-tze kiang, he commenced to study the flora of central China. The river above I-chang passes through a long gorge where the rough cliffs and ravines Df the side streams bear a vegetation which escapes the destructiveness of Chinese agriculture. This he could examine from I-chang : and to collect further afield he trained Chinese who brought large collections tD him : further he made a vacation trip tD the north-west of his station which took him tD the border Df Sze-chuan. In 1889 he was transferred tD Hai-nan, where he continued his collecting, but was not there bng before he proceeded on leave. On returning to China, he was posted (1892) to TakaD in Formosa, where he made new collections by the same methods. At a little distance inland was the village Df Bankinsing, where his chief collector lived, and by the agency of a lighthouse keeper he procured plants from the extreme south of the island, He was in Formosa until the Japanese took over the government ; then he was sent (1896) to Meng-tze in eastern Yun-nan and (1898) to Sze-maD in southern Yun-nan. His collectors from Meng-tze travelled as far north as Mi-le, and southwards for a somewhat less distance. At Sze-mao he was cbse tD the Shan frontier. No one has made in China such valuable collections as his.

A wealth Df horticultural material was made evident by them and the firm of Messrs. Veitch and Co. decided to send a collector to Henry's first area: they chose Ernest H. Wilson who from 19D0 tD 19D2 remitted material to them from Hu-peh, north and east of I-chang, and from the Province Df Sze-chuan.

While Henry was in China Baron A. von Rosthorn was there tDD ; and he decided to copy Henry's method Df collecting : several collectors were then employed for a short time by him north-west, north and south of Henry's area in Hu-peh |cf. Bretschneider, *European Botanical Discovzries in China,* 1898, p. 1093.) We think that part of the material which he remitted to Europe still lies undetermined : for all that we have seen, is labelled as from Nan-chuan, i.e., from the eastern parts Df Sze-chuan towards Kweichow.

Henry published a list of the plants (1297 in all) which he had collected in Formosa. After his departure the Japanese, working from Tokyo, under Professor Bunzo Hayata, quickly undertook the further study of the botany of their possession, and in 191D Kawakami (.4 *list of plants of Formosa)* enumerated 2,DB6 species, adding two Dioscoreas tD those known. In his *Enumeratio plantarum in Insula Formosa* (Journ. CDII. Sci. Imp. Univ. Tokyo, 22, 1906), Hayata has recorded the names of the Japanese botanists of Formosa to that year, which happens to be the year in which Kawakami commenced his work. The names of more recent workers will be found in our pages.

The Russian explorers and northern Cfcma.-Mention has been made of Bunge s iDurnev (1B30-1B31) to Pekin with the Eleventh Russian Ecclesiastical Mission, when he obtained *D. nipponka* and *D. opposita* and misnamed both. Kirilow was on the Mission as physician and he too collected *D. opposita.* Unlike Bunge, he stayed the ten years of the Mission and explored from Pekin as far as the Po-hua shan, say to sixty miles westward. Tatarinow was attached to the Twelfth Mission and stayed in Pekin for the next ten years, after which he explored in Jehol. Basilewski was surgeon to the Thirteenth Mission and: collected from 1B49 to 1859. Bretschneider went to Pekin in 1868 as physician to the Russian Legation and stayed until 1883. As contemporaries were Dtto von Moellendorf of the German Consular Service and S. W. Bushell, physician in the British Legation.

The value of mentioning so many names of botanists who have lived in Pekin, lies in the evidence afforded of the abundance there of *D. nipponica* as proved by the circumstance that they all collected it.

The Russian habit of approaching Pekin through Siberia led them across" the upper f the River Amur. In. 1854 General Muraviov opened that river to navigation aters lownwa^ds to the sea and in the next year Maack botanized along it. In the following year MaxiniDwicz returned by that route from his first coastal explorations, and a year later Radde was on the river. Von Schrenk and Maximowicz were there again in 1859. All these collected *D. nipponica* on its banks. Owing to SD much of their records being T? ' n they are not easy to use ; but the general impression obtained is that this in ussia ^i^+ifni frrjin a little above Blagovestschenk for a considerable distance *Dioscorea* is pienumi uw => downwar d but scarcely along that part of the course of the fiver which is most to the northward.' It appears to be plentiful on the banks of tributary rivers from the south; and Komarov, who devoted the years 1895-97 to exploring in Manchuria as far as the f P Corea has a very long list of localities at which he found it (see *Act a Hort. Petrop.,* 20' 19D1' p 85). Boris Fedtschenko has collected it relatively bw down the Amur in recent years. frontiers o

The Province of Kan-su naturally came in for attention by Russian travellers : but P ewalski's four journeys in that part of Asia seem *to* have been undertaken beyond the IZB of *Dioscorea,* except when he visited Pekin. Piasetsky in 1874-1875 obtained one rangB *D javonic'a.* Potanin, when in 1893 he passed out of Kan-su southwards, found SPBC ies mo e species, and it seems from his records as if the hardiest just cross the border into Kan-su from Sze-chuan.

The missionaries in C^nfl.-Missionaries, by interesting themselves in the flora of China have done excellent service, either by exploring expeditions or by the investigation of the' vegetation near their stations. The first has been named-Loureiro who resided at n f n fnr three vears after his thirty-six years in Anam. Then came a long interval, Canton ior- Maxime Marie CaU,ry at Macao After broken only by

Twhodeserves mention was Armand David (posted to Pekin in 1862). From Pekin Tvid explored in Mongolia and then up the Yang-tze valley into the Province of Sze-h n through which he passed to Mu-pin : in the third place he explored the upper Han c ua h d in southern Shen-si. Ernst Faber, likewise a missionary, reached Hong Kong water-s e in reached Pekin, and he too collected up the Yang-tze valley thre rs and Ltr Sze-luan, reaching Mount D-mei.

The end of the nineteenth century ushered in the work of Emile Bodinier in Pekin, TT Kong and Kwei-chow; Julien Cavalerie and Paul Chaffanjon in Kwei-chow ; J ong Marie Delavay in north-western Yun-nan ; Francois Ducloux in Yun-nan-fu ; J0SBph ean

Esquirol in Kwei-chow ; Paul Farges in north-eastern Sze-chuan ; Guiseppe Giraldi in southern Shen-si ; E. E, Maire in Yun-nan-fu ; L. Martin in Kwei-chow ; Theodore Moubeig at Tse-kou in the extreme north-west of Yun-nan ; Hugh Scallan in Sze-chuan and in Shen-si; CiprianD Silvestri in Hu-peh; Jean André SDUIIB in western Sze-chuan : and, away towards the north, Urbain Faurie of Japan, who collected in Corea as well; T. Tacquet who collected in the island of Quelpart; and Ralph G. Mills who has given us an account of the vegetation of a small area in northern Corea near the Ya-lu river. He likens the climate there to that of the lower Provinces of Canada.

Exploration of French Indo-China.—Loureiro left the service of the King of Anam in the year 1777 and after the period of three years spent in Canton and after p. delay in Mozambique, reached Europe in 1782. In 179D he published his *Flora CoDhinchimnsis.* From that date a very long time passed before any further botanical information was drawn from what is now French In do-China, in fact none until after Saigon had (1859) been made à French port and after Tonkin had (1885) become a French Protectorate.

In 1855, in order that a Botanical Garden might be laid out, Jean Baptists Louis Pierre, once on the staff of the Royal Botanic Garden, Calcutta, was invited to Saigon. From Saigon he collected diligently, chiefly in two areas, the one comprising the undulating Provinces CIDSB to Saigon, the other the mountains towards the Gulf Df Siam. He continued to collect until 1877 when he went to Paris to prepare his *Flore forestière dz la Cochinchine.* During the early years Df Pierre's service in Saigon, collections were made by Thorel, and by Harmand, in the course of political journeys. In 1879 came Pavie's Mission, a continued period (1879 to 1B95) of establishing communications, mapping and opening up the country from Saigon to Tonkin (Pavie, *Travaux,* 19 Dl) in the course of which no fewer than forty European officers were employed. Botanizing was secondary, but done by some of them.

After 1885, the missionary H. F. Bon, who had been for a time in Hong Kong, went to western Tonkin and continued to collect in his new surroundings. Dne year earlier, B. Balansa, a professional collector, had arrived in Indo-China, and, after paying visits tD a few places in the south, had settled to collect in the rugged but limited montane area Df Mount Bavi, to the south-west of Hanoi : thence he moved to the Provinces to the north-east of Hanoi and after four years of work put considerable collections on the market.

In 1909 LecDmte issued a map to indicate how far French Indo-China had been botanically explored. The map must be seen to realize what wide areas remained untouched : it shows Anam neglected except in the neighbourhood of Hue, the whole interior Df Tonkin neglected and the rest but partially worked. Towards remedying this defect and in order that his *Flore générale dz VIndo-chinz* might be a more lasting work, collecting was speeded up and much territory has been traversed for plants, chiefly by the activities of Eugene Poilane, while several volunteers have collected in different parts. Gagnepain |in *Ann. Mus. Col. Marseille,* 34 or 4 of ser. 4, 1925, p. 1) has reviewed their work.

Siam was still less worked at the commencement of the current century than IndD-China This is easy to realize by a reference to F. N. Williams' list Df the plants known in 1904 to occur in that kingdom *{Bull. Herb. Boiss.,* ser. 2, 4, 1904, p. 217). The brevity of the list is eloquent, and there are no Dioscoreas in it. Since then under the auspices of a Government Department directed by Dr. A. F. G. Kerr, every administrative Circle has received some attention and much information has been got together. Also in 19D4 C. C. Hosseus made collections in Siam.

India, proper, from 1851 forward.—Early in this period administrative changes were made which led to an increased amount of botanical study. In the first place a Forest Service was established |185B) ; then the Cinchona enterprise took shape (I860) : this was followed by a resolve tD teach Science in the colleges (about 1873) and at the same time there was a widening of the scope of the few existing Museums and the creation of new ones.

The establishment of the Forest Service made the greatest difference. Sir Dietrich Brandis, who from 18B4 was Inspect or-General, botanized. Colonel R. H. Bediome, as an officer of the service in southern India, did the same, studying in particular the plants of the Pulney Hills in the District of Madura and of other hills with forests under his charge, betweSn 1857 and 1882. J. S. Gamble's work in various parts of India was conspicuous |1871-1899). W. A. Talbot became the first to make known the botany of the Malabar forests and spent the years 1876-191D in service there or in other parts of the Bombay Presidency. T. F. Bourdillon controlled the forests of Travancore from 188B to 1908. G. M. Eyan wrote Dn the forests Df the Thana District. R. S. Hole, H. H. Haines, C. *G.* Rogers, C. E. C. Fischer, R. N. Parker and J. M. Cowan did the same for other areas.

But the greatest individual collections were those made by C. B. Clarke, who entered the Bengal Education Service in 18B5 and during inspection tours or vacations collected on all possible occasions : and those which Sir George King as Superintendent Df the Royal Botanic Garden, Calcutta (1B71-1898) and Director of the Botanic Survey of India **(1891-**1898) caused tD be made.

In 1873 Sir George Watt entered the same service as C. B. Clarke and while in it and when later seconded as Reporter on Economic Products to the Government of India, collected much, chiefly in Bengal, Assam, the Central Provinces and Gujarat.

In 1882 M. A. Lawson resigned his Professorship at Oxford to become Director of the Cinchona Department in Madras and from that time his residence in the Mlgiri Hills enabled him to collect assiduously.

Contemporaneously with this field-work Sir Joseph Hooker's *Flora of British India* was in preparation : the first part appeared in 1872 ; the last in 1897. Trimen, tDD, was occupied in writing a *Handbook to iht Flora of Ceylon,* issuing the first part in 1893 : the work was completed by Sir Joseph Hooker in 19D0 after Trimen's death.

After these dates suggestions were made and adopted for the preparation of Indian local Floras : these suggestions are fully explained in the first which appeared (Prain, *Bengal Plants,* 19D3, p. 2). The other Floras are the *Flora of the Bombay Presidency* by Theodore Cooke, the *Flora of the Upper Gangetic Plains* by Duthie, now being completed by R. N. Parker, the *Botany of Bihar and Orissa,* by H. H. Haines and the *Flora of the Presidency of Madras* by Gamble, completed by C. E. C. Fischer. Besides these complete Floras, ex *parte* Floras have appeared such as sometimes give information on the genus *Dioscorea* and sometimes do not, e. g. :—Bourdillon, *The Forest Trees of Travancore,* 19D8 ; Witt, *A list of trees, shrubs and climbers of the Berar Forest Cirdz,* 19D8 ; Hole, *A list of trees, shrubs and climbers of the Northern Forest Circle, Central Provinces of India,* 191)6 ; R. N. Parker, *A forest flora for the Punjab,* 1924: A. E. Osmaston, *A forest flora for Kumaon,* 1927 ; Heinig, *A list of Plants in the Chittagong Colledorate and Hill Tracts,* 1907, etc.

Alston has added a supplementary volume to Trimen's *Handbook of the Flora of Ceylon* (1931).

Collecting in the mountains towards the north-east of India.—The specimens obtained by Wallich's collectors had not been accurately localized ; but it is evident that the Khasia Hills had been visited from the south face before he, with Griffith, crossed the hills from south to north and the records became more precise. Next came Hooker and Thomson's visit, when 2,5DD species were obtained (see the *Himalayan Journals,* ed. of 1891, p. 521) mostly from the Khasia Hills, but some from the Jaintea Hills. Dne of us spent a year in the Naga Hills. Dollett, Watt and Clarke next succeeded in botanizing in Manipur ; Keenan and Draib made collections in the Dachar Hills ; small additional packets of plants were brought from the Naga Hills : the Garo Hills came in for an investigation, where latterly Mrs. Parry has collected : Gage visited the Lushai Hills in 1899 and thence quite recently the missionary, W. J. L. Wenger, has sent plants : Heinig collected in the forests of DhittagDng and in the Dhittagong Hill Tracts. Into Northern Arakan which is just to the southward, Kurz had penetrated in 1869. Dne of us visited Akyab in 1907 and travelled tD the edge of Northern Arakan : otherwise Arakan has been neglected.

Collecting in Burma and other parts of Western Indo-China.—The resources of Burma in teak were undergoing rapid destruction, when in the middle of the last century Sir Dietrich Brandis was appointed (185B) to arrest the damage. In Burma, he collected plants; and in 1854 he became Inspector-General of Forests, India. In the same year Sulpiz Kurz was taken into service and started, working from Calcutta, that study which ended in the publication of his *Forest Flora of British Burma,* 1877; and three years earlier in the *Journal of the Asiatic Society of Bengal* (43/2, p. 42) he had enumerated the collections which he had made to that date. His observations were available through those two publications for use in all the parts of the *Flora of British India* except the very first.

In 1858 John Anderson, a zoologist, went to Yun-nan Dn Sladen's mission, and collected plants. Such Dioscoreas as he obtained are those which grow in Burma and appear to have been gathered before the border was crossed.

Between 1885 and 1888 Sir Henry Collett, who was in command of a Brigade in Burma, collected in the Shan Hills and in central Burma, where he ascended Mount Popa. This was the beginning Df a series Df opportunities for botanizing which he had about the edges of Assam and Burma. In 1895 Abdul Khalil was sent from the Botanic Garden, Calcutta, to continue his collecting in the Southern Shan States. In 1897 Lieutenant E. Pottinger made an exploring expedition into the Kachin country, bringing back a small collection of plants : and this led to another nativB collector from Calcutta being sent to Burma—Shaik Mokim, who under the direction of Lieutenant Cruddas collected to the northward of Myitkyina. In 19DD and 19D1 a third collector, J. G. Prazer, was employed by the Calcutta Garden in Burma : he was sent up the Chindwin river. In 19D3 Colonel A. T. Gage made an expedition in Burma, when, joined by Leon Aubert Df the Department Df Land Records, an attempt was mada tD collect up to the watershed Df the Arakan Yomas from the eastern side. The results were published in the *Records of the Botanic Survey of India* |19D4). At that period, and subsequently, much information Dn enonomic plants was brought together by Mr. A. Gaitskell and Sir Reginald McKenna at the instance of the Reporter Dn Economic Products. Captain R. W. MacGregor of the Indian Medical Service, collectedin the Southern Shan States ; Mr. Alfred Meebold collected in many parts; and finally J. H. Lace, as a Conservator Df Forests, got valuable materials together.

The Botany of th& Bay Islands.—On the Andaman Islands in 1788 the East India Company made an establishment but soon abandoned it. It was renewed in 1856 ; and in 1857 the decision was taken tD use it as a place Df detention for the men who had been guilty of mutiny. This meant a considerable organization ; and officers Df various qualifications were required. Rurz, in 18B5, paid a visit to examine the vegetation, and in the course of time it was found possible tD set a convict tD collect plants under the direction of an officer stationed there, usually the Conservator of Forests. The chief collections Df Andamanese plants were obtained in this way, such officers as R. L. Heinig, C. *G.* Rogers and B. B. Osmaston directing the work. Latterly C. E. Parkinson has published a partial Flora—*A forest flora of the Andaman Islands* (1923). Most Df the collecting has been done near Port Blair, the outlying parts and islands receiving less attention. But in 189D one of us visited Barren Island and Narcondam [see Prain in *Proc. As. Soc. Bmgal* for 1891, p. 2D4 and *Journ. As. Soc. Bengal,* BQ, 1891, p. 283, and 62, 1893, p. 39).

The NicDbarese have never resisted the approach of foreigners with that implacability formerly characteristic of the Andamanese ; but though the inhabitants did not prove hostile, the climate did, hindering the study of the flora; but a few small collections have been procured in one way or another.

Uolhding in Malaya.—The turbulence of Chinese immigrant miners in the Malay Peninsula, not in one State only, but in two, led in 1874 to the necessity, for the protection of the Straits Settlements, of somB control Df thB Malay governments. The State least able to control the miners was Perak, which therefore was the one brought most under outside influence, and the establishment of orderly rule made botanizing in the interior of it a possibility. In 1877, Sir Hugh Low being Resident, J. H\ Murton, then Superintendent of the Botanic Gardens, Singapore, was sent to collect in the most accessible part of the State, namely Larut. Three years later Hermann Kunstler, who had been engaged to collect for the Botanic Garden, Calcutta, chose Larut for his first work. Again one year later, Le3nard Wray was appointed Superintendent of experimental gardens on the Larut hills, and in 1884 |i.e., seven years after Murton's visit) the priest Benedetto Scortechini came from Australia in company with the geologist Tenison Woods, to collect also and made the town of Taiping in Larut his centre for work. By the gradual opening up of the.country Kunstler, Wray and Scortechini were able to work back to the remoter parts, Kunstler in 1885 collecting Dn the Main Range, not of Perak, but beyond, in Selangor.

Scortechini died in 1885 and Kunstler went to Australia: the collections of both becoming the property of the Royal Botanic Garden, Calcutta. Murton on leaving the Straits in 1882, had destroyed most of his collections.

Nathaniel Cantley, Murton's successor in Singapore, having been instructed to investigate thB forests of the Settlements, employed a collector, M. V. Alvins, in Malacca, during ths years 1884-88. This collector contrived to make one expedition 'through the States of Negri Sembilan nearly tD its northern border.

But though early enough, neither his work nor that of the Perak collectors named above had any great effect on Hooker's *Flora of British India.*

Ridley arrived in Singapore in 1888 as successor to Cantley and began to collect. Dne of his first expeditions was an attempt with two companions to reach the highest mountain in the Peninsula—Gunong Tahan—through the State of Pahang. This proved an under-

taking tDD arduous in the then condition of the country and the mountain was not climbed until 19D5. Skeat's equally unsuccessful, expedition to it (1899) from the north resulted in collecting by N. Annandale and H. D. Robinson in the valleys Df Kelantan.

It is interesting to arrange in sequence by dates the first visits of botanists to the more conspicuous mountains of Malaya, at least as far as the year 19DD. William Jack went up Western Hill in Penang |830 m. high) in 1818 and was impressed by meeting the Conifer *Dacrydium* there. Mount Dphir, behind Malacca, was ascended in the same year by William Fanjuhar who brought down the fern *Matonia:* Hugh Cuming ascended it in 1839, the surgeon Dxley in 1840, Griffith in 1842, Dxley again in 1848, Maingay in 18S7, Hulbtt in 1882 and 1888, Hervey and Ridley in 1892 and Ridley again in 1898.

The next mountain tD obtain attention was Gunong Jerai or Kedah Peak 11211 m.). Thomas Lobb climbed it in 1845, James Low in 1857, Murton in 1875, Sir Hugh Low and Boxall in 188D and Ridley in 1893.

The fourth place is held by the mountains over Taiping, in Larut, where Gunone Hijau rises to 1445 m. They became easily accessible from 1877 |see *Gard. Bull., Straits Settlements,* 3, 1925, p. 3D4). The top Df Gunong Bubo, slightly to tliB south, was reached almost immediately afterwards.

We read of the slopes Df the Main Chain above Seremban being reached by Alvins in 1885. In the same year it seems that Scortechini climbed GunDng Inas |1797 m.) in northern Perak. Wray climbed it in 1892 and Yapp in 1899.

Hunstler reached the neighbourhood of the water-parting on the Main Chain near the Gap, in SelangDr, in 1885. Wray reached the neighbourhood of Cameron's Plateau in 189D and Ridley botanized on the Main Chain at Bukit Kutu and on the passes to the south in 1895.

Between 1922 and 1925 the six volumes of Ridley's *Flora of the Malay Peninsula* appeared, and in the last named year an estimate was made, based Dn the collections in the Herbarium of the Botanic Gardens, Singapore, as well as the *Flora,* of the degree to which investigation had proceeded in the different parts Df the Peninsula *Gard. Bull, Straits Settlements,* 4, 1927, p. 113). The conclusion was reached that thB Flowering Plants of such an area as the island of Penang or Df Singapore were 99 per cent, known : but that there were widB areas in the Peninsula of which not so much as ID per cent, is known. Collecting progressss.

Collecting in Western Malaysia.—It has been said earlisr that Dn the departure of Blume from Java in 1825, the Botanic Garden, Buitenzorg, ceased to be a scisntific institution, but was maintained as a very highly efficient horticultural institution.

To Java in 1835 Franz Wilhelm Junghuhn went as an Army surgeon. His attainments SDDn made him a member of a committee called the Indian Science Committee which was charged with a very broadly understood physiographic investigation of the Dutch Indies and he became its Director (1845) and a most vigorous explorer. The result was h' great *Java, deszelfs gedaante, inkleeding en inwendige structur* |1S5D-1853). The collect" which Junghuhn made in the course of his journeys went to Miquel at Leiden, who, with the help Df others enumerated them under the title *Plantae Junghuhnianae* (1851-1855). In 1852 the Dutch embarked on a project to grow cinchona ; and Hasskarl was sent to South America for plants and seeds. HB returnsd in 1854. In 1855 Junghuhn was

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made Director of the new venture. Hendrik de Vriese, whD had been largely concerned in procuring the cinchona plants took bng leave from his teaching duties at Leiden and spent the years 1859-18BD on a journey, via Ceylon, to Java, and from Java to Amboina, Teijsmann accompanying him to the eastward of Java. Thus, just as cinchona cultivation in India had led tD extending botanical work, SD it did in the Dutch Indies, sending Junghuhn into the mountains for land, and leading tD de Vriese's visit.

Buitenzorg was supplied anew in 18B8 with a botanist as Director. This officer was R. H. C. C. Scheffer; and he, dying in 188D, was succeeded by Melchior Treub, whose administrative genius built up a large organization.

During Treub'fl time the Forest officer S. H. Koorders carried on an intensive study of the trees and extended it to the herbs of Java, getting together the extensive collections which his wife enumerated *[System. Verztichniss der zum Herbar Koorders gehorenden Phaneroqamen und Pteridophyten,* 1910-1913) and writing his *Excursions flora von Java* (1911-1912) It was claimed that the botany Df Java yet needed much study, and t>.P i=lar^ i. H i .] + • i i. n A T. i island has since been collected over very extensively by C. A. Backer and others. Dr. W. M. Docters van Leeuwen set himself the task of studying the montane Flora *Biohgy of Plants and Animlds occurring m the higher parts of Mount Pangrango-Gedeh in West Java,* as vol 31 of the *Verhandl. d. Kononkl.-Akad. van Wetensch. te Amsterdam,* afdeel. Naturk.) : j .P_.."R ée studied certain teak plantations in detail *Fhra. analyt. Onderzoek kunstmatia ZTati_ plantsoenen,* 1922), and Dchse studied the cultivated plants *{Vegetables of the Dutch East Indies, 1931).* But in spite of the intense work thus inaugurated, it is obvious that much remains uncertain in regard to the genus *Dioscorea* in Java.

Sumatra, at the beginning Df the eighteenth century received a little attenf officers of the British East India Company. William Marsden was on the west^ ^t f^'* 1771 to 1779. William Roxburgh, junior, who was his father's assistant'VTalcuiT before Roxburgh took leave in 1BD5 and so far as we know was on duty ther» fU Dr. Roxburgh returned, soon after his father got back was given charge of the P ^ * pepper garden at Fort Marlborough, Bencoolen, and held that post till \g\i ^rsfieni who had entered the Company's service under Raffles, was sent to B k . ^ B and tD BencDDlen in 1818 : Charles Campbell, younger brother of W. H and J n™ served at BencDDbnasasurgeonandwasfolbwedby William Jack whose herbariu ^^ with all Sir Stamford Raffles' collections in the burning of the "Fame" "S^TT ^ Sumatra became entirely Dutch, and such attention as its flora received w th^ Df energy bestowed on Java : thus Junghuhn contrived to make an expedition t "p^ ^ (184D-1841), Zollinger to the Lampongs (1845), and Teijsmann.to PadanHl855 i^f Bangka and Palembang (1857), and tothe Lampongs (1S5D). Meanwhile *twoJdm-* "^ PraetDrius in Priaman and Diepenhorst in Palembang collected plants.

Miguel wrote up the results tD 18BD in his *Sumatra, seiner Pflanzenwelt,* 18B2.

Collections of more recent years seem to have accumulated in ^nm^ ^ T> oume measure in the Herbarium of the Botanic Garden, Buitenzorg (see Bartlett in *Nat. and A pp. Sc. Bull of the Univ. of the Philippines,* 4, 1935, p. 215), where they await elaboration, collections have been made in the East Coast Residency by botanists employed on the Rubber estates, and of their collections Dr. Bartlett has given a detailed account in the *Bulletin* just quoted.

In 1914 J. A. Lbrzing was sent tD Sibolangit to develop a Botanic Garden and his collections are now at BuitenzDrg. In 1915 D. W. F. Grashoff went to Sumatra to collect for

the Economic Museum in BuitenzDrg. After his death the work was entrusted to a native collector. In 1918 H. A. B. Biinnemeijer was sent thither on a commission similar to that *of* Poilane in IndD-China, namely tD get together as much material for herbarium-study as possible. At the same time the collecting pf forest trees was organized bv F. H. Endert. The time has not yet come for assessing the gain due to all this work : but progressive as it has been, it is obvious that an enormous amount remains to be done.

The great island of Borneo like Sumatra remains backward. Not a botanist collected in it until Korthals' pioneer expedition to the south coast in 1836 (see Merrill in *Journ Roy. As. Sac. Straits branch,* special nD. 1921, p. 9). Next Thomas Lobb paid a visit to the north coast and Sir Hugh Low resided there. James Motley went to Labuan and during an effort to make a coal-mine pay, as a relaxation studied the botany (1852-1854). From Labuan he went to Banjermassin, still collecting ; and therehe was murdered in 1859. Odoardo Beccari proceeded tD Sarawak in 1865 and made very valuable collections until 1868. F. W. Burbidge went to northern Borneo in 1875. G. D. Haviland went to Sarawak as a Government physician in 1891, then became Curator of the Government Museum and collected with great diligence until 1895. At this time the Dutch physician A. W. Nieuwenhuis was interesting himself in the vegetation of Pontianak, and later from that port he led his great expedition across Borneo (1896-1897) to the east coast. Ridley visited northern Borneo several times—both Sarawak and British North Borneo. In 19D5 J. Hewitt became Curator of the Sarawak Museum and remained until 1909. J. C. MoultDn succeeded him until 1915. The last named supervised the work of a native collector employed by the Bureau of Science, Manila, and later the Bureau made a similar arrangement for collection un'der the Forest service in British North Borneo. The German professor, Hubert Winkler, collected in southern Borneo in 1908.

Merrill, in the publication quoted above, reviewed the collecting to 1913, with the remark " the collections have been only partly worked up " so that no enumeration can be otherwise than more incomplete than the collections.

Latterly collections have been made by Chaplain J. Clemens, Mrs. Clemens, and the forest officers F. W. Foxworthy, D. M. Matthews, D. D. Wood and H. 3. Keith.

Collecting in thz Philippine Archipelago.—After 185D various relatively small collections of plants were made in the Philippine Islands, and two priests, Navez and Villar, with very indifferent results compiled a supplement to Blanco's *Flora.* Next (1871) Sebastian Vidal was sent tD the islands as Inspect or-General of a Forestry Department, and for eighteen years until his death, he laboured with great energy at the botany. His collections were lost by fire in 1897 and only a year and a half later the less important collections of *Navez and* VJJar, the foundations of their supplement to Blanco's *Flora,* suffered the same fate. Thus it was that when the United States took over the administration of the Philippine ArchipelagD there was nothing in the islands on which tD build a knowledge Df the flora. Cuming's great collections were in European Herbaria and the collections of the Malaspina expedition also : Vidal had found it necessary to visit Kew in Drd to study Cuming's plants and on that occasion had given to the Royal Botanic Garden not a little duplicate material: the collections made by Dtto Warburg in 1888 were undetermined at Berlin. Mr. A. Loher, a resident in business at Manila, had CDmmenced to collect (1891) and to send considerable quantities of material to Kew : but Manila has lost all it had had.

In 1902 Dr. E. D. Merrill was appointed Botanist in a newly created scientific staff and his efforts were directed to building up new collections as quickly as possible. He has

told how it was done in his *Enumeration of Philippine Flowering Plants* [4, 1925, p. 53) and gives the names of his collaborators. It suffices here tD refer the reader to that publication.

Collecting in eastern Malaysia.—The Dutch in Java speak Df Dther parts of their Eastern Empire as the " outer possessions " : this very well expresses their attitude towards them ; and just as Sumatra only benefited by an overflow of energy from Java, so has it been with the Duter possessions in Eastern Malaysia ; but with one exception, for Rumpf's splendid work focussed so much attention on Amboina as to make it a place pf botanical pilgrimage. Its flora is not diverse ; for small islands are likely to hold commonplace floras and it is under the impoverishing shadow of the dryness of Australia : its area is 386 square miles and its mountains reach 1,027 m. The writings of Rumpf and the visits Df a very considerable number Df botanists, have made us fairly well acijuanted with its plants : and Merrill, using the data so far collected, has written up in modern plant-names the *Herbarium Amboinense.*

But to know fairly well what plants DDcur in that island is by no means to know those that occur elsewhers in Eastern Malaysia : and by way of contrast one may turn to Celebes with its 71,4DD square miles of surface and its mountains Df over 3DDD m. The best known part Df Celebes is the extreme north-east: Beccari, Warburg and Koorders collected there, the last named spending six months from December 1894 to May 1895 in Minahassa. The next best known is the neighbourhood of the mountain of Bonthain Peak : yet there must be a vast amount of collecting to be done Dn it: and there is an enormous unstudied contrast between the botany of its elevated summits and Df that of the coast immediately to the southward which has the least annual rainfall of any part Df Malaysia. Beccari collected on different sides of this mountain. Warburg spent a short time on its eastern side and Vanvuuren led an expedition round and to the top Df the peak.

The brothers Paul and Fritz Sarasin explored Celebes between 1893 and 1896 and again in 19D2-19D3, reaching remote parts of the island and producing their pleasing *Eeisen in Celebes,* 1905.

Timor, an upturned marginal part of the Asiatic Shelf, claims attention after little known Celebes. It has long supplied eastern markets with sandalwDod and therefore attracted the Portuguese earlier navigators, and having safe harbours was a resort later for voyagers on their way to the Pacific. But for all that, it will not be botanically known for yet a long time. High mountains exist in the interior such as suit DioscDreas, but, as table 33 shows, such species as have been brought from the island may be called commonplace. Teijsmann visited Timor in 1874 and H. D. Forbes spent five months there in 1882-1883.

The rest Df Eastern Malaysia may be dismissed in a paragraph. Buton, somewhat accessible in Rumpf's time, remains botanically unknown. Recently collections have been made in the Soela Islands which lie as a prolongation of the eastern arm of Celebes, and down the bng chain of the Lesser Sunda Islands. We have small collections from Lombok |Mrs. Rensch in 1927), Sumbawa |Coifs in 1883 and 1884) and Soemba [Iboet shortly before 1BU0).

Papuasia, the least known part of the East.— Various of the early voyagers coasted along the shores of New Guinea and collected a few plants. In 1871 Teijsmann visited Andas in north-western New Guinea and in 1872 Beccari went to the western end. Teijsmann was

soon back in Java ; but Beccari spent three years in New Guinea, the Aru and the Kei Islands. In 1875 the German " Gazelle" expedition took place; Naumann was the naturalist on board and the north-eastern coasts of New Guinea were explored. About the the same date Baron Ferdinand von Mueller began tD beg friends who visited New Guinea to bring back botanical specimens : among those who did SD was R. Parkinson. In 1885 H. D. Forbes collected near Port Moresby. In 1885 Hollrung was sent, and in 1888 Franz Carl Hellwig followed him, to the coast of German New Guinea ; and the latter made expeditions inland until his early death in 1889. On one expedition, undertaken in company with Dtto Warburg, who had arrived in New Guinea, he reached 2550 m. The Dwen Stanley Mountains and Mount Scratchley were reached from Port Moresby : the first in 1889 by Sir William MacGrcgor, the latter in 189B by Giulianetti and A. J. English. Karl Schumann and Lauterbach reviewed the collectors' work up to 1931 in their *Flora dzr Deutsches Schutzge.biele in der Sudsee,* with more details than can be given here.

Dutch New Guinea began tD demand increased attention. Jaheri, a Buitenzorg collector, was sent in 1901 to Merauke on the Torres Straits : Dr. W. den Berger collected in the Arfak Mountains over Geelvink Bay (1906) : A. J. Gooszens, accompanied by B. Branderhorst, collected in 19D7-19D8 Dn the south coast: and in 19D7 also, Dr. H. A. Lorentz led an expedition inland, when an Army surgeon, Dr. G. M. Versteeg, who accompanied him, collected plants. In 1909-191D Dr. Lorentz made his second expedition, reaching 25D0 m., and in 1911 Mr. A. F. R. Wollaston, accompanied by Mr. Cecil Boden Kloss, made another, both from the south coast, in attempts tD reach the snow-capped Charles Louis Mountains. Latterly others have penetrated towards these mountains from the north coast. In 1913 Miss L. S. Gibbs collected adventurously in the Arfak mountains. Dr. H. J. Lam, who himself has collected in New Guinea, has reviewed the position to which this work has brought us (in *Blumea* 1, 1934, p. 115). TD his review the reader is referred ; additional names will be found in it. But the collections contain only these few species of *Dioscorea* :—

D. esculmta which is reported as an abundantly cultivated plant in eastern New Guin ea ;

D. bulbifera and *D. pzntaphylla* which have been obtained in several places Dn the north-east and on the south-east coasts ;

D. elegans which was got in the lower hills penetrated by the Wollaston expedition;

D. opaca obtained by Ledermann near the Kaiserin Augusta river at 85D m.;

D. nummularia which must be common in Eastern New Guinea; and

D. hispida which has been found at the western end and then again to the eastward only in the island of New Britain.

That New Guinea has been inadequately investigated is apparent.

The Kei Islands were collected in by Jaheri. Ternate was visited by de Vriese in 18B1 and has been collected in again recently DD behalf of the Botanic Garden at Buitenzorg.

Collecting in the Pazifiz.—The greater exploring voyages have been mentioned on p. 454 above : as explained, they brought back a more considerable amount of information Dn the vegetation of the coasts than Dn the vegetation inland. It is desirable tD mention the more extended investigations of scientists who resided for considerable periods in one island or group of islands. Nadeaud was one of these. As a French Surgeon of Marine his occupation took him tD Tahiti in 1855 and there he remained for 3£ years, publishing his *Plantes usudles des Tahitiens* in 18 62 and bringing home a considerable herbarium. Bertold Seemann was another. As SDDn as it became reasonably safe to live in Fiji, he arranged tD reside there for a year (186D-1861); and he returned to London with the materials for his *Flora Vitiensis* (1873). Hillebrand was a third, Driven-by illness to seek a mild climate, and having tried several he domiciled himself in the Hawaiian Islands in 1851: shortly after his death his son published in 1888 his *Flora of the Hawaiian Islands.* Dne further investigation demands mention : namely D. S. Crosby's attempt, during a year spent Dn the island of VavaD, to gather every species growing DII the island.

Drake del Castillo in a *Flore de la Polynesie Franzaisz* |1893) worked up the botany of the remoter parts of the Pacific tD that date named.

An estimate, of the imperfection of present knowledge.

We have already explained |p. 451) that the number of species known from our part of the Globe, stood in 1900 at 45, and that it is now 154. These are the additions of the intervening thirty-six years :—

Balkans, *D. balcaniza;*

India, *D. arachidna* |in the course of time found to be rather Indo-Chinese than Indian, for it only just reaches India) *D. Kalkapershadii, D. Trimenii, D. Wattii* and *D. trinervia* [also in In do-China): the total 5;

Himalaya, *D- melanophyma* (also in South-West China and Western IndD-China), *D. Upcharum* (also in Western IndD-China and just into India), *D. Listeri* (with similar extensions): the total 3;

Japan, *D. aschpiadea* and *D. Zentaroana*: the total 2 ;

Cathay, *D. coreana, D. Huii, D. enneanmra* and *D. futschauensis* : the total 4 ;

Sollth-West China, *D- panthaica, D. biserialis, D. althaeoides, D. yunnanensis, D. subcalva, D. nitens, D. Martini, D. Esquirolii* (also in Eastern Indo-China), *D. bkolor, D. aspersa, D. Potanini* (also in Dathay) and *D. p-ulverea :* the total 12 ;

Eastern IndD-China, *D. Chingii, D. Petelotii, D. Poilanei, D. simulans, D. dissimulans, D. limaricordata, D. Owenii, D. Benthamii, D. intempestiva, D. Bonii, D. hainanmsis, D. Fordii* [also in Cathay), *D. persimilis* (also in South-West China and Western Indo-China): the total 13 ;

Western Indo-China, *D. Prazeri* (with an extension to the Himalaya), *D. tmtaculigera, D. Rockii, D. birmancia* (also in Malaysia), *D. Garrettii, D. paradoxa* (also in Eastern Indo-Dhina), *D. Hemshyi* (subsequently found to occur widely in South-West China

and to be in Eastern Indo-Dhina), *D. pseudo-nitens, D. velutipes* (also in South-West China), *D. Brandisii, D. inopinata, D. Kerrii, D. psmdo-tomzntosa, D. filicaulis, D. Craibiana,* (also in Eastern IndD-China), *D. kratica* |alsD in Malaysia), *D. depauperata, D. stemonoides* and *D. oryzetorwn:* the total 19;

Malaysia] *D- palawana, D. membranacea* |alsD in Western IndD-Dhina), *D. Ridhyi, D. mindanamsis* (but this name is almost a liDmen nudum), *D. stenomeriflora, D. daunaea* |alsD in Western IndD-China), *D. keduensis, D. sumatrana, D. cambodiana, D. flabdlifolia, D. bullata, D. piscatorum, D. tamarisciflora, D. Pierrei* |alsD in both Eastern and Western IndD-China), *D. Elmeri, D. inaequifolia, D. Cumingii, D. polyphylla, D. Blumei, D. Scortechinii* (also in Eastern Indo-China), *D. Havilandii, D. bancana, D. Vanvuurenii, D. Warburgiana, D. madiunmsis, D. piperoides* (alsD in Eastern IndD-China), *D. Moultonii, D. Sarasinii, D. brRvipdiolata* (also in bDth Eastern and Western IndD-China), *D. lamprocaula, D. Kingii, D. calcicola, D. gracilipes, D. vezans, D. gedensis, D. Sitamiana, D. Nieuwenhuisii, D. grata, D. Lohzri, D. Foxworthyi, D. Merrillii* and *D. platycarpa*: the total 42 ;

Papiiasia, *D- degans* and *D. opaca:* the total 2 ;

Pacific, *D. Ledwrnannii* Dnly.

Since the greatest number Df accessions has been from Malaysia—nearly one half of the total—and since the accessions show no diminution, it is evident that there are more species to be obtained from Malaysia. A further one-fifth of the accessions came from Western IndD-China, mainly from Siam, and one-eighth from South-West China. It is certain that more new species will be described from these two parts of the East as exploration proceeds.

Df the five from India, three were obtained Dnly Dn the Eastern edge Df India proper, and the Dther two are satellite species Df species well-known in India. India then would seem tD have yielded tD Science something like the whole of the species which are present. Papuasia must be in strong contrast ; for in the wide unexplored stretches of that country unknown species are likely to lie hid.

The greatest number of species from any of the unit-areas in our tables (pp. 431-449) is 18: that unit is the Siamese Circle Df Payap. Other totals follow thus :—15, the State of Perak ; 15, an arbitrary Western Yun-nan, and the East Coast Residency Df Sumatra; 14, an arbitrary North-East Yun-nan ; 13, the Siamese Circles of Prachinburi and of Surat, and the Residency Df Batavia in Java; 12, the Chinese Province of Che-kiang, the District of Darjeeling, the Hhasia Hills, the State of Kedah, the State of Pahang and the Province Df Laguna in the Philippine Islands ; 11, the State Df Travancore, the Chinese Province of Kwei-chow, that Df Kwang-si, an arbitrary Central Sze-chuan, the Bhamo District Df Burma and the Circle Df Rachaburi in Siam.

Our units vary in size : this is unavoidable: but we have made efforts tD use such as may be comparable; and it seems as if when 11—18 species are found to grow in them, they are " gDDd Dioscorea areas ".

As second class units, with 7 to ID species each, come the following :—

Sub-region Df India, the Central Province of Ceylon; the Districts D!' North Kanara, Nilgiri Hills, Godaveri, Vizagapatam, Ganjam, Angul; the State of Mayurbhanja;

the Districts of Balasore, Singbhum, Ranchi and Hazaribagh; the Sontal Pergunnahs; the Districts of Raipur, Bhandara, Amraoti; the Darjeeling terai; the Districts ot Jalpaiguri, Nowgong, Lakhimpur and Cachar ;

Japan, the Provinces of Shimotsuke, Musashi, Tosa and Hizen ;

Cathay, the Provinces of Fu-kien, Hu-peh and Kiang-si ;

South-West China, the arbitrary areas of South-east Yun-nan and South Yun-nan ;

Eastern IndD-China, the Provinces of Kwang-tung, the Islands of Hai-nan and Formosa, the Provinces of Nha-trang and Binh-thuan ;

Western IndD-China, the Districts Df Dhittagong, Minbu, Pegu and Katha, the States of Hsi-paw and Yawng-hwe, the Circles of Ayuthia and Rachasima ;

Malaysia, the Districts of Amherst and Tavoy, the Circles of Puket, Nakawn Sritamarat, the Island of Penang, the States of SelangDr, Negri Seinbilan and Johore and the Settlements of Malacca and Singapore, the Residencies Df Bantam, Preanger, Rembang and Besoeki, the States of Sarawak and British North Borneo, and, in the Philippine islands, the Provinces of Rizal and Davao.

The reader will mark this most important fact that all the units are mountainous. Eighteen of the first twenty, which we called "good Dioscorea areas" lie between bng. 88" E. and 108° E., and their northern limit is at lat. 27° N. No unit with more than seven species occurs to the northward of lat. 32° N. except those in Japan. It seems incontrovertible that ths best parts of Asia for development of the genus lie within these limits.

However the unequal exploration of the units brings in elements Df doubt, on lesser points which cannot be ignored, but may in some cases be resolved by making comparisons in the following way.

Units if land in Malaya arranged as far as possible in order from the most explored to the least explored.

Unit.	Approximate area in square miles.	Greatest elevation in metres.	The number of species of Dioscorea recorded.
Singapore	200	150	9
Penang	1D7	830	8
Malacca	660	433	10
Province Wellesley	288	518	4
Perak	7,900	2,152	IB
Negri Sembilan	2,600	1,433	9
S elan g or	3,200	1,774	ID
Kedah	3,15D	1,860	12
Din dings	265	492	3
Perlis	240	722	3
Johore	9,000	1,287	10
Pahang	14,300	2,159	12
Kelantan	5,5D0	2,159	B
Trengganu	5,000	1,448	3

The greatest number of species recorded is] fi, the unit, holding them being Perak. Not dissimilar in size, in the height which the mountains attain and in physical aspects, are Pahang with 12 and Kelantan with [). As these two States are inadequately explored, much less so than Perak—16 species may be expected to occur in them too. Kcdah and Selangor approach the States named in the height which the mountains reach and in area - taking into consideration the measure in which their botany is known, 15 species would appear likely to occur in each of them. Johore with its large area and vast forests promises as many. Kelantan and the Negri Sembilan arc likely to furnish in time almost as many. The small units of Penang, Singapore and Malacca, which are botanically well known (vide *Gard. Bull., Straits Settlement**, 4, 1927, nos. 4 and 5) have furnished 8, !) and 10 respectively. The State of Trengganu is certain to produce more than they do mid may approach 15. We would submit that 15 is what may be expected to occur in any area of the Malay Peninsula of 2,000 to 15,01)0 square miles, and that in small lowland areas at least half this number grow.

If from Malaya we cross the Straits of Malacca to Sumatra, observing (p. 44(;) that fifteen is the actual number of species recorded as occurring in the Residency of the East Coast, but that four is the maximum recorded as occurring in any Df the other divisions of Sumatra, we feel that only one Residency in that great island is anything like adequately botanized.

A part of the East which has been even better botanized than Penang, is Lower Bengal, where through more than a century and a half a botanical staff has been maintained at the Royal Botanic Garden, Calcutta and an intense study made of the vegetation of the adjacent districts. Table ID jp. 435) shows the result, namely that three or four species occur in each District of Western Bengal, and the same or fewer in each District Df Central Bengal. It is quite certain that such figures are right: that a number such as fifteen is altogether unapproachable, although the rainfall is abundant, and that the difference may be largely ascribed to want of such adequate drainage aa sloping ground affords.

Willis claims {*Phil. Trans. Roy. Soc. Land.* B 206, 1915, p. 3D8) that Ceylon as a whole is as well botanized as any part of the East; and accepting hia opinion, the island may be used to furnish another comparison. It has mountains rising to 2,524 m. and a surface of 25,0DO square miles : the average size of one of its Provinces is 2,815 square miles : the richest of them in *Dioscorea* holds eight species, which happens to be the number known to occur in Penang, with a total area of less than one-tenth of that of a Ceylon Province, and much less elevated mountains. Rainfall, elevation and distance from the Equator suggesting equality with a Malay State, a minimum of fifteen, or about twice as many as are there, would be appropriate for at least the moister and more elevated of the Provinces of Ceylon. Failure to attain this number cannot be ascribed to edaphic causes, such as we are able to invoke in the consideration Df Lower Bengal. But a reason for the relative poverty may be sought, instead, in the events Df the Tertiary Epoch which appear to have excluded material for evolution or imposed climatic handicaps DII what existed.

We have pointed Dut that the best stocked part of Asia is between long. 88° E. and 108° E.: Ceylon is more or less bisected by long. 81° E. and therefore well outside it.

The Peninsula Df India as well as that part Df Asia which, being on the west of lone 88° E., makes South-West China, appears to be very old land, but the age of the land surface is not all: the study of *Dioscorea* points to more intense climatic interferences in the former than in the latter ; and these have caused the former to be an inferior creative centre.

THE DIOSCDREAS DFTHE EAST PHYTDGEOGRAPHICALLY CONSIDERED.

Phytogeography is a compartment of Botany with four sides: one of these is towards the present day physical surroundings of the plants under study : a second is ecological, bound up with the interrelations of plants : a third is towards the past and is chiefly a study of barriers to migration ; and the fourth is towards Man, admitting his power to modify physical surroundings by cultivation, tD annul competition and tD pass plants over barriers. Humboldt in his *E.imi sur la Geograjrfiie des Plantes* [1805) and in the "Prolegomenes" to his *Nova genem d sjiecies plantarum* (1815) brought into clear day the first side of the compartment: the Darwinian Theory (1850) threw a strong light on the third side : Warming and others much later thrust the SDCDndinto notice: Man's influence has long been under study, but, strange tD say, the extent to which he can make a plant grow in the open air beyond the limits which Nature would allow, has never been compressed into precise rules.

PhytDgeography and Zoogeography have parallel destinations, make together Biogeography, and should lead tD interchangeable results. Their terms should be identical. If they could be studied in an ideal way, work would proceed from the small to the great, from the lesser units of ecology to the larger units Df geography and a geographical unit would be defined as occupied by such and such percentages of the various ecological formations present. But the ideal is impossible because the details cannot be got together without an untold amount of labour. In default biDgeographers of both classes have tried to divide the surface Df the World into natural divisions by their own impressions ; and the result has been considerable diversity. We have felt that this, forcing on us the need of taking a line Df our own, leads to the necessity of entering here into explanations regarding it. Part of the explanation is in the form Df an appendix |sse p. 519 forward): we will enter into the matter Df terms at once.

Various terms have been used by biogeographers for the units : from among them we adopt "region", with, for the parts of the regions, "subregion", "sub-subregion", and sub-sub-subregion"—terms precise enough, which advantage outweighs their inelegance. We agree with those who require a phytDgeDgraphic region to be characterized by the systematism of its plants, which again depends on all the factors that have made it what it is. We disagree, for instance, in his use of the word "region" with that eminent botanist who, not long ago, in an article on Phytogeography, dividing the land of the whole Globe into three parts by temperature alone to the entire disregard of the vegetation, called them the North Temperate Region, the Tropical Region and the South Temperate Region. We agree Dn the Dther hand in the use of the term, with those who give it a place in such expressions as Palaearctic Region, Mediterranean Region, Indian Monsoon Region, Chinese Monsoon Region, Eastern Equatorial Rpgion and Australian Region (see the appendix). India, proper, is a subregion Df the Indian Monsoon Region, Hindustan a sub-subregion. We have indicated the Subregions and Sub-subregions Df our area Dn plate 81.

In the terms used by writers for the units of area the qualifying adjectives have varied: "Indian" and " Driental" in particular have had divergent applications. Still greater variation has appeared in the boundaries assigned tD them. In boundaries one cannot follow De Dandolle, Wallace, the Sclaters, Hcilprin, Lydekker, Blandford, Engler or Drude without departing a great way from others. The reason for the divergence is, as we have said, that the work of dividing the Globe has been based largely Dn impressions: with a very flickering candle thB attempt has been made to see ahead. But the attempt must be made in order that voluminous data may be so orderly set down that

biogeographers can absorb them. That point of view has forced on us a detailed consideration of the geographic schemes of others., wherein finding none altogether to our satisfaction, we decided to go our own way.

We have not thought it advisable to enumerate our localities strictly Region by Region, but we have enumerated the whole in one Subregion before proceeding to another. This has arisen from a desire to arrange the data as far as possible from West to East. Thus it happens (see for illustration the data under *I). Mbifera* or *I). ptntaphjUa)* that having enumerated the localities of the Subregion India proper, which is a part of the Indian Monsoon R.gbn, we proceed to enumerate the localities of the Chinoso Monsoon Region before enumerating those of the Eastern and Western Subrcgmns of Inrto-lhina, which are likewise parts of the Indian Monsoon Region. Further the Australian Region is inserted between two of the Subregions of the Eastern Equatorial Region. The utility of thus giving greater prominence *tc* the Subregions than to the Regions is SD great that there is little need for an apology for doing so. Irom these generalities we now return to the distribution of the" genus *Dioscorea.*

Dioscorea occurs in three isolated parts of the Mediterranean Region, one species in each : these being *D. pyrvnaiw,* * *bal*TM*nica* and *D.*COTCMtCB-

We have indicated |p. 17) how extremely small is the area which *D. pyrmaka* DCcupiBS. It is onlv eighteen miles long and descends vary little from the water-parting of the Pyrenees Moreover it is in the wettest part of the mountains close under the highest peaks.

D M TM i M may or may not occupy a larger area. It «. in the upper Dm, valley t • uhar features in the land-conformation lead tD an unexpectedly large rifiWl^foroff the coast in the Adriatic a permanent low-pressure area exists, and the *ul* so Ue in relation to the coast that from this area a current of tamui a,r ,s drawn niiit, nt, *ninvrnrea* is found. *D. caucasica* is not, within its area, a rare intD those parts.vhcre t ^ X » t of the oth , ^ species ; it is pcralia, ^ Plant is its area s t 7of th 0 ucasus is to the north. Round the end of that wall a hitter wind from *fCXlotu*Sern Kussia sweeps, making, for instance, the town of Nowo KossHk the Stepp*i 01 *Dmmask%* iDBS not pass westwa.-ds so far as to be exposed to 1 7 ^ant ^ ^ t occurs in woods which are so entirely shared that Raddc points tnat wina: s where th re. Again the arDa whcre lt rows out the possihihty of TM « ,'tt Ha* Sectoral. At Sotchi, winch ,s withfn the

si ' ^ st' he south r-1, r. -JM,t_ ^ .t^d climatic oases of unusual amounts of ram.

There are four climatic regimes m the East where Diosooreas grow : there are two in continental Asia, ' ^ ^ ^ fn CDmffiDn mDnSDOn conditions is due to the heating Chinese Monsoo. ^* * ^ sun is in the nDrth : then when the sun has passed of the centre of ^^ ontin nt when ^ ^ ^^ rf ^^ ^ arg ^ Bouthwards and th, ^ inent centrally ^ Dhina chilling the land : but the Himalaya defends outwards and| P TM 1 ^ influBncB. Furthermore Dhina occupies higher latitudes than India from their I^ B ^. taracBrBncB3 Df winter, as well as causing some reduction in India, which aggravates tne *am*

the temperatures Df summer when the winds are reversed. Thus it is that Asia holds an Indian MonsDDn Region which is essentially tropical with warm winter-seasons, and a Chinese Monsoon Region which has a warm-temperate summer and a cold winter. It is well, perhaps, here to enumerate their Subregions :—

Indian Monsoon Region.	Chinese Monsoon Region.
India, proper, the Himalaya, taking no account of its cold interior parts ; Western Indo-China; Eastern IndD-China which is atypic, but by being tropical, cannot be added to the Chinese Monsoon Region.	Japan ; Cathay ; South-West China.

The whole of the continent of Asia is to the north of the equator. Astride of th Equator a climate rules in marked contrast with the Monsoon climates. It has two periods of rain falling at times when the sun is overhead and so has four seasons alternate in raininess. The equator crosses Sumatra, Borneo, and the islands of the Pacific and only misses New Guinea by so little as to bring Papuasia under its influence ; and Our Eastern Equatorial Region has three Subreginns :—

Malaysia ; Papuasia ; the Pacific, from which we exclude New Zealand.

The fourth climatic regime is that of Australia. In the north it has a monsoon climate with rain in the southern summer : in the south it has a Mediterranean climate with rain in the southern winter. We are consequently not quite logical in recognizing a Mediterranean Region and not recognizing the south of Australia as something apart from the north : but to debatB that here is not necessary. Climatologists recognize in Australia a third climate—that Df the centre : but no Dioscoreas can su... ZDDbgists have distinguished in thB fauna Df Australia (i) a northern element ... to have entered Australia Dver the Torres Straits or at a time when there was a land bridge in place Df the Straits and (ii) a southern element supposed tD have entered Australia across the Bass Straits (see for instance Hedley in *Proc. Linn. Soc. N. S. Wales*, 1899, p. 39S). We need not trouble ourselves with the word "entered" ... two elements the northern or Torresian is monsDDnal, and the southern or Bassian ... a climate of Mediterranean type. And with this climate of Mediterranean type DiDscprea, *D. hastifolia*, has associated itself, just as Dioscoreas have associated themselves with the true Mediterranean climate in Europe : but every one is in a climatic oasis of limited range ; and the great interest of their occurrence is how they got there.

Dioscorea reaches its extreme northern limit in the neighbourhood of the Amur river. Drude called this part of Asia Amurland, and the name is ... ID use. It is *D. nipponica* which grows in Amurland. It associates with pines and birches along the rivers. The winters are so cold as to hold the rivers frozen from October until April ... thpn follows a hot summer. The waters in the river increase ... heaves and splits, great bbeks are thrown on the banks and, while they melt, *D. nipponica* shoots up in a summer which never goes back when it has come in. In cultivation it ... comes above ground in March, and it is interesting that late frosts damage it.

In 1935 a frost in the middle of May cut it back to theground (see *Ksw Bull* 1PV ... 73) and in 1935 a frost in early April destroyed the tips Df shoots which had made ID ... cm. Df growth. It is certain that part of its success on ths Amur is due to the reliability of ...

summer. This summer is hot, with a small amount Df distributed rain—Dnly about 5D0 mm. or 21) inches with a peak in July or August: and at Vladivostock, where also this species grows, the rain is 38D mm. or 15 inches. There is none in winter.

It may be that the rivers on the banks of which it grows add to the water which it gets ; but this is not established.

It seems that it does not grow along that part of the river Amur which is most to the northward; but at any rate it is common from a little north Df Blago vests chensk southwards, i.e., to the south Df lat. 52° N. (see p. 466).

D. villosa reaches lat. 43° N. in North America. *D. balcanica* and *D. caucasica* occur in Europe in lat. 42° N.

All f Dur species can be grown in the open in England : and in Scotland it is possible to grow *D. pyrznaica,* which, it may be claimed, is even hardier : for it occurs wild in the Pyrenees at 1,5DD m., the latitude being 42° 4D', and the equivalent Df lat. 5D° N. at sea-level if judged by isotherms. However to watch it in comparative cultivation has not yet been our good fortune : for it dies in winter at Kew as if from too much humidity. Within the genus it is very distinct having its closest relatives not in Asia but in Africa.

Except *D. pyrenaica,* the species named belong to the section StenDphora. And, again excepting *D. pyrenaica,* no section shows a power of surviving the cold of a northern winter equal to that of *Stenophora* and at the same time no Dther section is common tD Asia and North America. It is to be assumed that in Miocene times the section was able to pass across that land bridge of the Behring Straits which enabled *Coptis, Gordonia,* etc., as well as the camel, to pass from one of these continents to the other : so that we can use the genus *Dioszorsa* for determining the climate Df the bridge when it existed.

Though some botanists, under the impression that the seedlings of *Tamus* and *Dioscorea* have two cotyledons, at one time gave to the family *Dioscoreaczae* a position near the *Aristolochiaceae,* and though others have grouped it with the *Taccaceae,* and the *Burmanniaoeae* under the name *Artorrhizae,* the view has become general that a class called *Liliales* can be recognized, and that the place of the *Dioscoreaceae* is in this class Liliales along with the *Juncaceaz* and *Liliaceae* (which go further north), the *Amaryllidaceaz* and *Iridaceae* |which do not), and the *Stemonaceae,, Haemodoraceae., Vzlloziaceas* and *Taccaceas* which are decidedly tropical. The *Dioscoreaceae* seem to be most closely allied, among these, to the *Taccaceas.* and *Iridaceae,* but yet are abundantly distinct.

The families of the *Liliahs* are usually tropophytic, passing through their resting season as rhizomes, tubers or bulbs. It seems to be Df interest that the genera which gD furthest north are rhizDmatous rather than bulbous, and that the section of *Dioscorza—iStenophora*—which goes furthest north is rhizomatous. There is a slight—ever so slight—adjustment of situation by a rhizome which is not made by a bulb : for the rhizome branches and if a branch reaches better soil Dr gets a better position than the parent axis, it flourishes and assumes leadership : but this advantage in the rhizDmatous habit over the more stationary bulbous and tuberous habits can be but one of several adaptations in the section *Stznophora* for resisting a harsher climate than other sections endure : another and probably more important adaptation is in the number of buds carried Dn a rhizome. In the *Journal of Botany* (1935 p. 9D) attention was called to the great number of buds present on the rhizome of *D. glauca, \D. villosa* subsp. *D. glauca),* mostly existing as safeguards, and Dnly called into activity if the better prepared suffer destruction. Of course of

these buds, separated by small distances from each other, some may be destroyed and some escapg a mishap which is exceedingly local; and so again an advantage accrues to the more mobile plant.

It is interesting to turn to the palms : this family is unable to persist as far north as the *Dioscoreaceaz* and on the whole is lacking in frost-resistance. The palms have a number of features observed in the *Dioscoreaczae,* such as incanspicuous green flowers of symmetrical form, mostly unisexual but with signs of the missing sex, typically with six stamens, and in the ovary with a general constancy in the number of ovules : moreover the *Palmae* and the *Dioscoreacem* compete with Dicotyledonous trees for light: but the two families have met thi£ competition in very different ways—the one by means of a persistent trunk, the other by rapid spring growth and by finding support by climbing. At the apex of the trunk of the *Palmae* is a single bud; and, as every botanist knows, its destruction involves a tremendous loss to the palm, for it is with great difficulty, or not at all, replaceable. On the other hand the loss Df a shoot in the *Dioscoreaceae* is soon repaired, the sooner in the section *Stmophora,* on account of the readiness of the rhizome with spare buds, than in other sections ; but soon apparently in all: and one is at liberty to use this contrasting of *Palmae* and *Dioscorzaceae* as an illustration to account for the extension into harsh conditions of rhizomatous *Dioscorzac&ae.*

The optimum temperature of growth has not been recorded for any species of *Dioscorea.*

Altitudes attained. We have used our Table 1 |p. 427) to givjs the altitudes recorded for the montane species : but as there was insufficient' room in it fDr adding the latitudes at which they have been observed, we repeat the more striking altitudes now :—

lat. 32^{D}N.	*D. nipponica,*	to2,D00m. in Japan,
lat. 28^{D}30'	*D. dzltoidm*	to 3,30D m. in the Himalaya,
lat. 27°3[)'	*D. melanophyma*	to 3,D50 m. in Yun-nan,
lat. 27°	*D. panthaica*	to 3,05 Dm. in Yun-nan,
	D. althaeoides	to 3,2DO m. in Yun-nan,
lat. 25^{U}	*D. Hsmskyi*	to 3,D50m. in Yun-nan,
	D. bicolor	to 2,000 m. in Yun-nan,
lat. 25^{D}3D'	*D. Collettii*	to 3,05 Dm. in Yun-nan,
	D. bulbifzra	to 2,750 m. in Yun-nan,
	D. alata	to 3,050 m. in Yun-nan,
lat. 25°	*D. bismalis*	to 2,800 m. in Yun-nan,
	D. nitms	to 2,450 m. in Yun-nan,
	D. kamoomnsis	to 4,200 m. in Yun-nan',
lat. 23°30'	*D. aspersa*	to 2,450 in Yun-nan,
lat. 18^{D}30'	*D. persimilis*	to 2,000 m. in Hai-nan,
lat. *V*	*D. mindanmnsis*	between 2,000 and 3,0DD m. in the Philippine Islands,
lat. 7^{D}3D'S.	*D.filiformis*	to 2,400 m. in Java.

In the north-western Himalaya 0-59^{D}C. of temperature is lost with every 1D0 metres ascended. At this rate *D. ddtoidea* at 3,300 m. is (theoretically) at temperatures 19^{8}C. below the sea-level figure for the latitude: or taking its average elevation in the Himalaya as 2,000 m. it is at temperatures about 12°C. bebw the sea-level figure for the latitude : by which reasoning one might expect to find it almost as far north as *D. nipponica* goes.

And DneloDks at the high altitudes attained in Yun-nan by other species, wandering how far north they might be expected at gD, but not daring to apply tD the tangle of mountains in that part of China the facts of loss of temperature obtained Dn the wall of the outer Himalaya. Still the fact is patent that the genus *Dioscorea* has been able to evolve, in the mountains of the East, species which ascend into the cold just as it has been able to evolve species which pass northwards into the cold.

A table of the Yun-nan species by relative resistance to cold, takes the following form :—

|1) most resistant ; *D. deltoidea, D. althaeoides, D. panthaica, D. Colhttii, D. kamoonensis, D. melanophyma, D. Hemsleyi,* and *D. alata;*

|2) moderately resistant : *D. biserialis* and *D. bulbifera ;*

13) less resistant : *D. nitens, D. aspersa* and *D. bicolor.*

This brings to notice the following fact:—the section *Stenophora* supplies such as are hardiest among these, and the section *Enantiophyllum* supplies *D. alata* excepted) the least hardy.

We do not understand how it is that *D. alata* in Yun-nan and in Sikkim grows at such considerable elevations |see. p. 312).

The ability, Df which we have just written, to grow well beyond the tropics, is not found in all the Asiatic sections of the genus, but in three sections, which we must notice as being the three largest—*Sfenophora, Lasiophyton* and *Enantiophyllum,* and in two of the smaller—*Shannicorea* and *Opsophyton.* This ability is absent from the SBCtions *Stenocorea, Combilium, Paramecocarpa* and *Illigerastrum.* Df the sections in which it is seen, it is most marked in *iStmophora.*

Nothing is known to exist in the mode of life above ground which can be regarded as a mark distinguishing the temperate from the tropical species. Df the parts below ground, which are those submitting to winter, we have already written, calling attention to the many buds in reserve Dn a rhizome and suggesting that there is some connection between survival under harsh conditions and the many buds. Attention may be directed tD a paper by Holm *Amer. Midi. Naturalist, 9, 1925,* p. 458) which shows that at the end Df its first season the rhizome of *D. villosa* has already three internodes, i.e., two more than exist in the storage organ of the common tropical species of the genus, and therefore presumedly at least three buds : and the number of buds in reserve on the maturerhizDmB of *D.* in^Dsa sub-species *D. glaucais* much greater *Journ. Bot.,*\9^, p. 89). But again it may be pointed Dut-that a rhizome lies entirely in the parts of the soil which freeze most, while a tuber thrust down into the soil, although its developed bud is superficial has parts capable of renewing destroyed buds at depths which may escape freezing. But what could escape freezing in Amurland where the river itself gets a coating Df ice Df five feet in depth, and is ice-bound for **150** days at a time ?

Admitting the ability which the genus *Dioscorea* has shown of evolving species in mountains which rise out Df tropical low country, it must be recognized that such success is local; and in a continent where Dioscoreas have been observed at above 3,DDD m. in latitudes north of 32° N., their absence at 2,DDOm. in lat. 1D[D] becomes worthy of remark. In India, Fyson tells us *[Flora of the Nilgiri and Pulney Hill-tops above 6,500 ft.,* **1915-1921),** they are absent from the higher parts Df the Nilgiri and Pulney Hills : our extreme limit **for**

D. oppositifolia in southern India (from a record by Gamble) is 1,830 m.: our extreme limit for *D. spicata* is 1,525 m.; and we have collected records for *D. oppositifolia,* several in number, of 1,220 m. As the Nilgiri Hills reach 2,674 m., the Western Ghats in northern Travancore 2,393 m., and the mountains of Ceylon 2,536 m., the south of India affords considerable surfaces apparently beyond the reach of the DiDSCDreas of their neighbourhood.

In Java, similarly, there is a margin between the altitudes reached locally by the Dioscoreas and the mountain summits. *D. filiformis* is the most montane species of the island: ithas been obtained on Mount Smeroe between 2,10D and 2,400 m.; but the top of the volcano is 3,676 m. high. *D. pentaphylla* has been obtained in the Tenggyr at 1,2DD m., where Goenoeng Argapoera, in its neighbourhood, rises to 3,D88 m.: *D. bulbifera, D. salicifolia* and *D. pyrifoliaa.re* recorded as reaching 1,DDD m. in Java : *D. polyclades* and *D.pubzra* as reaching 7DD m.

Altitudes recorded for species in the Malay Peninsula, where the mountains rise to 2,190 m., are *D. laurifolia* at 1,220 m., *D. pentaphylla* at 868 m.; *D. bulbifzra* at 550 m.

Somewhat greater elevations have been recorded in the loot hills under Mount Kinabalu |4,175 m. high), where *D. pentaphylla* has be?n obtained between 914 and 1,220 m. and *D. pyrifolia* at 1,524 m. In the Philippine Islands *D. mindanaensis* is said to have been obtained between 2,000 and 3,0DD m.: *D. Merrillii* occurs at 700 m. It has been demonstrated that the greater a mountain-mass the higher the limits in it which plants attain. Writers in German call this phenomenon " Massenerhebung." Conversely a summit by reason of its isolation exercises a rspellant effect on the plants which struggle upwards on its more exposed sides. " Massenerhebung " leads to species of *Dioscorza* reaching high bvels in the mountains of South-west China : and the repellant effect to their failure to ascend, as far as one might expect, on the isolated summits of Malaysia. It is apparent that » Massenerhebung " acting over a long time must favour local evolutionary progress : and it may be presumed that absence of endemic species of Dioscorea from the most elevated parts of the tropics is as much an outcome of lack of adequate area as lack of such climatic continuity as would afford the opportunities for their production.

Moisture requirermnt.—We have had occasion to remark tw n • . . l , , ,, ... , "u remark that *D. mppomca* grows in Amur and where the annual rainfall ,s about 500 mm. ,or 20 inches, bestowed in summer entirety, for the winter there is dry ; and that the rainfall is down at 38» mm. or 15 indies atVladlvOstocknSarWh,ehport,alSo itgrows. Butin the heated plains of India such small precipitations are inadequate: M> mm or 30 inches, are retired. Table, 7 and 7a, pp.433 and434) havebeengiveninorderto demonstrate: the oneahows howDioscoreas do not transgress, owards the driest part of India, a line which can be traced from the head of the Bay of Cambay to the n^hb.urhood of the Himalaya of Jaunsar, and the othergivestherecordedrainiallalDngthisline. The bwp<?t r... A • t T. ... DrBarwani—518 mm. or 20-38 inches : the average oi the series is almost 9D0 mm nr ... oi, say ... do inches. If the six summer months be taken, their average is just over 8D0 mm ... inches ... is cent, of the rainfall for the whole year. It may be that ... situation in which *Dioszorea* DCcursatBarwam is more favourable than the rainfall fio- visited the place .. ourselves. But though the rain-gauge at Barwam has recorded 20 inches it is reasonable tD regard the genus in these hot lowland ... eneral where the rainfall available for growth is about 30 inches, which is 762 m.

Another line of approach towards determining their limits is provided by an examination of the Upper Gangetic Plains. These plains are very level ... under the Himalaya they receive rain from thunderstorms beiore the monsoon brpat« +k ... ureaks, the centre remaining dry.

Dur tables 8 and 9 (pp. 434 and 435) are intended to show that where these pre-monsDon falls Df rain occur Dioscoreas grow more freely than where they do not: the tables demonstrate, for instance, that *D. glabra* and *D. pub era* fail in the centre Df the plains to pass further west than long. 87^{D}E., but that under the mountains they pass westward to lon^ 81^{D}E.; and that *D. hispida* fails in the centre of the plains at long. 87^{a}E., but at the foot Df the mountains passes westward to long. 77°E.; and again that *D. bulbifera* fails in the centre of the plains at long. 79^{D}E. but at the foot of the hills passes westward to lone 75^{U}E.

D. pmtaphylla is recorded for only one Df the plains-districts in table 8 and *D. bulbifera* for Dnly two. It has to be admitted that the intense agriculture Df the plains reduces their possible habitats.

Salinity.—Saline soils arc injurious. Such small patches in the Gangetic plains as are saline—usar soils—do not produce them : and in the Sundribans one spot only, the artificial mound of the Jatta PagDda, carries a member ol the genus.

The struggle of Dioscoreas for light.—There is not an Asiatic *Dioscorea,* unless it be *D. asclepiadea* which does not grow in the vicinity Df trees, and compete with them for light. Many families of Monocotyledons do that, Dicotyledonous trees being their opponents in the struggle. SDHIB run their course in the spring woods before the summer foliage shuts the light out : a few like the *Palmae, Pandanaceae* and *Bambuseae* meet the Dicotyledons on even ground by woody stems, which hold their leaves aloft and get their efficiency by enduring for several seasons : the *Dioscoreaceae* steal support by climbing, get to the sun Dn the shoulders of a competitor and as they have in the World a somewhat wider range than the *Palmae, Pandanaceae* and *Bambuseae,* evidently thrive by the theft. Let it be noted that there is scarcely a member of the whole family which is not guilty of this theft, for almost without exception they climb. All of them die back each year to the ground, to make a fresh demand Dn the complacency of their competing neighbours in the spring. The dying back would seem disadvantageous : of that more a few paragraphs later.

A discussion on stems immediately brings to mind that constant phenomenon of Dicotyledonous growth—secondary increment in thickness, and the fact that among Monocotyledons, where it is so rare, some members of the *Dioscureaceae* possess it. But it is in no way in the *Dioscoreaceae* connected, as in the Dicotyledons, with the uplifting of the foliage : it is a device with them for increasing the storage space in permanent tuberous organs and would seem Entirely unconnected with the phenomenon of secondary increment in the stem of *Dracaena.* At any rate, as we are dealing with Asiatic species from which it is absent, our interest in it is comparative, for it links some Df the African and American sections of *Dioscorza* together and places them in contrast with the Asiatic. But *D. pyrenaim ha,3* it, and, as has been said, is related tD African sections. *Tamus* which also has it, is related tD *Dioscorea* apparently through an ancestry related to that of *D. pyrenaica,* and belongs to the Mediterranean Region.

The stem, then, is an organ without characters suggestive Df the alliances of the *Dioscoreaceae;* and on the other hand suggestive Df the family being Dne which has a climbing habit so deeply embedded in its nature as tD be a mark of distinction. Moreover the direction of the climbing, in this section tD the right, in that section to the left, appears as if fixed from far back in the history Df the family. We maintain that those few members Df the family such as the genus *Trichopus* which do not climb, come of a climbing ancestry.

The stem each year is pushed out from the underground parts of the plant in spring, grows tD the light, flowers if it can and fruits if it is female, then dies, and the whole plant is again subterranean and in a condition of relative rest. Some species require less time than others to run through the vegetative period : we discussed above *D. bulbifera, D. pentaphylla,* etc., requiring six months at the line where a reduced rainfall limits their spread towards north-western India. The time which *D. nipponica* has for growth in Amurland may be a little less. From such periods the growth lengthens out until certain species scarcely end Dne season before they commence to send out new shoots for their next. Climatic conditions limit the various species to parts of the World which are appropriate, those with the longest growth-periods clustering Dn the Equator, where the warmth never fails them and where in certain places there is humidity for uninterrupted growth. Yet they retain the ingrained habit of dying to the ground once in each year. Assuredly their ancestry was shaped in a different climate where seasons were more pronounced : and they are invaders of the tropical evergreen Rain-forest. However the mDst vigorous of them seem not to be in their most favourable conditions where the trees are high: they endure a long suppression period and the same plasticity which is evident in the spring push, enables them, when a big tree falls to snatch the opportunity of flowering and fruiting. Thus are they opportunists.

The maximum length to which a *Dioscorea* can grow is unknown to us ; but we have records of the tops of trees of 24 m. being reached. In Asia the openings which Man makes, such as roadsides, provide the best chances they get of the sun. The broken canopy which covers a rocky slope is perhaps the best situation which Nature provides.

Unquestionably the genus demands an open soil and, in Asia, shelter from desiccation to a greater measure than is the case with various South African species and perhaps with certain American species.

Mucilage-containing hairs are commonly produced : they coat the youngest parts and do much to keep them moist.

Emergences on the stem.—Prickles are not uncommon in the genus. They occur in certain species in great abundance Dn the West above-ground internodes and in *D. piscatorum* make long crests |see plats 41). The positions are undoubtedly in lines in other" species, the lines determined by the course of underlying vascular bundles : but as the bundles may be numerous, they look as if indiscriminately scattered. Upwards on the stem they become less abundant and finally are confined to the base of the petiole, one on each side : then towards the stem-tips they disappear altogether.

In species which are most prickly they occur not only on the stem, but Dn the back of the petiole, and on the larger nerves in the leaf at the back only. But it is only in a few species such as *D. birmanica, D. piscatorum* and *D. escuhnta,* that the prickles extend to the foliage These three are from beyond India and twine in common to the left.

In various species at the base of the petiole weak stipule-like organs are found : they arB 2—4 mm. long and have nD vascular tissue. Beyond doubt they are morphologically identical with the prickles Df other species.

The emergences to a certain extent characterize sections of the genus : the soft stipule-like condition is met with here and there in the section *Stenophora* and the appearance of the organs is exactly as in the genus *Tamus.* They have been seen also in

D' kamoonenns. Abundance of indurated prickles characterizes the sections *Combilium Paramecocarpa* and *Enantiophyllum* : the prickles arc present an the section *Lasiophyton'.* they are absent from the stems of the sections *Shnocorez, Shannicorea Opsovhvton ,J* apparently *Illigerastrum.* ' *upso*$P^{n}y^{ton}$ and

D, birmanica is exceptional in the section *Stenophora* in its prickliness : and it is to b regretted that we have had, as yet no opportunity of studying it in development. ° °

The Jetwea.—Alternate leaves are more commonly observed than opposite leaves Opposite leaves characterize the section *Enantiophyllum;* but the first leaves at the 1 of the stem are not opposite : the opposite position appears at a short distance *Ihovl* ground, and may or may not continue to the stem-tips. We regard it as a secondary character when present; and observe that there may be no direct vascular connection i the stem between the one and the other of a pair.

The leaf-rudiment, on emergence.from the growing point of the stem, commonly ci DrigintD a water-excreting gland at its tip. This gland when newly produced is fed by the mi drib; but in m Dst sp B cies the first lateral nerves s o on rea ch it and aft er th cir cours e has be laid down an arrest of growth just below the gland occurs which leaves these two later 1 nerves tied above it to the midrib. The gland, now fed by three nerves and with a iD-ht amount of chlorophyll-containing tissue, constitutes the forerunner tip: the leaf bJ- *H proper, is an intercalary development below it of later date ; and the growth which iv ^ rise to the lateral expansion of this leaf-blade comes much too late to disturb the uni f the first lateral nerves with the midrib in the forerunner tip, but gives them curves in v ing degree, while it removes the ends of the later-formed nerves from the neighbourhood of the others. Another arrest of growth gives rise to a basal tying and below this has 1 tying occurs the intercalation of the petiole. Every *Dioscorea* produces petioles • and every *Dioscorsa* we observe this basipetal leaf-growth, the direction of which has noth" extraordinary in it: but the arrests of growth in its course make the characters of spec and sections. In the section *Lasiophyton* it is usual for the forerunner tip to suffer a che- k before the first lateral nerves have been laid down, with the consequence that expans' of the leaf-blade here interposes chlorophyll-containing tissue between the gland • fwh" n remains small) and the ends of the first lateral nerves : thus the midrib alone reaches it leaf-apex. At the same time, also in the species of the section *Lasiophyton,* in proxim't tD that basal check to growth which results in the differentiation of blade and petiole oth checks direct the energy of growth laterally into the formation of side-leaves, 2 4 6 even 8 in *D. polyphylla,* in pairs following each other basipetally. (Actually 10 leaflets h been observedin this species, which indicates greaterpDSsibilities). It is clear that i sidering the taxDnomic value of the leaf of *Dioscorea* a series of points present themselv < weighment:—(i) to what extent does the forerunner tip round itself off before the tim foliar growth comes, fw) with what measure of basipetal regularity does the increase f foliar growth proceed ; \iii) is the check at the place where blade and petiole part occurrence, or are developments sufficiently undecided for it to be repeated

The forerunner-tip is fed by three nerves in all the Asiatic sections except *Lasiophyton,* but even in *Lasiophyton,* in *D. hispida* and its African relatives, w tl tl nerves. We find it to be fed by three nerves in general in other parts of th W also; and we surmise that such a condition is older than the 1_np™ ^ TT J • J i *4.* +u +• • • *.- "tuvea condition. Undersized leaves, at the same time, m various sections may have the reaching the tip, from general arrest, which is another matter, even though i+ i_e quite uugn it, may b common in *D. hashfoha.*

Major M. Y. Orr has given an account Df the development of the gland in the forerunner-tip Df several species |*Notes from Roy. Bot. Qard. Edinburgh,* 14, 1923, p. 57 and 15, 1923, p. 133).

Among the species which he examined, were *D. balcanica. D. villosa* subp. *glauca, D. caucasica, D. nipponica* and *D. tokoro* of the section *Stenophora.* He shows that differentiation of the forerunner-tip from the leaf-blade is in these not at its greatest, i.e., the check is not very strongly pronounced. It is interesting that in this section more than any other of the East, the first check is followed by a series of others which cause the margins of the leaf to be sinuate in varying degree. The checks are contemporaneous with the broadening in the blade, but decrease in effect in such a way that the more the broadening is established, the less the indentation resulting from the checking. Reference should be made to the plates Df *D. szptemloba, D. quinqueloba, D. althaeoides, D. futszhauensis* and *D. membranazea* (plates 7, *ID,* 23, 25 and 25) for illustrations : *D. althaeoides* exhibits the greatest number of sinuations : and this must be regarded as the consequence of an equal number of checks. The check at the line where blade and petiole join, which is much more cogent in its effects, causes the expanding leaf-blade to thrust itself out into auricles : and SD gives origin to the basal lobes of the leaf. Reference may next be made tD the plates of those species with compound leaves (plates 54, 55 tD 79 and 80/3) for evidence that when the check between blade and petiole is repeated, the lateral expansion of the intermediate leaf-blades is, also, checked SD that no basal lobes are formed on them. One may explain this teleologically as, were basal lobes developed on the leaflets above the lowest, they would interfere with the light Df the others. The plate of *D. pentaphylla* (no. 55) contains a series Df drawings |figs. 13 to 19) of leaves Df arrested growth, showing what may happen if the vigour of the stems is nat sufficient for full development.

In summary, a leaf-rudiment as soon as large enough becomes checked in growth at two points, one cuts *oft* the forerunner-tip ; the other the blade to be : and after this it is possible for both the checks tD be repeated basipetally. The check which cuts off the blade is generic ; for all the species of *Dioscorea* have petioles : that which cuts off the forerunner-tip is almost generic, such differences in its effect being slight, though sectional in distribution : the checks which cause the leaf to be compound are sectional: but those which cause the leaf-blade tD be sinuate are more Dr less specific, yet commonest in the section *Stenophora.*

During the enlargement of the growing leaf-blade, the relation of increment in breadth tD increment in length results in different degrees of curvature Df the larger veins.

Understood in the way we have tried to explain, the leaf Df *Dioscoreaceae* is easily conceived as being in conformity with the Monocotyledonous type.

It has been observed in certain species that the removal of overhead shade arrests the elongation of the leaf-blade and alters its shape : figure 9 on plate 137 shows the result in *D. pyrifolia.* It has not been ascertained if the alteration of the incident sunlight operates Dn the leaf itself, Dr operates through its action on the growing stem which bears such a leaf. The change in shape may be explained as produced by an access of vigour towards the end Df the expansion-period of the leaf. Conversely the production of leaves without auricles in the uppermost parts Df stems may be explained as due to a waning of vigour.

The dimorphism in *D. hastifolia* (plate 11D) requires study in its home with the object of ascertaining if the hastate leaf-blades are altogether sun-leaves and the linear leaf-blades shade-leaves.

The inflorescence.—The panicle is perhaps more primitive than the spike, the latter being a setting together of panicles each reduced to its terminal flower. Panicles characterize, among Asiatic sections, *Stenophora :* and our sequence of the sections on p. 9 is in general a progression from what we surmise to be the more primitive to the more specialized. The sections *Combilium* and *Paramecocarpa* on rare occasions have vigorous racemose male inflorescences developing into panicles. The section *Shannicorea* has them as cymes : the section *Stenocorea* as racemes. The section *Opsophyton* has the flowers spicate, the sections *Lasiophyton* sometimes and *Enantiuphyllum* almost invariably have the flowers si^uat Dn the axis of a spike.

There is one species in the section *Enantiophyllum* in which we have seen a second flower by the side of the first: it is *D. spicata* and we have figured this Dn plate 1D2. We think the presence of the second flower an indication of a lost ancestral panicle.

The divergence in the inflorescence is usually about f and the genetic spiral is sometimes to the right, sometimes to the left, in a wholly inconsistent way.

The flower.—Sepals and petals are always slightly but never conspicuously differentiated. We have seen them increased above the number Df three in *Tamus* but not in *Dioscorea.* Usually they are leaf-green ; but in *D. bulbifzra* greenish white, in *D. simulans* purple, and in *D. Hemsleyi* with a crimson tint. Sometimes the flowers are strongly scented with a smell suggesting benzoin. The pollination remains unstudied but must be by insects. The sexes are SD uniformly segregated on different plants, as to suggest that incDnspicuDUsness is no serious handicap. But there is an obvious waste *oi* male pollen ; for the male flowers are very much more abundant than the female. The male flowers are also more conspicuous than the female. Now and then flowers are seen with the appearance of being hermaphrodite. That they can produce at the same time fertile pollen and fertile ovules has not been demonstrated. It is interesting that a cultivated variety of *D. bulbifera* should be one which bears these |see p. 11B) : another is *D. Hemsleyi* (see p. 42 D).

The stamens in male flowers of species of the several sections and almost throughout the section *Lasiophyton* are reduced from six to three. When they are reduced to three, as in *D. Collettii* (see plate 15), the three stamens which remain are forked so as to present their anthers in six positions, filling up in this way the whole ring of the androecium, i.e., presenting tD visiting insects as many points for contact as if six stamens were present; Dn the other hand in the section *Lasiophyton* there is a definite decrease in the area where pollen is exposed ; but the places Df the missing anthers are occupied by large staminodes which prevent access to the base Df the flower between, instead of along the developed anthers. Only in a few species, as *D. asclepiadea* and *D. Zmtaroanā,* are the anthers reduced to three without any indication of some alternative for compelling insect-visitors to effect pollination. In brief the position of the anthers seems much more important than the amount of pollen made available by them.

The female organs present great uniformity.

The fruits.—The number of loculi and ovules is perfectly constant in *Dioscorza,* if the little known American genus *Higinbothamia* be excluded.* We find this last genus too little known for discussion.

The position of the ovules on the placenta, whether high up or IDW down or in the middle, varies from section to section, and varies also a little within the sections, thus it is that *D. tokoro* and *D. tznuipes* both of the section *Shnophora,* are most intimately connected with each other, but differ in the position of the ovules. The position of the ovules and the shape of the wing on the seeds are two sides of the same character, with an ovule placed IDW down the greater part or all of the wing of the mature seed is towards the apex of the capsule, and with an ovule placed high up, the wing has its direction reversed. When wings surround a seed, obviously its DVUIB had a middle position. The larger the capsule the larger can the wing Df the seed be.

From a study of the size of the capsules some-interesting facts emerge. Here are two lists, one Df the species in which the capsules measure along the placenta 3D mm. and more : and another of the species with wings attaining 22 mm. and more in maximum width. It was arbitrary to fix 3D mm. and *22* mm. as the limits, but the object in view was to obtain two lists of similar size.

The first list being of species in which the capsules measure 3D mm. and more along the placenta, the species arranged in decreasing order by the column on the left.

Maximum recorded length.	Name.	Section.	Country.	Maximum recorded width.
bDmm.	*D. Petdotii*	Paramecocarpa	Tonkin	10 mm.
5D	*D. Ledermannii*	Do.	Palau Islands	18
45	*D. Scortechinii*	Lasiophyton	S. China, Malaya	12
45	*D. hispida*	Do.	TrDp. Asia-Malaysia	
40	*D. sumatrana*	Stenocorea	Sumatra	4D
35	*D. inaequifolia*	Lasiophyton	Philippine Islands	12
35	*D. polyphylla*	Do.	Do.	12
35	*D. Esquirolii*	Do.	S. E. China	11
35	*D. flabzllifolia*	Paramecocarpa	Philippine Islands	9
32	*D. tznuifolia*	EnantiDphyllum	Singapore and Sumatra.	3D
32	*B. Poilami*	Stenophora	Anam	15
3D	*D. Wattii*	Enantiophyllum	N. E. India	27
3D	*D. orbiculata*	DD.	Sundaland	26
3D	*D. Prainiana*	DD.	DD.	25
3D	*D. Hamiltonii*	Do.	Malabar to Tenaserim.	2D
31	*D. birmanica*	Stenophora	Burma	15

* Morton *Bot. Maya Area, 11, in Carnegie Instil. Washington, Publ, 451,* 1935, page 24B) expresses the opinion that *Higinbothamia* is not a, genus apart from *Dioscorw.* It has four ovules in a loculus.

Second list, of species in which the capsule-wings measure *22* mm. across or more, at thB widest place, arranged by order by the column on the right.

Maximum recorded length.	Name.	Section.	Country.	Maximum recorded width.
4Dmm.	*D. sumatrana* ..	Stenocorea ..	Sumatra ..	4Dmm.
26	*D. spicata* ..	Enantiophyllum ..	S. India and Ceylon	43
32	*D. tenuifolia* ..	Do. ..	Singapore and Sumatra.	3D
27	*D. madiunensis* ..	Do. ..	Java ..	•30
30	*D. Wattii* ..	Do. ..	N. E. India ..	27
3D	*D. orbiculata* ..	Do. ..	Sundaland ..	25
28	*D. gedznsis* ..	Do. ..	Java ..	25
3D	*D. Prainiana* ..	Do. ..	Malaya ..	25
25	*D. paradoxa* ..	Stenocorea ..	Siam ..	25
21	*D. platycarpa* ..	Enantiophyllum	Java ..	*22*
20	*D. Kingii* ..	Do. ..	Malaya ..	22
18	*D. pyrifolia* ..	Do. ..	Do. ..	22
24	*D. myriantha* ..	Do. ..	Malaysia ..	22
2D	*D. cirrhosa* ..	DD. ..	Indo- China ..	*22*
27	*D. laurifolia* ..	Do. ..	Malaya ..	*22*
18	*D. Havilandii* ..	DD. ..	Borneo ..	22

TherB is a striking difference in the representation of the sections in the two tables. There are four sections in the first list but two in the second. There are five species which get into both lists. Obviously it is necessary to turn to the superficies ; and these are the results then obtained, which will be given section by section.

Of thB section *Stenophora* :—

D. Poilanei	..	..	.. 39D square mm.
D. birmanica	..	..	.. 3DD

Of the section *Stenocorea* :—

D. sumatrana,	..	..	.. 1,53D square mm.
D. paradoxa	..	..	.. BDD

Df the section *Paramecocarpa* :—

J). Ledermannii	..	..	.. 700 square mm.
D. flabellifolia	..	..	.. 55 D
D. Pztehtii	..	..	.. 52 D

Of the section *Lasiophyton* :—

D. Scortechinii	..	..	.. 415 square mm.
D. inaequifolia	..	..	.. 370
D. hispida	..	..	.. 370
D. polyphylla	..	..	.. 36D
D. Esquirolii	..	..	.. 33 D

Of the section *Enantiophyllum* :—

B. spicata	880 square mm.
J). Wattii	720
B. madiuntnsis	670
B. Prainiana	620
D.gedensis	**600**
B. cirrhosa	**520**
B. tenuifolia	50D
B.laurifolia	5D0
D. orbicillata	430
Z). *myriantha*	4DD
D. Xṁgn̈	40D
B. platycarpa	39D
D. *Havilandii*	360
2). *pyrifolia*	350

These figures make) it evident that *B. sumatrana* (for which see plate 32/3) has by a long way the largest capsules. Second comes *B. spicata* (for which see plate 102). In the third place comBS *D. Ledermannii.* Fourth, fifth and sixth come *D. madiunmsis, B. Prainiana* and *D. gzdensis* (plates 93, 89 and 93 respectively). These, which are the largest of the eastern species, arB found within 10° of the equator. They have wings surrounding the seed and all take higher places in the "second list than in the first, indicating that without proportionally large transverse growth the greatest superficies is unlikely to be achieved by the winged seeds. One of the species belongs to the section *Shnocorea* ; onB tD the section *ParamRcocarpa,* and four to the section *Enantiophyllum.*

Such sections as have the seeds winged on one side only, e.g., *Lasiophyton* and *Opsophyton,* even though the largB capsules of *D. inaequifolia, D. polyphylla, B. Esquirolii* and *D. SwrtecMnii* are comparatively striking objects, fail to grow to the equal of those which we have enumerated. On the other hand the species most abundant individually and wide-spread, are such as have small capsules, and fall outside our list.

The proportions of the capsule-wings demand a little attention. The greatest discrepancy is met with in *D. Petdotii* where the length of wing to width of wing is 5:1. In *D. yunnamnsis* it is 4 : 1, and so also in *B. Oraibiana* and *D. Scortzchinii.*

In contrast in *D. spicata* it is 3 : 5 in extreme cases, and is commonly 3 : 4.

In the section *Stenophora* the commonest proportion in 3 : 2. In the section *Stenowren* it is 1 :1- In the section *Paramzmcarpa* it ranges from 3 : 1 to 8 : 1. In the section *Shannicorea* it is about 3 :1. In the section *Opsophyton* it ranges between 5-2 and 5:3. In the section *Lasiophyton* it is commonly 3:1. I_n the section *Illigerastrum* it i3 3 : 2. And lastly in the section *Enantiophyllum* it varies round about 1 : 1 and the commonest proportions arB 10:ll.Dr 10:12.

We desire to call attention to the circumstance that the section with the length most pronounced, namely *Pararmcocarpa,* has a geographic distribution similar to that Df the genus *Stenomms,* wherein the capsules is still more markedly elongated, and it is likely that both evolved somewhere about the south of the China Sea.

The amount of the World that a very wide-spread species is able to make its home. The broader problems of phytDgeography demand an approach through well characterized species, and we shall pay little attention to what we have called satellite species.

Table 1 shows that:—

D. alata in range reaches 11 of the units of area in the East.

D. bulbifera is also in 11

D. pentaphylla is in ID

D. esculenta has been taken tD 8 .

D. hispida is in 7

D. *glabra* is in 6

These are, according tD that Table, thB most widespread. It is worth passing mention that every one of them is pressed more Dr less intD the service Df Man, though the last comparatively little : and that *D. alata* and *D. esculent a* owe their extension to Man. On the contrary *D. bulbifera, D. pentaphylla* and in a lesser degree *D. hispida* evidently owe their wideness to their fitness tD exist, and in a secondary degree tD their service to Man and to thrusting themselves in his way : for every DioscDrea with a tuber is liable tD be exploited by Man, and the commoner they are the more heavily his demand falls on them. *D. glabra* is not so easily got, nDr so widely exploited.

It is evident that fitness'to exist in *D. hispida* has not quite the same causes as it has in *D bulbifera* and *D. pmtaphylla.* The last two are abundantly bulbiferous and possess somewhat Df the characters of an abundantly multiplying proletariat. The first is very poisonous and well defended by its poison. It is striking that Df all Asiatic species *D bulbifera* and *D. pentaphylla* are the species found Dn islands. *D. bulbifera* is the only wild *Dioscorea* recorded for the Laccaiive Islands and for the island Df MinicDi, midway between them and the Maldives. It is plentiful in the Andaman Islands, including Barren Island, which is a volcano devastated about 184D and since rDclothed with vegetation. It is the species which collectors in Malaysia bring in from small islands : for instance it is the one *Dioscorea* Df Pulau Merambong near Singapore and of Kleen Kombuit in Batavia Bay. Backer found it in several of the islands of the Kangean and into the Pacific it spreads at least tD Nukahiva in the Marquesas Islands and Ts apparently in Pitcarin Island. It passes freely up the Liu-kiu chain.

D pentaphylla is as yet the only *Dioscorea* obtained wild in the Maldive islands. It is plentiful in the Andaman Islands. Backer obtained it in the Kangean Islands and it occurs in the island of Bawean. Dut into the Pacific it goes approximately as far as *D. bulbifera.* But a corresponding connection with very small islets has not been established.

Guppy tested the notability of the seeds Df *D. bulbifera and* found it small *{Observations of a Naturalist in the Pacific, 2,* 19DS p. 532). Bulbils seem to float for longer periods. But it is neither to floatability of seeds, not to the floatability of bulbils that we would ascribe its success in spreading. It is rather to the powsr added to propagation which the bulbils bring. We see the question in this way. Species A has bulbils : species B. has none : seeds of both chance to reach a possibly new home by the aame accident : both grow, and species A. multiplies its opportunities of survival, trying

out varying situations by means of its bulbils : B. cannot : a single mishap coming before either can reach seed-time, will end the career of B. but may spare A. *D. bulbifera and D. pentaphylla*, with their free bulbil-formation live in the position of A., but *D. hispida*, which does not seem to occur on small islands, lives in the position of B. and ecesis or establishment is more difficult for it, than for the others.

D. bulbifera and *D. pentaphylla* are very much alike in their climatic requirements. Maps of their distribution have been given on plates 82 and 85 and should be compared. *D bulbifera* is able to maintain itself just a little further to the north than *D. pentaphylla,* and ascends in the Himalaya a little higher (see table 11, p. 436) • moreover it maintains itself a little further to the westward about the line limiting Dioscoreas towards Rajputana (table 7). The abundance of both species in India should recommend them to the attention of phytogeographers interested in delimiting zones of vegetation on the mountains. But they break up into varieties, which have different powers of resistance to adverse conditions and differ in length of seasonal growth.

It will probably be proved as collecting proceeds in Indo-China and in Malaysia, that *D. bulbifera* is everywhere except in isolated pockets of unusual dryness and if so this will be a good index for these also. It is doubtful if *D. pentaphylla* is as general throughout these parts ; and it may be pointed out, in regard to this, that there are few records for it in Borneo and none for the Philippine Islands north of lat. 15° N. Attention is directed to this scarcity of records. Again out in the eastern Pacific, it is cultivated • and collectors have not yet disentangled the records of cultivated from'the records of 'wild plants.

However *D. bulbifera* and *D. pentaphylla* are thoroughly characteristic species of the Indian Monsoon Region and of the Eastern Equatorial Region. Both pass over the borders into the Chinese Monsoon Region : *D. bulbifzra* passes into the Australian Region and *D. pentaphylla* reaches its threshold at Thursday island.

The two cultivated species—*D. alata* and *D. esculenta*—have attained a distribution similar to the natural distribution of *D. bulbifera* and *D. pentaphylla* by the aid of Man (for their dispersal in the World see plates 147 and 82). The general similarity so established can be used also in determining the limits of the Indian Monsoon, o • ˙ , luian monsoon Region and Eastern Equatorial Regions.

D. hispida has the narrower dispersal indicated on plate 85. It is general in the Indian Monsoon Region. It fails to ascend in the Himalaya as high as *D. bulbifera* and *D. pentaphylla :* and it fails to extend into China except that it is found just over the border in southern Yun-nan. Strangely it is absent from Ceylon and it is absent from the Andaman Islands. Small islands in Malaysia do not seem to contain it. It is not known in Australia and while rare in Papuasia is not to be met ™^v, • ..i wim in the Pacific.

D. glabra scarcely runs on all fours with the wide-spread species which have been discussed : but if instead of *D. glabra* as a segregate species the " group of *D. glabra* " (as defined on p. 348) is brought under consideration, a unit is obtained which compares in ihe area it occupies very well with *D. bulbifera* and *D. pentaphylla.* The dispersal of the " group of *D. glabra* " has been given in five maps, two of them on plate 149 and three on plate 150 : those on plate 149 are *D. belophylla* and *D. glabra* itself, those on plate 150 are the others. One observes this from them :—that Ceylon is outside the

limits and so is most of western India, though *D. bdophyUa* reaches the central part of the Western Ghats where the rain during the height of the south-west monsoon is most intense. Eastwards of India, the group seems to be general and so too in Malaysia; but it does not reach Cathay, nor does it reach Australia.

Regarded as a stock breaking up, the " group of *D. glaira* " appears Many a family line demanding considerable moisture which has given off a species able to survive on steep and rapidly drained slopes, this species being *D. bdophyUa;* and from the ability of *D. bdophyUa* the group has progressed furthest towards the dry western part of Asia which again in itself has found suitable the climate of the forests of *robusta* and has suffered arrest with *Shona* both at the Godaveri river and Himalaya. Under the

Towards the East the " group of *D. glabra* " in *D. nummularia* reaches Tahiti with intermediate stations in several of the larger islands—as Viti Levu in the Fijian Tutuila in the Samoan group. It occurs also in the Palau Islands. It is as yet unrecorded from other groups. Whether it is genuinely absent or has been overlooked, we do not know : but Crosby who claimed to have obtained all the species of Vavao, in the Friendly group did not meet with it. That Man carried it out into the Pacific is possible (see p. 370).

Our six "wides" are then (i) by ability to hold their own—*D. bulbifera, D. pentaphylla, D. hispida* and the group of *D. glabra*", and (ii) by the aid of Man *D. alata* and *D. escuhnta.* Their presence characterizes two Regions, the Indian Monsoon Region and the Eastern Equatorial Region : but in spite of this bi-regional citizenship the only one of the six that has been able, unaided by Man, to find a footing to the west of India is *D. bulbifera,* which is widely spread also in Africa.

*Species which more or less characterize Subngions.—*Under an atlas be taken and the areas occupied by the Dioscoreas in the East demarcated, those of eleven species, additional to the species already discussed, will be found to have limits some 2,000 miles apart, and a further sixteen to have limits some 1,000 miles apart. The first eleven are :—

Name.	Section.	Its centre.	Extending to
D. Hamiltonii	Enantiophyllum	N. E. India	From Malabar to Laos.
D. pubera	"	"	Malabar to Java.
D. deltoidea	Stenophora	Himalaya	to the edge of Tonkin.
D. nipponica	"	N. China	Japan to Sze-chuan.
D. opposita	Enantiophyllum	China	Japan to S. W. China.
D. japonica	"	"	"
D. Colhttii	Stenophora	S. W. China	Shan Hills to Formosa.
D. melanophyma	Lasiophyton	"	N. W. Himalaya.
D. kamoonensis	"	"	" "
D. myriantha	Enantiophyllum	Malaysia	Siam to Kei Island.
D. transversa	"	E. Australia	"

The second sixteen are :—

Name.	section.	Country.	Extension.
D. tomentosa, ..	Lasiophyton ..	India ..	....
D. oppositifolia ..	Enantiophyllum ..	»	....
D. Wallichii ..	„	„	to Peninsular Siam.
D. gracillima ..	Stenophora ..	Japan ..	Che-kiang.
D. tokoro ..	J>	3J	
D. quinqueloba ..	„	„	Ho-pei.
D. cirrhosa ..	EnantiophyUum	.- E. In do-China ..	Che-kiang and Liu-kiu Islands.
D. persimilis ..	„	„	Yun-nan
D. Prazsri ..	Stenophora	.. W. Indo- China ..	Himalaya.
D. membranacza ..	J>	5)	Peninsular Siam.
D. arachidna ..	Lasiophyton ..	?J	Assam to Peninsular Siam.
D. decipiens ..	EnantiDphyllum ..	5>	Yun-nan to Peninsular Siam.
D. piscatorum ..	Paramecocarpa ..	Malaysia ..	....
D. piper aides ..	Enantiophyllum ..	3J	Tonkin.
D. polyclades ..	J»	5!	....
D. orbiculata ..	„	J3	....

Three observations arise from the examination of these tables :—*\i)* that the climate on the mainland of Asia which most nearly corresponds to that of Japan is by no means in the same latitudes, but is as far south as Che-kiang ; and therefore a Japanese plant under present conditions if it is to escape in a natural way from confinement in the islands, must be able tD make the leap to Che-kiang : *\ii)* that the plants of the Himalaya and South-West China find homes vicariously by extending from one to the other : and *\iii)* that a species abundant in Western Indo-China is likely to find its way for at any rate a little distance down the peninsular part of Siam.

We proceed to an examination of the species in detail: with the first six added and counting the " group of *D. glabra* " as one, they amount to 33.

1B belong to the section *Enantiophyllum,*
8 belong tD the section *Stenophora,*
B belong to the section *Lasiophyton,* and
1 tD each of the sections *Combilium, Paramecocarpa and Opsophyton.*

- The sections *Steno core a, Shannicorea* and *Illigerastrum* supply none.

There is a proportionate relationship between the size of the section and the number of wide-spread species in it, which evokes the natural comment—a successful section holds successful species. Df the section *Enantiophyllum* we enumerate 76 species ; of *Stenophora* 32 ; Df *Lasiophyton* 21. The others are small.

We have prepared for the discussion Df the most interesting Df these species by maps : e.g. for *D. tommtosa* on plate 85; for *D. oppositifolia* on plate 139; for *D. polyclades* and for *D. orbiculata* on plate 149. We have been able tD use a considerable amount of material for furnishing data for most of them :—of *D. oppositifolia from* 152 localities ; of *D. tomentosa*

from 115 localities : and Df the others, *D. transversa* 75, *D. orbiculata* 76, *D. decipiens* 62, *D. myriantha* 55, *D. polycladzs* 54, *D.pvrsimilis* 54, and than *D. arachidna 22, D. piscatorum* 18 and *D. msmbranacea* 17. We givs these figures that the reader may for himself judge how far we have been able to establish our deductions, regarding distribution.

It appears that every Subregion Df the warmer parts of the East, except Papuasia and the Pacific, has served as a nursery for some successful species which has taken possession more or less Df its whole, and at its bounds attempts to travel further. Dur summary now becomes an effort to understand, from the circumstances Df present distribution, the course of events influencing the history of Dioscoreas in the past, and we must review one phyto-geographical Subregion after another in an orderly way. As we have proceeded in Dur enumeration of data from West to East, so in the discussion of Subregions we do the same.

The Subregion of India, proper, has a flora out of harmony in the south. One of the most interesting of the Dioscoreas in India is *D. spicata.* It occurs in the south only, including Ceylon. It is known from the Western Ghats to the east of Cochin, and from the contiguous Anamallai Hills of the District of Doimbatore, from which it extends southwards down the Ghats both on the seaward face in the State Df Travancore, and on the landward face in the Districts of Madura and Tinnevelly. Then again it is in Ceylon in the Central Province, the Sabaragamuwa Province, the Southern Province, and the Uva Province. The altitude at which it occurs is usually 1,000 m. and upwards, but one Df Thwaites' labels records it as at Galle, i.e., at the coast: but Thwaites was careless in localities and this may not be precise. It has as a satellite species in Ceylon *D. Trimenii* which does not occur outside the range of *D. spicata.* It associates with Dipterocarps and other trees of Malaysian type, has a bng period Df growth, and is obviously a member Df the Bain-forest flora found there. It presents one peculiarity—a peculiarity which was mentioned on p. 239 :—it sometimes produces a second flower by the side of another on the male spikes, SD that strictly we have no longer a spike but a paniculate inflorescence.

D. spicata does not in itself reveal its origin. But the associated trees make it evident that the Rain-forest flora Df which it is a member, was Dnce in contact with the Rain-forests which havb remained or become much more developed in Malaysia. The connection between them had been so long severed—one surmises that it has been severed since the cbse Df the Miocene, drier conditions then spreading southwards—that few species are now common to the two. But the occurrence of *D. spicata* is association with Dipterocarpa is a reason for believing that the section *Enantiophyllum* was in southern India (this includes here Ceylon) at that Epoch. That the family Dioscoreaceae was otherwise represented the distribution of the genus *Trichopus* proves: and it brings with it another observation, namely, that *Dioscoreaceae* must have been there for a vety long time as *Trichopus* is remote from *Diosvorea. Trichopus* does not climb, but grows in shade among lofty trees. One is struck on seeing it for the first time with the idea that inability to get tD direct sunlight in the overwhelming Rain-forest led to abandonment of a useless effort to climb ; and the seeds having nD distance tD fall were not in need of wings, so that these were bst, whereon followed the abandonment of dehiscence with a reduction Df the produced seeds tD one. But the discovery of the genus *Avetra*—a Madagascan genus which combines a climbing habit with the fruit-characters of *Trichopus*—alters the view a little. *Avetra* suggests that dehiscene was lost *pari passu* with reduction Df the seeds tD one, the wings Df the capsule sufficing for wind-dispersal, and that after the establishment of these two characters *Trichopus* came from the parental stock by the abandonment of climbing. *Trichopus* grows in Ceylon and in the Malay Peninsula in

almost identical forms. If the South Indian and Malaysian Rain-forests were sundered on the close of the Miocene, *Trichopus* was then fashioned as now, and the whole history of the development of the TrichDpus-condition through an Avetra-condition had takon place before the sundering.

If the specialization of the DiDSCDreaceae had gone so far in genera, it had undoubtedly gone far in sections of the genus *Dioscorea.*

The other Dioscoreas of Southern India, additional to *D. spicata* and its satellite *D. Trimenii,* which do not reach Malaysia, are *D. oppositifolia, D. obcuneata* (apparently a satellite of *D. oppositifolia) D. intermedia* (the same) and *D. tomentosa.* Observing that they seem to be confronted with barriers which have not held in *D. bulbifera* and *D. pentaphylla* in which direction, we ask, did the latter two species cross the barriers ?

The Peninsula of India, tD the north Df the Rain-forest flora which contains *D. spicata,* holds a vegetation which must have gained in space as the climate compressed the Rain-forest flora. It is characterized by *D. oppositifolia* and *D. tomentosa;* but they demand much moisture and are therefore absent from the driest parts Df the Deccan, as our maps indicate. The reader will profit if he turns to several maps, e.g., to that for *D. tomentosa* (plate 85), for *D. Wallichii* (plate 115), for *D. oppositifolia* (plate 139), for *D. bdophylla* (plate 149), for *D. Hamiltonii* (plate 148), for *D. pubera* (plate 149), for *D. pentaphylla* (platB 85), for *D. hispida* (plate 85), for *D. bulbifera* (plate 82), and the maps of the cultivation of *D. esculenta* (plate 82) and *D. alata* (plate 147), as showing very conclusively how much of the Peninsula is too dry for the genus ; and as suggesting the value of the hills across India in thB Central Provinces as a corridor from East to West.

Assuming it to be incontrovertible that the climate of the Peninsula of India has dried from the north towards the south since MiocenB times, the corridor must once have been more suitable for the rain-demanding species than it is now and have provided a route by which late comers might travel. If so the plains by which the Ganges and the Brahmaputra now reach the Bay of Bengal offered a greater obstacle to the passing of montane Dioscoreas between the Khasia Hills and the Western Ghats than any dryness in the Deccan. ThosB plains limit *D. oppositifolia* and may be said to limit *D. tomentosa* which on their eastern side has not been obtained elsewhere than on thB old red alluvium of the Madhupur jungles near Dacca (see p. 157).

Why is *D. hispida* absent from Ceylon ? We cannot say : but its distribution is on all sides a little more restricted than that of *D. pmtaphylla* (compare the maps on plate 85), and it is absent from islands of small size as well as from Ceylon.

We have suggested (p. 171) that *D. pmtaphylla* is a species that has had in southern India a double origin : that a condition with long tubers existed there at an earlier period than thB more wide-spread condition with short tubers, and that the latter at the present day, by crossing with the former, is producing a population of a new type.

It may be that *D. hispida* is at the present time advancing towards Ceylon, as the short-tubered *D. pentaphylla* appears to have done, but has failed to keep pace.

Characteristic Dioscoreas in Burma.—Burma has two species almost restricted to it: they are *D. birmanica* and *D. decipiens.* The first is known to extend northwards to lat. 26° 20' in the Hukong valley : the latter to Thesama in the Naga Hills. The first extends southwards to lat. 14D N. or possibly a little further, for Heifer's specimen is not localized : the latter extends to lat. 13° N. The former has not been obtained in Arakan :

the latter Dnly in Dne district of Arakan. Both enter the Shan Hills and northern Siam. The former is not known to cross the Salween : the latter does, and oven crosses the Mekong also, where the country about it is of the same nature as the Shan Hills. Neither species, as far as is known, enters Yun-nan over the border of the BhamD District: but the latter gets into Yun-nan tD the south of Sze-maD along with a few other southern species.

If it be quite correct, it is very interesting that Arakan should neither hold *D. birmanica nor* hold *D. decipiens* as plentifully as does Burma tD the East of the Arakan Yomas. It may be correct, for the better explored hills of Assam seem not to harbour them : and *D. hispida* also is not known in Arakan. The dry centre of Burma is too dry for them ; and they are absent : but as we have explained |p. 443) with few exceptions the Districts which, united make Dry Central Burma*, run back tD moister hills which harbour these species ; and as a consequence data such as ours on a District-basis do not bring Dut their absences clearly. Table *22* |p. 443) indicates *D. decipiens* as more general than *D. birmanica*,. At the centre of the dry districts Df Burma the rainfall is below the 73D mm. Dr 3D inches which amount we found |p. 481J) the minimum for Dioscoreas towards north-western India ; and just as *D. bulbifera* ventures furthest into the dry area of north-western India, so it seems tD be that which holds its own best in Dry Central Burma.

The distribution of *D. birmanica* and *D. decipiens* invites a comparison with the distribution of *D. tomentosa* and *D. oppositifolia.* All extend over an area which embraces a dry core, and which is approximately equal both in dimensions and latitude. But it is difficult to gather the nature of the circumstances limiting the Burmese species. What they are is not evident yet.

Species which occupy a wide arc facing the Bay current of the south-west monsoon.—Attention may be directed in the first place to *D. Prazeri* and *D. arachidna.* The former occurs in the lower Himalaya from western Nepal to theAbor Hills and from the mountains for a short way into the plains, in the Naga Hills and Northern Burma, down the Shan Plateau, in the mountains of Siam and down Peninsular Siam tD the northern edge of British Malaya. The second Dccurs in the Khasi-Naga Hills, descending tD their base in the Nowgong District of Assam, then, after a wide interruption, is met with at the southern end of the Shan Plateau where it enters Siam and spreads down the Peninsula to lat. 11° 2D'N. The greater abundance of *D. Prazeri* is towards the northern end Df the arc and the greater abundance of *D. arachidna* towards the southern. *D.* Prazen is known to ascend the Himalaya tD l,5D0m. and the Naga Hills to l,b"7D m. ; but its southern localities are more or less at sea-level. *D. arachidna,* having been recorded as growing Dn the Boga Pani in the Khasia Hills at a certain specified place, would seem there to Dccur at 1,3DD m. and it descends the hills to the forests at the fDDt where they arB intensely humid : again at its southern limits it is at sea-level. Seasonal humidity certainly is a potent determining factor in the distribution of these two, and probably does more to control their occurrence than seasonal temperatures : but it is scarcely possible to understand why the arc along which they grow is so disposed around Burma that, Arakan is within the arc without being within the plants' area. There is an overlap of distribution with *D. birmanica* and *D. decipiens* which is relatively small.

Here attention may be called tD *D. membranacea* because it shares its area considerably with *D. arachidna.* It has been obtained from the Gangaw valley—a narrow valley administratively attached to the Pakokku District Df Burma, but opening northward tD the

• Stamp *{The Vegetation of Burma from an ecological standpoint,* 1025, p. 5) defines Dry Central Burma as the area where the rainfall is under 40 inchus |1,D15 mm.). If the boundariDs laid down in his map be drawn on a map with DistriDta indicated, it will bB observed that these Districts alone—Sagaing, Myingynn and Magwe—full within them.

Chiniwin, and phytogeDgraphically belonging to Upper Burma ; then again at the southern end of the Shan Plateau, where it is in Siamese territory ; through the mountains of Siam ; just into Lower Cochin-China ; and down Peninsular Siam to the northern edge of British Malaya. Its distribution resembles that of *D. arathidna* in tailing out considerably to thB north-west.

D. Rochii may be counted a satellite species of *D. mzmbranacea,* and *D. Kerrii* a satellite species Df *D. arazhidna.* Neither exists beyond the range of the more widespread species tD which we thus assign its relationship.

Spades centred in South-west China, the widest finding their way into the Himalaya. D.melanophymaa,nAD. kamoomnsis are very common species of Yunnan, the second perhapsthe commoner of the two,sothat every collectorbringsitback. Both extend along the Himalaya beyond Nepal (see table 11, p. 435), but perhaps in a discontinuous way, though we cannot insist on the discontinuity owing to the scantiness of the collections from any part Df the Eastern Himalaya except the Darjeeling District and Sikkim. Almost as common in Yun-nan as *D. kamoonensis,* areD. *Hemsleyi md D. Colhttii* ;but neither has been found in the Himalaya. Both of these species, and *D. kamoonensis* as well, are found in the Shan Plateau. *D. Hemshyi* and *D. kamoomnsis* extend alike towards the south-east into Kwang-si and Tonkin. *D. Collettii* has an eastward extension, but in a latitude further north, by which it reaches Formosa : moreover it is plentiful in the Province of Sze-chuan. The indications are that it is a slightly more northern species than *D.melanophyma, D.kamoonensis* and *D.* -ffmsZe^anditsapparentinabilitytofindahome in the Himalaya may be a result; but the absence from the Himalaya of *D. Hemsleyi* is not to be explained thus. Explorers in Yunnan with their attention called t_D this, may find in their local habitats or seasonal growth an explanation which is not available yet.

There are many reasons for thinking that at the close of the Pleistocene Ice-Ages the Himalaya received a measure of re-stocking from South-west China. The abundance and variability in China of *D. kamoomnsis* suggests China as its home and the Himalaya as an extension, and if that be probable in the case of *D. kamoomnsis* it is also probable in the case of *D. mdanophyma.*

We shall need to revert to this probability.

Ćommoner in the North-western Himalaya than either ofthesetwo species is *D. deltoidea.* It has been obtained by collectors in western Sze-chuan and in north-western Yun-nan, i.e., Yun-nan of the great gorges. It is certainly of very limited range in South-west China, —far more limited than in the North-western Himalaya. If abundance be accepted as an indication of its ancestral home, that home was in the Himalaya, and a post-glacial migration along the Himalaya into China must be postulated, i.e., a migration in the reverse direction to that of *D. kamoomnsis* andD. *melanophyma.* The relatives of these species suggest that the postulation is right: for *D. caucasica,* restricted to the Caucasus, and *D. balcanica,* restricted to the Balkans, are very close allies of *D. deltoidea:* and the three must have had a common ancestral stock in Tertiary times, not away in the East but perhaps or even probably in Europe where the Miocene deposits actually contain fossil Dioscoreas.

Whether the climatic fluctuations of the Pleistocene Ice-Ages actually permitted the ancestors of *D. ieltoidea* to enter the Himalaya is probably an insoluble question : that they decimated northern floras is certain, the damage decreasing towards the east of Asia. If the Ice-Ages did not let *D. dzltoidminto* the Himalaya, it was there already—a possibility BUggested by the distribution of its ally *D. Prazeri*: but it did not come from China.

Heavy rains are unsuitable for it, and it seems to be absent from the Himalaya Df Sikkim.

In table 18 (p. 44D)are enumerated all the DiDSCDreas of South-west Dhina : the following are not typical of the Subregion, occurring just within the borders on various sides :—

D. dzltuidea, which has just been discussed, Dn the western edge ;

D. nipponica on the northern edge ;

D. hispida, D. pentaphylla, D. persimilis, D. glabra and *D. dwipims* Dn the southern edge;and

D. doryphora |a satellite species *of D. japonica)* on the eastern edge.

By removing these eight, the number of twenty-Dne is left, ten of them confined to the Vi . These ten are *D. panthaica, D. biserialis, D. althaeoides, D. yunnanensis, D sublalva, D. nitens, D. Martini, D. Bonatiana, D. bkolor* and *D. asptrsa.* Df these the second, *D. 'biserialis,* is a satellite species to the preceding. *D. subcalva, D. nitens* and *Z^ Martini* are also satellite species to *D.Hemsleyi;* and *D. Bonatiana* is a satellite species to *D. kamoonensis* : the others are :—

D. panthaica, which is found widely in Yun-nan and extends just into Sze-chuan ;

D. althazoides, which occurs in Yun-nan towards the north-west;

D. yunnamnsis, which occurs in Yun-nan, both towards the north-west and towards the south-east;

D bicolor, which occurs in Yun-nan towards the north-west and in the east ; and

D aspersa, which occurs towards the south-east and may perhaps extend over the border into Kwei-chow.

It is tD be remarked that of the Provinces composing South-west Dhina the one with the strongest endemism is Yun-nan. Sze-chuan receives from Yun-nan as an overflow *D panthaica,* and Kwei-chow as an overflow perhaps of *D. aspersa :* but neither of them hold species which are confined within their borders.

It seems justifiable to claim that Yun-nan has been an evolutionary centre for the t im p, nnt remote Its climatB would seem tD have invited a variety of ancestral lines Ifor these five species belong to three sections) to a residence within its scarcely fenced-in borders |see the comments on p. 44D above and on p. 504) where stimulated by the great variety of aspect, drainage, temperature and rainfall within its mountainous surface, they have evolved into characteristic species.

Readers will remember Vavilov's theory regarding the origin of Man's cultivated plants diffuse way, but in centres of evolution |see his paper entitled *The Problem of the l12n ofth* World's Agriculture,* London, 1931) wherein he located a centre in South-west Weseenoreasonwhy cultivated plants shouldnot respond to conditions stimulating th evolution of wild plants and why a wide mountainous area should not be from the variability of the surface the home of new forms of either.

Th south western parts of Dhina are extremely old land : and if they serve as a centre Df solution now it is probable that they have long done so.

None of the five species have, within Yun-nan, the great abundance of *D. kamoonensis :* bTthattheyremainto-day confined within South-west Dhinabecause |as Willis'theory and ArBa suggests) they are later products Df evolution which missed the chance of

reaching the Himalaya with *D. kamoonensis;* but chances are multiplied by wideness Df area as well as by time ; and *D. kamoomnsis* is accommodating enough tD have possessed itself Df a wide area.

The administrative Provinces, climates and Dioscoreas of China.—ClimatDlogistshave long complained of the lack of data, such as they need, from China : attempts are now in progress to organize the collection of the data and a tentative scheme of climates in China has been issued from Nan-king |B. Burgoyne Chapman in *Bull. Coll. Agric. and Forestry, Nan-king,* 1935). We refer to his scheme in the appendix on p. 525 forward: his rounded lines cross and rccross the irregular boundaries of the administrative Provinces, but nevertheless in a fair proportion assign whole Provinces to certain climates, except in the west where his climatic boundaries cut across the boundaries of the administrative Provinces much. The great Province of Sze-chuan is in fact divided by him between three " climates "—a climate of the edge towards Tibet and two climates tD the eastward.

The climatic boundary line between the part Df" Sze-chuan towards Tibet and the rest is recognizable by more than climate. E. H. Wilson called it an " ecclesiastical boundary " because Lamaists live tD the west of it and men of the religions of China tD the east of it. This is because the climatca Dn the opposing sides determine the way of life Df those who live there, hence their stock and so their religion. The boundary line is the western edge of the plain of Cheng-tu where the hills rise and the rugged country to the west, refusing a living tD the Chinese cultivator, offers meagre rewards to his brother trader. It is a line which has attracted not a little attention. In 1BB9 David crDssed-it on his expedition tD Mu-pin, when he stayed with missionaries who had successfully established in their adopted home the potato and the European cabbage. In 1885 Potanin, who had reached Sze-chuan from Han-su, explored along it. In 1889 Pratt crossed it, making a journey on the trade-route to Ta-tsien-lu, and at that centre he found the missionary Soulie who was already collecting botanical specimens tD send to Paris. In 1893 Potanin returned to these parts, on this occasion from the Province of Shcn-si, and travelling via Kwang-yuan (long. 1D6^{D} E). passed over the Cheng-tu plain to Mount 0-mei in the southern part $_{D}$f the line, and then doubled back to Ta-tsien-lu, whence, while his companion Kashkarov went westward t_{D} Batang, he proceeded northwards to Li-fan-fu. In 1DD3 E. H. Wilson went to Ta-tsien-lu and then to the north-west tD Sung-pan-ting near the Kan-su border. It is in a description of this journey *(A Naturalist in Western Chïna,* 1913 p. 191) that he calls the line an " ecclesiastical boundary ". In 1930 Mr. F. T. Wang starting from Dheng-tu travelled to the line and along it northwards and from it north-eastwards tD Kwang-yuan in the direction Df Shen-si whence he returned on a parallel course.

Mount D-mei, 2,35D m. high, in the southern part of the line, has attracted much attention. Joining the pilgrims who resort thither, Baber visited Mount 0-mei in 1877, not botanizing himself, but making the way easier for others. Faberfollowed and botanized in 1887 ; Potanin in 1893 ; Wilson in 1928 ; Wang in 1931. We have had the use of the collections of these explorers as a guide to the Botany Df the line.

Their expeditions on the "Bcclesiatical boundary" have brought to light the occurrence of the following Disoscoreas :— *D. zingiberensis, D. Colhttii, D. nipponka, D. bulbifera, D. Hmshyi, D. subcalva, D. melanophyma, D. kamoomnsis, D. Potanini, D. opposita* and *D. japonica.* It seems from the number of specimens dried, that *D. Collettii* and

D. opposita are the most general. Those which arc indicated as penetrating to the west are *D. Hemsleyi* and *D. subcalva :* unfortunately as the labels Df the specimens of these two which Wilson got on the west Df the line carry no localities or indications Df habitat the localities have to be assumed from dates of collection which are recorded. The rest are species of the plain of Dheng-tu.

It is striking that among them are not found the species which, while being of restricted distribution,are characteristic DfYun-nan *D. subcalva*excepted) : and this absencesurrgests that phytDgeographically Yun-nan and Sze-chuan do not go well together. The species are in fact the species of Hu-peh, and their presence makes it appear ay if Sze-chuan east of the line would be more suitably united tD Hu-peh than made, as we have done, a part of South-west China. For such a division, however, gDDd administrative maps are required : they are not available.

KendrEW *{The Cli?nates of the Continents,* ed. of 193D, p. 134) comments on the protection which the mountains west Df the line give in winter to the plain of Chens-tu when it has a " delightfully bright and dry " season. That protection turns the plain into a climatic oasis resembling the Punjab in air conditions.

The climate of this plain is Chapman's climate no. 4—which nowhere in his snheme extends beyond Sze-chuan : the climate of Kwei-chow is his climate no. 3 and extends over most of Yun-nan : but the climate on the west of these to the Tibetan borders DfYun-nan and Sze-chuan is his climate no. *9 ;* and this last climatic province he carries rilflit round the outskirts of China to Amurland. We doubt the reasonableness of so wide an extension of climate no. 9, and note th^at *D. nipponica,* the characteristic Dioscorea Df Amurland, seems tD begin to fail in Sze-chuan and seems tD be absent from Yun-nan.

ThisDiDSCDreais obviously common near Pekin; for every collector obtains it (seep. 4BB). It must be common in Shan-si and Shen-si south of which it seems to be driven, into the hills, so that it occurs in the mountains called the Huang-shan in southern Ngan-hwei, the Tien-mu shan in Che-kiang southwards from Nan-king, the Ku-liang hills of Fo-kien, and elsewhere. We have given it the first line in Table 17, as being the most northern of the Dioscoreas in that table; but the table shows that it comes south freely; and to the South-east associates with such local members Dfthe section *SUnophora* as *D. futschaumsis, D. ennsaneura* and *D. Huii,*—species which in no way dare the rigours of climate no. 9.

Chapman's map puts a climatic boundary between Che-kiang and Fu-kien : the Dioscoreas dD not indicate that the climates differ. We have taken as a major phytogeographical boundary the southern boundary of Fo-kien ; and the Dioscomis seem to justify this. By the use Df this boundary the province of Hwang-tung becomes the northernmost part of the Subregion Df Eastern IndD-China and the Province of Fo-kien the southernmost at the coast Df the Region of the Chinese Monsoon. Bentham in his *Flora Hongkongensis* [1861 p. 16*) remarked that a number Df tropical plants find their northern limit on the Chinese coast at Hong Kong, i.e., south of the Fo-kien—Kwang-tung boundary.

The Dioscoreas of Kwang-tung are of a markedly tropical type : and even its mountain Df Loh-fau shan which reaches 1,5DD m., seems not to carry *D. nipponica:* but the following are the species which have been obtained on it:—*D. bulbifera, D. pentaphylla, D. cirrhosa D. Fordii, D. japonica* and *D. persimilis.* Four of these occur in Hong Kong itself • *A D. psntaphylla* and *D. japonica* are additional. The rest of the Province 'add *D. doryphora* and *D. limari-cordata* which are scarcely more than satellite specie to

D. japonica. The Kwang-tung climate has a bright dry cold weather like the " cold weather " of India ; but instead of the Indian " hot weather " a damp foggy spring supervenes before the summer rains set in : then the coast becomes hot, SD that though the isotherms of winter cross China from west to east, the isotherms of summer tend to run from south to north. The study of the behaviour of the Dioscoreas in the Kwang-tung spring would seem to promise interesting comparative results.

The coconut palm reaches the island DI Hai-nan, which again is more tropical than Kwang-tung. This island has recently been explored, partly by Mr. W. Y. Chun who spent a whole year in collecting there, and partly by a series D! expeditions from the Lingnan University in Canton (see the *Lingnan Science Journ., 12,* 1933, pp. 377 and 35^, and j jn 1934, p. 579). Its mountains rise to 19DD m., bearing forests to their summits *Lingnan Agric.* £ei;.,l,1922,p.71). The Dioscoreas occurring are—*D.pmtaphylla, D.Scortechinii, D. hispida, D. Fordii, D. hainamnsis, D. drrhosa, D. persimilis* and *D. Owenii* as well as a plant which has been assigned to *D. nummularia,* but is somewhat doubtful In them again, as in the species of Kwang-tung, a southern type is evident: and with it there is a slight indication of endemism : for instance *D. hainanensis* is not known from elsewhere, nor is *D. Owmii*; and it is a variety of *D. Scortechinii* |var. *parviflora)* which is there met with. These species are satellite species, so that the endemism is not strongly marked. The plant assigned to *D. nummularia* may ultimately be attached to another species.

Westward of Kwang-tung and north-westward of Hai-nap lies the province of Kwang-si. It has furnished two striking species—D. *simulan's* and *D. Chingii.* Both were collected by Mr. Ken Chang Ching during an extensive journey in the northern and western parts of the province. The second has been obtained also in Tonkin • this was by d'AleizBtte who unfortunately recorded no locality. As *D. Chingii* belongs^5 to^the section *Stmophora* its affinity is northern : but *D. simulans* belongs to the section *Illigerastrum,* which has its other representative in Anam. Kwamr «i ai -"-waug-si also produces *D. Esquiroln* which belongs to a southern group.

It would seem that Kwang-si is transitional between Kwang-tung and Kwei-chow ; but it is as yet little explored.

The Dioscoreas of the islands off eastern Asia.—The islands which lie in festoons off Bastern Asia may conveniently be considered at this point, the Japanese festoon first.

We are dissatisfied with the data which we have been able to collect in regard to the genus in Japan, as in respect of very wide stretches of the Kingdom they are extremely scanty. The provinces within easy reach of Tokyo are obviously better known than the others. In them *D. tenuipes, D. tokoro, D. quinqueloba, D. gracillima, D. septemhba, D. nippomca* and *V. japonica* are iDuni. J^ive D! these ssven are said to pass beyond the limits Df the Japanese islands ; but Mr. Matsuda's statement that D. *tokoro* does so appears tD us tD need confirmation. We are satisfied that the others do. Two of the seven which do not occur outside Japan are *D. tenuipes* and *D. septemhba.* They one assumes naturally, originated in the Japanese Islands : we think it probable that the others with the exception of *D. nipponica* and *D. japonica* did SD also. Moreover southern Japan must have originated *D. ascehpiadea.*

Japan shares with China its monsoon and ita wide range of temperatures : but the insularity brings considerable mitigations by way of a milder winter, and a current of warm sea-water moves northwards along its outer shores. But cast and west, as well as north and south, Japan affords great contrasts ; and the mountainous nature D!" the surface adds tD the diversity. The climatologists make the contrasts in its different climates mainly, as in China, a question of the intensity and duration of the winter. It may be that the southern half of the island of Nippon actually has that striking difference from the northern half in the number and development of the Dioscoreas which our table 14 suggests. If so then the difficulty of escape from Japan of those that are endemic is really great as the distance to any corresponding climate is several times more than the distance direct to the mainland of Asia. Dn the other hand the hardy *D. nipponica,* being wide spread on the nearest parts of that mainland, may be considered to have had no remarkably difficult task in getting transport to and establishment in Japan.

In passing one maybe pardoned for commenting on nomenclature by this remark that *I), nipponica,* seems no more to have been a development of Nippon than *D. kamoonensis* of Kumaon.

The festoon, which is the Japanese Kingdom, must be regarded, from a phytDgeDgraphic point of view, aa embracing the Corean Island of Quelpart, for Dioscoreas grow in Quelpart as in the islands and not as Dn the Mainland (see table IB, p. 438).

Table 15 (p. 438) gives *thd* Dioscoreas which Dccur down the second featDon which the Liu-kiu islands make : some species pass down the chain from the north ; some come up from the south ; and Dn the chain *D. Zmtaroana* seems tD have taken its origin.

When, passing southwards, Formosa is reached, the temperature at ths coast, where there is never frost, justifies exclusion Df the island from the Region Df the China Monsoon, and its inclusion with Kwang-tung, etc., in the Region of the Indian Monsoon, though as a somewhat atypic addition : but the mountains of Formosa rise to such heights that some Df the northern DiDScoreas should be looked for on them. Professor Hayata gaVBnew names to several lowland Dioscoreas which he obtained from the island, but when he very kindly had supplied notes and materials tD us, though we found ourselves unable to recognize his new species as valid we admitted that there may be varietal endemism in Formosa. Its recognition, however needs more work in the field.

TD produce mals flowers Dn pedicels is, in the section *Stmophora,* more usual in the species which are found to the eastward than in those not found there. When no pedicel is produced the fbwsrs usually lie open tD the rain, should rain fall at their flowering season : flowers Dn pedicels may be bent earthwards SD that the pollen and stigmas are protected and the honey escapes dilution.

Some of the species of Eastern Indo- China are peculiarly allied to species in the Philippine Archipelago. The Dioscoreas of Eastern IndD-China are enumerated in Table l'J : they provide material of intense interest; for there is among them an element suggestive of a past link between Indo-China and the Philippine Islands. It is found in the relationship of *D. Esquirolii* and *D. Scortechinii* var. *parviflora* to the Philippine *D. polyphylla* and its allies ; (n) in the relationship of *D. Petelotii* to the Philippine *D. flahellifolia,* and (in) in the occurrence of *D. piperoides* var. *angulatain* Tonkin, the type

being Philippine. At the same time certain species which are very characteristic of Eastern Indo-China find no place in ttiB Philippine Islands, e.g. *D. Benthamii, D. Fordii, D. cirrhosa* and *D.persimilis,* all of which belong to the section *Enantiophylhm. D. piperoides* belongs to the same section : but, of the others named with it, two belong to the section *Lasiophyton* and one to the section *Paramezozarpa*-Bections in which the stem winds to the left.

We have no ready explanation of this. In very late Tertiary times Formosa was attached to China, and to the Philippines earlier : but that Dioscoreas were able to establish a community between Luzon and the northern parts of Eastern Indo-China by this means, ia not demonstrated.

D. simulans in Kwang-si and *D. dmimuhns* in Anam, being the only known species of the section *Ilhgerastrum,* mark the Subregion Eastern Indo-China as peculiar: they do not extend to the Philippine Islands.

The limits of the Diosconas found in Eastern, and Western Indo-China Five species of the section *Enantiophyllum-D. behphylla, D. Hamiltonii, D vubera D. Wallkhii* and *D.* ^ora-which are found in India, are found also in one or both of the two Indo-Chinas, but *D. behphylla* only just. All except *B. Wallkhii* have a considerable distribution m the Himalaya, where the la3t named is not excluded but local• Three other species are likewise at the same time Indian, Himalayan' and Indo-Chmese-Z). *bulhfera*, *D*. *pentaphylla* and *D. hispida.* They together indicate that a species common to both is almost certain to reach the Himalaya • a3 Dne WDUld expect; for it must have been more difficult for such species to cross'the wet plains of the Ganges valley than *U* have reached those mountains whether their origin be supposed to have been in Peninsular India or in Indo-China. At the same time India has its *D. toimntosa* and *D. oppostiifoha,* and Burma its *D. birmanica* and *D deciviens* which neither leap the lowlands on the north side of the Bay of B] l, the Himalaya These, „ may look Dn a. miking a eroup apart *12'ZJZt* mentioned: and we have to recognize, then a third group which belongs to the Himalaya as well as to one or other of the other two arpa* TI,- +I.- J , *c j* . . . *r* • ... «"eas. inis third erouD is not found to consist of species uniting the Himalaya with *UA*, v, • uniting the Himalaya with the Indo-Chinas : they are for L rr, 8PeC1BS with which we have already dealt, *D. deltoiiea* which just gets *7 V Z* onKIR *T* and *D. Prazeri* which spreads from Nepal to Malaya In brif U Gangetic plains, as well . the Tethys S,· which the p,™ ^ ^ *J Z* long offered a very real barrier to plants particularly suited to mountainous regions.

The relationship between *D. cirrhusa* and *D. Wattii* being close, the dist 'b f of these two taken together, again indicates the relationship of thp *W* \ " ^ Himalaya to the Indo-Chinas being closer than to India proper.

The southern boundaries of Indo-Dhina, are difficult to fix, for the S *h* . Eastern and Western, pass very gradually into Malaysia. The curve of th region South of Anam in lat. 15° N. exposes part of the Subregion of Eastern Indo.China tn *th* *ZT* winds of winter and they deluge it locally with rain : from the same part the windTof ^ are excluded by the mountains behind the coast: there results an area with I ^ T ^ gether peculiar climate, wherein grows *D. intempzstiva* ; but unfortunately it has n t t from botanists the attention which it deserves (p. 179) south f + ^ ^^ receiVBcl ending and the curve ,f the coMt being mersed, the country *Z* ^ ^ ^ eouth-weBt monsoon in comidBrabk quantities, and Dioscoreas flourish. This Trt of

Anam is made up of the Provinces of Binh-thuan and Nha-trang, and their DioscorDaa include *D.paradoxa, D. arachidna, D. Phrrei, D. brevipetiolata, D. kratica,* a species which may be *D. polydadzs* and *D. Craibiana* |a satellite species of *D. arachidna).* Table 25 |p. 442) shows that *D. paradoxa, D. Pierrei* and *D. brmipetiolata* occur in various Circles of Siam, but in none north of Kachasima.

These three belong SD much to the south of Siam, proper, that one is compelled to regard them as not Anamese : they belong to the range of mountains which lines thB Gulf Df Siam from within sight of Bangkok (see p. 523) to the province of KampDt in French IndD-China—the range known as the Cardamon mountains, where the moisture and thB shelter arB such that the Durian is cultivated. We explain Dn p. 525 that we take tha cultivation of the Durian as a mark of Malaysia ; and therefore we regard this range as essentially Malaysian. But the country boundaries run SD counter to thB natural boundaries in thia part of Asia that in the compromises which we havB adopted, part of the range is in Indo-China and part in Malaysia. The thrss species, named must be looked on as DiDScoreas Df Malaysian type which are able to rsach ths Binh-thuan and Nha-trang mountains. It ia interesting that the cultivation of the Durian has recently been extended to the Provinces Df Thu-dau-mot and Gia-dinh, near Saigon.

Behind the Cardamon mountains is a dry patch comparable to Dry Central Burma which extends into eastern Siam, and embraces the Circles Df Udawn, Roiet and Ubon, where the dryness Df a sandy soil, so porous that the inhabitants havB difficulty in supplying themselves with water in the dry season, intensifies the unsuitability of the area for Dioscoreaa.

At thB west end of this dry area, the Eastern Siamese plateau falls abruptly towards the head Df the Gulf of Siam in a knot of mountains which, catching thB south-west winds, make an outlying station for the Dioscoreas of the Dardamon mountains.

Dn thB east side of thia dry area, wherB the river Mekhong SDW, rising ground again catches the winds and the fertility improves. The Mekhong, thus, forms a phytogeD-graphic boundary between Sub-subregions ; and as such we USB it.

Tenasaerim presents another range Df mountains tD DppDSB thB SDuth-WBst wind and obtain from it much rain,—Moulmein receives 4,57Dmm. andTavoy 5,D8Dmm. in thB year, but WB havB not found there any DiDSDDreas which we could rsgard as local species. Those which occur are *D. Hamiltonii, D. decipiens, D. Wallichii* and *D. birmanica,* two of them characteristically Burmese, and the other two common to Indo-China and India. Also *D. daunaea* intrudes from Siam.

The Andaman Islands which are in the same latitude aa Tenaaserim, hold none of these species : but hold the widespread *D. glabra, D. bulbifera* and *D. pmtaphylla* aa well as *D. vexans,* a local development from *D. glabra,* and, it is reported, wild *D. esculenta.* HDW to interpret the wildnesa of the last in islands whsre there was no cultivation bv Andamanese, we dD not know.

Psninaular Siam has yielded all the apeciea of Tenaaserim and aa many again •. we in—ay sortthemintDthreegrDups :—

\i) thDSB which Bxtsnd southwards from Siam, proper,—*D. arachidna, D. oryzetorum D. membranacea, D. Pierrei, D. daunaea and D. depaupsrata* ;

|n) those passing northwards into the Peninsula from the south—*D. gibbiflora, D. myriantha, D. orbiculata, D. tamariscijlora* and *D. laurifolia :*

\iii) those peculiar to the Peninsula—*D. inopinata, D. cahkola* and *D. jrarilipzs.*

The last two are only satellite specie3 ; but *D. inopinata* is a very interesting plant which has been found as yet nowhere save in the valleys of the Sam Roi Yawt Hills" These are limestone hills in the Circle of Rachaburi, close to the coast and separated by a plain from the Main Range of Tenasserim. They gBt pbnty of rain, but it percolates; in the soil at a great rate andissoon lost (seeKerr in *The Record,* 28, 1928) Dn our first sight of this plant wo suggested that it might be a hybrid between!), *bulbiferazni* one ofthespecies of *EnanUophyllum* : but Dr. Kerr has obtained it at a second locality near the first and Mr. Lakshnakara assures us, as the result of an independent visit, that it is plentiful in the mils, feu en plenty QDDS not suggest hybridity.

Thesame Circle produces *D. hispida^v. neo-soaphoides.* It comprises other yet more rugged mountains, being the eastern slopes of the Main Range of Tenasserim, which when explored may perhaps reveal more of interest.

This Main Range rises to 2,068 *m.* on the borders of thB Districts of Mergui and Tavov and southward gradually grows .nsignificant until it ends in sea-cliffs in lat >N Where this happens the Peninsula is supplied with a new backbone on a parallel line a little to the sastward-the hills of the *to** of Nakawn Srita-nara, Theyl tun. cease, and a third backbone is supplied, again to the eastward. Thus thoudi tW Peninsula has which encourages Z ---- -omewhat |see Kerr in of little depth until British Malaya is reached, where they widen into a more complex andmore

Malaya, for — plants, v.rt.aUy an island ^th the *J J* * ^ ^, making a broken causeway to it. This causeway changes in its botany all along its co so that it is easy to support by argument phytogDDgraphic boundaries in almost^' latitude along it |see *Qard. Bull, Straits Settlements, 3* , 1925 p. 334) ™ almDB* m> A traveller who starts at Moulmein may get his first sight of *D. orbiculata* in lai 8DN . \hen ,n in lat.. 7°N.: of *D. polydades* and *D. Kingn* in lat .BQN' and 'I. T ^ n ^mariScl ford fi *D. stenomeriflora, D. Prainiana* and *D. pyrifolia* in lat'. 5°N. - lampT0TMula>

The Dioscoreas of Sundaland and north-eastwards on the P 1 a.au n DioscDreas of Western Malaysia exhibit less individualism than mmhTlh CaUBewaym The the striking exceptions of *D. sumatrana* and *D. palawana.* expected, with

D. sumatrana, it was pointed out on p.494, has conspicuously the k™.* 1 among the species with which we deal. Dr. H. H. Bartlett I" *N* capsules *Bull. Univ. of Philippines,* 4, 1935 p. 29D) has described his locahtv M *"* ^ **" with lowland high-forest, in a part of the Tanah Djawa district of Simeb ^ Valley ^^ clearings haVB been allowed to break into the natural vegetatio 1 "^ DBngDen, where and Dr. Yates' locality for it is where the Tangga river spreads on the'lowT 7 ^^ vegetation newly reduced from a very interesting original state . It b 1 ™ ^ thro Ug^ *Stenocorea* which has SBVenspecies, one is Malayan and extends to S e.on ^st ot'ne section tra ; is found in the extreme north of Siam where the Shan Plateau endT^he th"^ ^SBCDnd with extensions of range into Tenasserim and Peninsular Siam; the fourth d f" ^ Siamese Siam with an extension eastwards to southern Anam ; the fifth is " P is K Dlmd "* Central ifl in Java and Celebes—a puzzling association of localities fnr „ ^l in am D di a ; ttlB Bixtn iui a piant or restricted range :

and *D. sumatrana,* whith makes the seventh, grows in the outer part of the area the section occupies. None of the species are common : most are montane, but *D. sumatrana* scarcDlvso. They DCCUT as if scattered fragments of a section once more successful, but now Dn the down-grade. Sundaland would have been drier, at least in parts, when, as happened in earlier Tertiary times, its islands were united into a large block of land : and that such a condition may have favoured the section *Stenoc.orea* is possible : but this at present is entirely a matter of theory.

A capsule *so* much larger than the average, seems not tD have brought it any marked success : nor, one must say, have the large capsules in the section *Lasiophyton* made those species which produce them, of wide distribution.

We turn *to D.palawana,* the species which we coupled with *D. sumatrana,* above, as a striking plant among the less individualistic species of Malaysia.

It has been obtained once only. When WB described it, which was in the year 1925, we gave it a position in the section *Stmophora* and commented on its distinctness and its occūrrence outside the range of this section. It is not so far outside the range, however, if *D. mindanamsis* be another species of the section. But its male flowers—the female plant is unknown-are somewhat suggestive of those of the section *Paramecocarpa,* and if it belongs to that section, the range is natural and the individuality reduced.

The section *Paramecocarpa* is centred in the Philippine Archipelago with extension* hich embrace the " China Sea festoonwise and has a curious extension to the Palau Lands eastward. Dne member of it—0. *Prtehtii-is* in Tonkin : another-D. *flabdli-foliar^-is* plentiful in Luzon: a third—*D. Ltdermanniir-* is a species of the Palau Islands ; a fourth—*D. piscatorum*—extends from BomeD to the Malay Peninsula and Sumatra, a fifth—*D. bullata-is* a montane satellite of the last in the region of Mount Kinabalu : and if *D. palawana* belongs to the section, its place on the Palawan causeway between Borneo and Luzon brings it into the festoon.

The distribution of the large-fruited species Df the section *Lasiophyton* agrees almost exactly with that of the section *Pararmcocarpa.*

It is much to be desired that the underground parts of *D. palawana* should be obtained.

Turning to the section *Enantiophyllum* and for the moment disregarding satellite species we observe that, so limited, Malaya contains 1D species, Sumatra 1D, Java 8 or 9 and Borneo' 12 i e, that the number in the larger land-units of Sundaland is similar, suggesting'similar and synchronous opportunity for diverging evolution.

With the bridge which the Peninsular part of Siam makes we have dealt : the cause-way between Borneo and Luzon, composed of theisland. of Balabac, Palawan, Busuanga and Mindoro, proclaims itself a real connection by carrying *D. pepenodes, D. luzomnsis* and apparently *D. nummularia,* whith are typically Philippine, although Balabac and Palawān are islands rising from the Sundaland platform and therefore in origin belong to Borneo.

We may without effort envisage the section *Paramecocarpa* and the large-fruited specie of the action *Lasiophyton* as having spread along the causeway.

D. polydades, D. myriantha and *D. pyrifolia* occur throughout Sundaland: *D. orbiculata* misses Java : *D. salicifolii* misses Malaya: *D. Prainiana, D. lamprocaula, D. qlabra* and *D. tenuifolia* arB in Malaya and Sumatra : *D. pubera* is in Sumatra and Java : the following two—*D. laurifolia* and *D. Kingii*—are confined to Malaya : *D. qedensis, D. filiformis, D. madiumnsis* and *D. platycarpa* are confined tD Java, but none of them are strongly characterized : *D. Havilandii, D. Moultonii* and *D. Nieuwmhuisii* are confined to Borneo.

There is a close relationship between *D. laurifolia* and *D. Havilandii,* the one Malayan, thB other Borncan ; and the type to which they belong, namely that with uprising male spikes, has species in Bangka, Java, Celebes and the Philippine Islands. This type, except as regards Bangka, which lies under the lee of Sumatra, has not been obtained in Sumatra ; but then, as we have pointed out (p. 479), most of Sumatra is scarcely known to botanists.

If the reader will turn to Tables 27 and 28 jpp. 445-445), he will observe that the DiDScoreas indicate those close relationships between Malaya and Sumatra which the floras in general are known to possess.

Thz endemic Dioscoreas of the Philippine Islands.—The Dioscoreas of the Philippine Islands arB enumerated in Tables 31 and 32 (pp. 447 and 448): there are eighteen of them in a wild state in the northernhalfoftheArchipelagDandthirteenofthemin thesouthem half whereof two, *D. piperoidzs* and *D. flabdlifolia,* are northern species which just enter the southern half.

In size and festDDn-arrangemBnt, the Philippine Archipelago is comparable with the JapanesB islands : and the degree of endemism is similar. Furthermore just as the largest island of Japan, Nippon, has evolved the most species, SD has the largest island, Luzon, of thB Philippine Archipelago. And yet again the abundance in Luzon of *D. luzonensis* is similar t_D thB abundance in Nippon of *D. tokoro*—both being characteristic and abundant at the same time; while the frequency $_D$f *D. flabdlifolia* in Luzon may be compared to the frequency in Nippon of *D. szpkmhba.*

D. piperoides is closely allied t_D *D. luzonensis,* but is more commonplace in its characters and a little wider in its distribution.

Two other groups $_D$f Philippine endemics exist: one consists of the large-fruited species of the section *Lasiophyton* which have been mentioned in connection with *D. Esquwolii* (seep. 507) : the other consists $_D$f satellite species of the" group ofD. *glabra."*

The Dioscoreas of Eastern Malaysia and Papuasia.—Celebes has yielded one peculiar species Df the genus : it is *D. Sarasinii* characterized by the union of the filaments so that no sign of the female organs is to be found by an inspection of the male flowers. The other islands of Eastern Malaysia contain only commonplace members of the genus. P_{apua}sia likewise has yielded nothing striking. It is true that two endemic species are recorded—*D degans* and *D. opaca* ; but they possess no features of note. The name *D. papuana* was bestowed on what is only *D. escuhnta. D. bulbifera, D. pentaphylla* and *D. nummularia* are the commonest local species : and the first extends into Australia for a considerable distance ; the others just touch Australia in a way which suggests that the waters of the Tones Straits are no real barrier, but the differ$_B$nce3 in the climates are.

The endemic species of Australia.—The continent of Australia lies in thB same latitudes as the Sahara, c-nly it is tu the south of the Equator instead Df to the north. It is dry from its latitude. SD is the Kalahari desert in southern Africa. Such mitigation as the climate of Australia recBivcs is due to Australia being the smallest of the continents—far smaller than Africa ; and the long line Df mountains in the cast by its proximity tD the coast catches enough rain—75Dmm. *or* 3D inches and mDTB—to enable Dioscoreas to grow. Down that lc-ng range, as far as Sydney in lat. 34^{D}S., *D. transversa* is found. DbviDUsly its ancestry came over the Torres Straits, i.e., it is part Df the Torresian element (see p. 482) : but in Australia it has developed into an endemic species.

D. hastifolia is allied tD it; but found in a remote climatic Dasis, the oasis of the Darling Mountains in "Western Australia, growing by means of limited cold weather rains, the fall being 838 mm. DF 33 inches with a peak in JMIB. It is hard to envisage its history: but that the path Df its ancestry into Australia was from the side ofPapuasia must be accepted and there is not the least indication that the genus Dioscorea had a place in that" Antarctic flora "which supplied SD much to Australia and New Zealand, and something tD the mountains of the Pacific.

D. punctata, is too obscure for cDmrnsnt.

Dioscorea in the Pacific.—The Dioscoreas of the Pacific reached the islands they inhabit frDmthewestandwitbthe exception Df *D. Ledermannii* have developed no specific differences during their wanderings. Table 35 |p. 449) gives what we know of them. Man has in some measure aided them, for he could use them as food and certainly did SD. *D. bulbifera* was of value tD the Hawaiians before thBy received from Europeans the potato : they dwell rather tDD far from the Equator to have raised *D.* afatoto perfection. *D.alata* was Df great value within the tropics but not to the exclusion Df *D. bulbifera, D. pentaphylla* and *D. nummularia. D. esmlenta* found its way into Fiji and Tahiti. *D. bulbifera* var. *sativa* undoubtedly was spread by Man and perhaps other forms of this species : but that it DWBS its place in the Pacific entirely to Man as Guppy thought *A Naturalist in the Pacific*, 2, p. 414) is not probable. At the present time data by which the question Df natural introduction Dr introduction by Man may be weighed, nsed seeking for. Such small areas of land as most of the Pacific Islands arB, do not lend themsslves to the development of endemism unless they are greatly isolated and much elevated. They have not done SD to the genus *Dioscorea.*

Insular endemism does declare itself in *D. vexans* in thB Andaman Islands. We have examined material from the Nicobar Islands which suggests the possibility of similar endemism thers ; but the material was meagre. We have again seen suggestions of corresponding endemism in the islands outside Sumatra. We have commented on indications DfitinHai-nanandinFDirnDsa. But the genus is one of such great difficulty that much material is desirable in order to establish the constancy of any small divergencss.

The Exhibition of Bndemism in the Palau islands is most interesting. The islands have been described as a continental outpost (Hedley in *Proc. Linn. Soc. N. 8. Wales*, 1899, p. 408) ; and DTDgraphically thsy are connected under the sea with thB western end Df New Guinea : but that does not supply us with an explanation, as thB relationship $_{D}$f the endemic *D. Ledermannii* is with the Philippine *D. flabellifolia.*

Six of the nine Asiatic Sections must have originated in Asia : the others may or may not have originated in Africa. Of the nins sections which we have recognized as Asiatic, *Stenophora, Stenocorea, Combilium, Illigerastrum, Paramecocarpa, Shannicorea, Opsophyton, Lasiophyton* and *Enantiophyllum,* only *Stenophora* extends to America.

It may be taken to be nearly certain that the parent stock of the Am Bri can members of the Ssction found its way into America from Asia, and that thi3 was by the Behring Soa land-bridge Df Miocene times, i.e., by a route far to the north Df Japan.

Three Df the nine are common to Asia and Africa—*Opsophyton, Lasiophyton* and *Enantiophyllum.* They are the three which may have had an African origin, because they occur there ; but no other argument can be put forward ibr an African origin Df *Opsophyton* and *Enantiophyllum ;* and for *Lasiophyton* only that CIDSB allies of *D. hispida* occur in Africa, whereas there are none in Asia.

The sections *Stenocorta, Combilium, Illigerastrum, Paramecocarpa* and *Shannicorea* offer not BVBn the suggestion of African origin that an extension towards Africa would make; and that their origin was in the East may be accepted. A line drawn on the map from a little north of Yun-nan to the sea near Hong Kong, thence east Df the Philippine Islands, the Palau Islands, and Celebes, and, surrounding Sundaland, back by the western edgB of the Shan Plateau to Yun-nan again, embraces the whole of their distributional area, unless WB admit that *D. esculenta* is really a wild plant in the Nicobars, Andamans, and Sontal Pergunnahs. This is an area closely corresponding with what we called, Dn p. 477, the part Df the East containing the " good-DiostTorea areas :" and so it happens that thesa sections occur where the greatest number of species Dccur.

These five sections exhibit much diversity in the shape of their capsules, in the way in which the capsules are carried, and in foliage, but they have in common a disc in the male flower : whereas none of the three sections which reach Africa have a disc. Aea" in as *Stenophora* has a disc it may be observed that all the sections which are *undoubtedly* Asiatic have male flowers with a disc. Yet they are so diff srent in other characters that no common origin can be presumed within any but truly remote times, obviously much more remote than the breaking down of the Behring Sea land-bridge, since at that time *Stenophora* was fully established as a section with physiological differences enabling it tDI" ive further tD the north than the others.

Passing back to the three sections, *Opsophyton, Lasiophyton* and *Enantiophyllum,* which have dLsc-less male flowers, their wide range—from the Atlantic to the remoter parts of the Pacific—is to be noticed. Circumstances have been in their favour and *Enantiophyllum* has even secured for itself a place with endemic species in Australia.

Whersin their common advantage lay, one does not know. There are deep cleavag between the three sections unless hybridization of *Opsophyton* and *Enantiophyllum*^ posaible (see Dur remarks on *D. Brandisn,* p. 133 and *D. punctata,* p. 134). All must have originated under tropical conditions. *Calamus* which is a genus of climbing palms that must have originated in Asia and have gained ita dispersal to the Guinea Coast b extending to Africa has a distribution SD extremely similar to that of *Enantiophyllum thlt* Dne may think Df them as having had similar histories, and continue tD seek for evidence for DI- against such a supposition. That Africa gave origin to entirsly dissimilar sections of the genus, with *D. pyrenaica* one dsvelopment and the genus *Tamus* an offshoot, is reasonably certain : we have to ask if Asia sent invaders into their continent.

It is very interesting that the direction Df twining should be among the Eastern Dioscoreas an almost universal character for the sections. *D. inopinata* offers the only exception ; and regarding this species it has to be added that fruit and root remain unknown, SD that its section is not fully established. Perhaps in America the direction of twining is a little less fundamental.

The origin of the genus is not ascertainable. We have commented |p. 483) on the Iridaceae being perhaps the nearest family ; others have regarded Taccaceae as the nearest; but there is a wide divergence between DioscDreacease, Taccaceae andlridaceae. The origin must have been in a climate with a major rainy period in the year contrasted with a dry period, for to be tropophytic is fundamental and the rain must have been sufficient to support a woody vegetation into which the ancestral Dioscoreaceae might climb, as climbing is also fundamental. There is another feature in the family which demands the greatest prominence ; it is the way in which the storage organs are lateral stem-swellings : and perhaps the missing key to the origin of the family may be found in it. When the seed germinates, the cotyledon remains embedded in the endosperm as an absorbing Drgan, but elongates enough tD push the rest of the little plant outside the seed-coats and after this its first leaf is thrust above ground tD assimilate andtoaddtothefood which the cotyledon absorbs. As this happens the great peculiarity of the family is called into existence—the unilateral storage organ which may become a large body and in some species as well as in *Tnmus* has secondary thickening. Dn its formation it is parsnchymatDiis and the radial structure which one sees in it when large is secondarily produced about the vertical axis which it acquires. In the section *Stenophora* its enlargement is not great and the vertical axis scarcely evoked ; in it as the little plant grows, a bud repeats the phenomenon of forming a lateral swelling ; and then another bud ; and these branchings, set together, graftedas it were into each other, constitute a rhizome . In *Opsophyton,* on the other hand, thefirst swelling suffices for the storage of all the manufactured food Df ayearandthebud destined to form the next swelling makes no increment until the next season. Then |one can see the process with very little trouble), the shoot does just as its parent shoot did ; it swells on the under side and the swelling rounds itself acquiring a vertical axis and thickening according to the amount of food available. Theswelling in *D. bulbifera*—the familiar member Df the section *Opsophyton*—is but little more in length than in diameter |see the figures on plate 51) ; but in the section *Enantiophyllum,* in species with as a rule one functional swelling renewed each year the length may be very much greater than the diameter and a clavate structure may be produced. A young plant of such a species as *D. opposita* |see plate 1D4) and *D. alata* will be unable to produce more than a single swelling in the year ; but when the plant has reached some age and become very vigorous it may produce more than one, if of a race which possesses the power to do so. *D. pyrifolia* produces many |see plate 138) ; and Man, operating through variations which he detected in *D. alata,* has been able to select races with the habit of producing several (see plate 125 and p. 313).

All Dur experimental cultivation shows us that the production of the storage organ as a lateral Drgan Dn a stem is general: we would like to be able tD prove it univRrsal in the DioscDreaceae, but have not had the time. We think it universal at any rate and fundamental.

The rhizome as the simplest form would be the first stage, and therein is a resemblance to the Iridaceae ; the condition in *D. bulbifera,* is a development from it, and the condition in species whereof the storage organ has secondary thickening is a development Dfstill greater concentration and complexity.

After these explanations of the underground parts it must be remarked that the condition which we have called the simplest—the rhizome—is found in the Asiatic section *Stznophora ;* and what we have called the development of greater complexity is not Asiatic at all, but is what we get in *Dioscorea elephantipes* and other African species, in some American species and in *Tarnus.*

The underground characters, which collectors so rarely heed, are therefore characteristic of continents and mark exceedingly remote cleavages in the genus *Dioscorza.*

The rhizome of *D. villosa,* subspecies *D. glauca,* as figured in the *Journal of Botany* 11935, p. 90) is one of the simplest and we think most primitive preserved for our examination today ; more complicated conditions are to be seen in Dur plates Df *D. nipponiza* (plate 24), *D. Prazeri* (plate 6) and *D. birmanica* (plate 29). We have explained (p. 483) that a rhizome may give an advantage over a tuber in a harsh climate.

If the section *Stenophora* be the most primitive as it is the most temperate, the genus *Dioscor&a* would seem during evolution to have penetrated into the Tropics ; and indeed this is a logical view, seeing that it would not seem fully at home as an invader of the tropical evergreen Rain-forest.

China, climatically extreme, seems by its warm summers to have invited back towards the north the section *Enantiophyllum* which there has in the "group of D. japonica" shown an unusal resistance to cold.

Man and the genus.— The starch and proteids of the subterranean parts, which the plant stores against the growth of the next season, arepotential food for animals and Man. The plant encounters their threat sometimes by hiding the food-storing organs deeply in the soil, sometimes by fencing them off with thorns and sometimes by associating the food-substances with poisons. The poisons may be alkaloids, *oi* glucosides, or tannins. Such diversity in protective means is very interesting ; and as one form of protection is not easily converted into another, there is a long history of natural selection behind each. Protection by tannin is the least peculiar, for tannin is commonly a transition-product in plants : but in *D. cirrhosa* which supplies the Chinese and Tonkinese with a tanning material, the amount present is excessive. Protection by a glucoside is more peculiar than protection by tannin and the glucoside of *D. tolcoro* has been shown to rank high in its toxic powers : and the rhizomes oi several species are economic as sc-aps and diaphoretic medicines on account Df glucDsides. In-as-much as the alkabid, dioscorine, most abundant in *D. hispida,* is a specific chemical compound of narrow distribution in the vegetable kingdom, protection by it must be considered as decidedly peculiar. Another alkaloid, dioscoricine is reported as accompanying it (see p. 194). Protection by deep burying is somewhat expensive in growth and demands specialization : but protection by organs so rare in the vegetable kingdom as root-thorns indicates very high specialization.

Wild pigs and other animals of like feeding-habit, rooting in the wastes, were prevented from destroying some species such as the *Enantiophylla,* by their in ability to reach the tubers owing to the amount of soil over them or from destroying *D. eszuhnta* owing to the formidable thorns above the tubers : and side by side grew species which had become distasteful or dangerous to eat.

The plant's method of protection has become in a great measure a sectional character, the structural devices more decidedly SD than the chemical.

Very many species carry prickles on the stems. These are always more abundant just above the soil than Dn the remoter parts of the stem. Undoubtedly they protect. Herbivores feeding at thesurface ofthesDílmay be expectedtDspara them. At the end of the season, when the stems with their prickles are completely indurated the latter may bB capable of hurting the snout of a pig in its endeavours to reach the tubers below. The stem remains weakest just below thesurface of the soil and breaks there at such a time. Food, still in the stem, is thereafter added to what may be in the seeds or bulbils.

When Man appeared as a seeker Df food by the side of the wild pig, his prehensile hand, armed with a stick, altered th e situation, for it was easy for him to turn the defence of thorny rDDts. Thus such a plant as *D. escuhnta* fell to him as if prepared for his particular use. As to the species with other methods of defence, he had to acquire a knowledge of cooking devices in order to use some of them and to acquire implements for deeper digging in order to use the others. These came in to him in time ; but meanwhile he had commenced to be a rude cultivator, bringing that which served him best to the places he frequented. His digestion was not delicate : he could subsist on tubers to us despicable ; and in the East he brought into cultivation *D. bulbifera*, *D. pentaphylla* and probably others tentatively as well as *D. escuhnta.* As his digging implements improved resort to the deep-burying species of *Enantiophyllwm* became more frequent and they tDD came into cultivation. Wherever *Enantiophylla* grow, both in Asia and Africa some species exhibit the influence Df Man : the most amenable to betterment would be those he kept. By a long way the most important of them to-day is *D. alata* which appears to have originated in the northern parts of Eastern IndD-China and probably beyond the parts where *D. escuhnta* had earher been adopted fbr growing. We have dealt with the cultivation of *D. alata* on p. 310 and of *D. escuhnta* on p. 84. Further north again, Man found in *D. opposita* another useful plant; but his cultivation has not modified it to any striking extent.

When *D. alata* came tD the front, the inferior species of earlier cultivation, such as *D. bulbifera* and *D. pentaphylla,* were relegated to the background, but races remain, fully distinct, cultivated tD the prssent time as testimony of their former interest to Man. We have endeavoured by a map |on plate 82 to suggest thewideness of the former area of the cultivation of *D- bulbifera.* Its history is discussed Dn p. 117 and that of *D. pentaphylla* on p. 170.

D. hispidais sometimes encouraged to grow. This is particularly the case in Malaysia. There is no evidence that it has been ennobled at all, which makes it seem improbable that Man has carried it from one country to another. But the report that it exists in NBW Britain, which is far beyond its otherwise eastward limit, makes enquiry there desirable.

The great abundance of this species in certain places and the ease with which its tubers can be dug—for they lie abundantly protected by their poisonous qualities in the surface soil—has made it one of the chief of famine foods in south-eastern Asia. With this use and the modes Df preparation we have dealt Dn p. 195.

In Malaya part of the encouragement to grow which it received in the last century was because the makers of sugar from the Arenga palm, used a poultice *oi* its pounded tubers to seal the cut surface of the palm when commencing work. Such a process as sugar boiling was never dreamed of by Man when the cultivation of yams began.

The species holding much saponin may be used for killing lice and stupefying fish (see *D. fcUoifoa*, p. 27: *D. Pmzzri*, p. 31: *D. piscaturum*, p. 99): and in small doses the saponin is sometimes medicinal.

The yam-harvest coincides with the rice-harvest, and SD cultivators who cannot grow enough rice, are apt to have recourse to yams. The yam-harvest comes at the beginning of the time of calms, when voyages are commenced: then men would set out to sea with yams in store and, if the voyage were prosperous, have still some living tubers whereby to spread the plant.

APPENDIX.

NOTES ON THE PHYTD RED GRAPHIC SCHEME WHICH WE AD OPT F OR THE PARTS OF ASIA IN WHICH THE GENUS *DI OS CO RE A* OCCURS.

The Scheme.

THE INDIAN MDNSDDN REGION, being that part of the East where the four seasons run their course in pairs thus :—

A. as the sun comes up from the south and the prevaihng wind is from the north-east;

Aa. The "cold weather" of January and February ;

Ab. the hot dry weather of March to mid-June.

B. as the sun returns from the north to the south, and the prevaihng wind is from the south-west ;

Ba. the season of general rains, mid-June to mid-September ;

Bb. the season of the retreating monsoon, through which the rains dwindle.

Its Subregions and Sub-subregions : the numbers of Dioscorea, which occur wild are added in brackets :—

INDIA .. .. **IY1ALABARIA (14).**
DDRDMANDELIA |9).
THE DECCAN |7),
HINDUSTAN |8),
THE SUB-SUBREGIDN OF RAINS FROM THE BAY DF BENGAL |15).

HIMALAYA .. .. **TRANS-INDUS HIMALAYA |1),**
NORTH-WESTERN HIMALAYA |8),
NEPAL HIMALAYA |1D),
EASTERN HIMALAYA |13).

WESTERN INDO- CHINA .. **HHASI-NAGA HILLS |17),**
NORTHERN BURMA (14),
CHITTAGDNG-ARAHAN |8),
DRY CENTRAL BURMA |9),
LOWER BURMA |7),
THE SHAN PLATEAU |13),
SIAM |32),
LADS (ID).

EASTERN INDD- CHINA .. **FORMOSA |7).**
THE HWANG5 (19),
TDNHIN (ID),
ANAM |15).

THE CHINESE MDNSDDN REGION, being that part Df the East where cold and heat make a greater contrast than dry and wet, and the seasons follow thus :—

A. the season Df the north-west wind :

Aa. growing cold and also dry, October to January ;

Ab. cold moderating, ending in an abrupt transition to summer, February to April.

B. the season of the south-east wind, which brings rain from the sea :

Ba. the increase of the rains, April to July ;

Bb. the decrease Df the rains, July to October.

Its Subregions and Sub-subregions :—

JAPAN	.. ..	**NORTH JAPAN |4),**
		CENTRAL JAPAN |7),
		SOUTHERN JAPAN |8),
		LIU-Kill ISLANDS |9).
CATHAY	.. ..	**CDREA |6),**
		AMUR BASIN AND MANCHURIA |2),
		NORTH CHINA |5),
		MID CHINA (17).
SOUTH-WEST CHINA	..	**SZE-CHUAN (14),**
		YUNNAN |24),
		KWEI-CHDW |11).

THE EASTERN EQUATORIAL REGION wherein the year is divided into two equal halves thus :—

A. when the sun crosses the Equator and passes southwards :

Aa. the sun over the Equator, rain;

Ab. the sun to the south, dry.

B. when the sun crosses the Equator and passes northwards :

Ba. the sun over the Equator, rain ;

Bb. the sun in the north, dry.

Its Subregions and Sub-subregions :—

MALAYSIA .. THE WARM MDIST PARTS OF FRENDH INDD-CHINA |12),
TENASSERIM (ID),
ANDAMAN ISLANDS (5),
PENINSULAR SIAM |23),
MALAYA (22),
SUMATRA |13),
NORTHERN BORNED (17),
SOUTHERN OR DUTCH BORNEO (6),
JAVA (IB),
THE PHILIPPINE ISLANDS (19),
CELEBES |9),
THE LESSER SUNDA ISLANDS (4),
THE AMBOINE5E MOLUCCAS (5).

PAPUASIA .. THE TERNATE MOLUCCAS (5),
WESTERN OR DUTCH NEW GUINEA (5),
EASTERN NEW GUINEA |5),
THE BISMARCK ARCHIPELAGD (3),
THE SOLOMON ISLANDS (2).

PACIFIC .. NEW CALEDDNIA |3),
THE WESTERN PACIFIC |4),
THE CENTRAL PACIFIC (3),
THE EASTERN PACIFIC (3),
THE NORTHERN PACIFIC OR HAWAIIAN ISLANDS (2).

Dur scheme has simplicity : the question is—have we simplified too much ? The face Dfthe Earth is very complex and climate, changing from place to place, impresses features Dn the life supported under it, brings about irregularities which it is the business of the biDgeDgrapher tD assess. We propose here to explain what observations directed us to Diir conclusions ; for the outline may perhaps aid others in parallel work. In the first place the foundations laid for us by earlier writers must be mentioned. In several cases they have had no call to fix precise boundaries as they had not set out to catalogue specimens.

Hooker and Thomson in the *Flora Indica* |1855) divided India roughly into units Df land which seemed tD them in vegetation to exhibit contrasting characters. We are not gointr t_0 trouble the reader with the terms which they and others applied tD the units : but Hooker's and Thomson's were of the area Df Sub-subregions. As Hooker revised his opinions much later, this passing mention of the *Flora Indica* suffices.

Wallace's *Distribution of Animals* [1876) marks a stage in the progress, wherein we find maps and the subject considered from the zoolDgical side. Engler printed at the end of his *Versuch einer Entwicklungsgeschichts der Pflanzenwelt* (1882) a complete scheme for the whole world as, with far less knowledge than we have now, he saw it. Drude followed in 1887 with maps in his *Atlas der Pflanzenvzrbreitung,* differing not a little from Engler.

C. B. Clarke having compiled data of very gr sat value on the Dyperaceae, thought that he would use them phytDgeDgraphically and published an analysis of those bearing on India in the *Journal of the Linnean Society of London \Bot.* 34, 1898, p. 1) dividing the Empire unto what he called sub-sub-areas.

In 1903 one c-f us touched on the subject (Prain, *Bengal Plants,* introduction p. 2).

Sir Joseph Hooker meanwhile had been invited to contribute to the *Imperial Gazetteer of India* a review of the vegetation of British India and setting to work on the basis of the sub-subregions which he and Thomas Thomson had used, wrote his *Sketch of the Flora of British India* |19D4), which, little altered, was printed in the Gazetteer in 19D7.

The climatobgists had during this period done much. In 19DB appeared Sir John Eliot's *Climatological Atlas of India,* and an account of the climates of India appeared in the *Gazetteer* in 19D7. Sir Gilbert Walker followed this up by printing the accumulated data of rainfall, humidity, temperature, etc., for India *Memoirs of the Indian Meteorological Department, 22,* 1914). Similar very valuable data have been summarized for the Dutch Indies by van der Stok.

Kendrew's *Climates of the Continents* serves as a convenient text-book and in it |ed. 2, p. 125) he has a map of the major climatic divisions of India. Quite recently an attempt has been made to define similar climatic divisions in China (B. Burgoyne Chapman in *Bulletin 3 of the College of Agriculture and Forestry, Nan-king,* 1935).

We desire to make our position as clear as possible by adding to what we havs written, comments Dn the more debateable boundaries in the scheme.

The districts, provinces, residencies, circles, Dr whatever they may be called, which we assign to the sub-subrcgions, can be ascertained from the tables on pp. 431-449 above.

We turn to India first.

Malabaria, in Dur scheme is the seaward face of western India, the India Aquosa of *Bengal Plants,* where the south-west monsDDn deposits heavy rains; and we include in it the corresponding parts of Ceylon. In all it extends over almost IB degrees of latitude : is that excessive for a Sub-subregion ? The Philippine Archipelago, which is also regarded as a single Sub-subregion, extends through thB same number of degrees of latitude and in fact almost through the very same degrees. The superficies is in reasonable proportion. The mountain chain loses altitude from south to north: the highest point in Ceylon is 2,53b m. above sea-level; that in Travancore 2,693 m ; that in the Nilgiri Hills 2,B74m. ; the wall of the mountains where the highest points occur scarcely falls below 1,2DD m.; but in the north it falls tD 9DD m. and in the extreme north of Malabaria to comparatively little. At the same time the duration of the rains is longsst in the south and shortest in the north, with, in the south, a break in the middle. In fact there are obvious signs in the seasons of the south of such an equatorial succession as characterizes our Eastern Equatorial Eegion |see p. 52D above). Th e longer duration of the rains in the south does not mean a greater amount of precipitation than further north : but the greatest fall in the coast (one has tD use coastal figures, for records have long been kept and the stations are comparable) is from Mangabre tD Karwar. From Karwar northwards the conditions seem to change very evenly until the Gulf of Cambay is reached.

The great wall of the Ghats has wetter stations Dn its slopes than at its foot, and the absolute maximum precipitation is probably unrecorded. But in gaps at the crest such heavy annual falls are recorded as—

at Igatpuri |which counts as in the Nasik District) 3,327 mm. or 131 inches ;

at Lanoli (which counts as in the Poona District) 4,31 D mm. or 17D inches ;

at Mahableshwar DT Malcolmpeth (which counts as in the Satara District) 6,R6D mm. or 274 inches ;

at Chandgad (which counts as in the Belgaum District) 2,615 mm. or 1D3 inches ; and

at Tirthahalli [which counts aa in the Shimoga District) 2,997 mm. Dr 118 inches ;

When the crest is passed the amount of precipitation, as the *Climatological Atlas of India* indicates, very rapidly dwindles, but streamers of rainy winds passing through the gaps carry similar streamers of thB Malabar Flora eastwards. C. B. Dlarke observed this and tried an arbitrary line from thB Nerbudda in long. 7B^{D}3D'E. to Mysore town and forward to the sea, as the Eastern limit of Malabaria. Hookei observed it, but accepted the crests of the Ghats as in general the limit. T *o* us there appears to be no alternative to ths accsptance of whatever administrative boundaries there may be on our maps which in the greatest degree accord with the crests of the Ghats, and we have adopted the inter-district boundaries which most nearly follow the crest.

This decision leaves us in considerable disagreement with D. B. Clarke.

Hooker rsgarded Ceylon as a unit by itself. Though he is not alone in this view, there are many who consider that Ceylon consists of two parts the one watered by thB Bouth-westmonsDDn; the other watered later and much more sparingly by the retreating monsoon ; or, put in another way, the one watered along with the Malabar coast of India and the other watered along with the Coromandel coast. We are in agreement with ths view which accepts Ceylon as of two parts and have divided it accordingly : theiB are six well-watered Provincss assignsd tD Malabaria and two dry Provinces assigned to Coromandelia.

Walker's statistics indicate that in spite of the distance, thB Relativs Humidity of Karwarinlat. 14°48'N. differs very little from the Relative Humidity of Colombo in lat. B°5B'N. Talbot in his *Forest Flora of Bombay and Sind {1,* 19D9, p. iii) commentBd on a changs in the vegetation about Karwar ; and it may bB suggested that as SDDn as thB botanists of India can bring together the necessary data, the distribution of plants from Galle to Surat or Broach should be tabulated statistically with the object of ascertaining if greater diffsrsnces are introduced at any latitude than between Ceylon and Travancore.

Wallace held that a break could be observed SDmewhsre in the southern part of Malabaria, for he added Travancore to Ceylon tD make a sub-subregion. Engler took more and Drude yet mors of Indiato add to Csylon. Kendrsw suggests in an indBfinite measure a return to Wallace's scheme.

Hooker suggests that therB is another break a littls to the north of Bombay.

Hooker took for the northernmost limit of Malabaria a line at lat. 21 °3D'N. : C. B. Clarke one at lat. 24°N. Engler's limit is yet a little further to the north. Wehavetaken it at lat. 21^{D}4D'N., i.e., in agreement with Hooker: and we would call attention to the steep

decline in Relative Humidity to the north of it, for, as an example, this at Ahmedabad (lat. 23°1D'N.) is under 5D through half of the year, but from Surat |lat. 21^{D}12'N.) southwards is never under BD.

CDromandelialiesback to back, in the south of India, with Malabaria, but northwards is separated by the southern point of the triangular Deccan. It extends from the Madras coast to the Ghats; and we take for its inland boundary the inter-district boundaries which approach nearest to the taps of the Ghats. Northwards it ends very definitely nearMasulipatam and, that being so, we take the near boundary between the Districts of Kistna and Godaveri as a limit. Near Masulipatam the direction of the coast changes : the winds of the Bay current of the south-west monsoon give much more rain to the north of this bend; and to the south of it, thB recurved winds of the dying monsoon give rain. Kendrew indicates this climatic boundary. Wallace and Hooker realized its existence: Wallace when he assigned the coast to Ceylon and Hooker when he assigned the Districts of the Circars to Orissa. The other phytogeagraphers mentioned above did not know of it.

Down in the south of Doromandelia streamers of the Malabaria flora arB lodged on the higher hills ; and the low country is in striking contrast.

The DBCCan receives very short streamers of the flora of Malabaria they are longer in Mysore than to the northward. For a northern limit to this sub-subregion, a reasonably natural boundary is obtained if the line of the Kistna -*Go* da veri boundary be continued inland, i.e., if the boundary between the Nizam's Dominions and the Central Provinces be accepted.

Hindustan is the dry and little elevated country of north-western India from the Arabian Sea to the foot Df the Himalayas, and from the edge of Baluchistan and the North-west Frontier Province eastwards until the climate has ameliorated considerably under the influence of rains coming from the Bay of Bengal. Within its limits is the Indian Desert. Writers have suggested that the Aravalli Mountains may be taken as aphytogeographical boundary dividing an eastern wetter part from a western drier part, and Drude went so far as to assign the western part to the Region of the Mediterranean and Orient. Hooker used the line to part what he called the Indus plains from the Grangetic plains. Kendrew lays a climatological boundary along it and we have traced the limits of the Dioscoreas to a parallel line on its western side. The part of India immediately east of the boundary we term the Indore Region, for we find no established and more distinctive namB for it.

The Sub-subregion of Rain from the Bay of Bengal is indicated as a climatological unit by Kendrew : but phytogeographers have scarcely realized it as such. They were impressed by the magnitude of the Grangetic plains and saw difficulty in uniting into one unit the hilly country nearby. Hooker then assigned the hilly country to the Deccan : C. B. Clarke had assigned it to Coromandelia.

The Sub-subregion makes a wedge towards the west between the Deccan (as we define it) and Hindustan |as WB define it), and down this wedge hills extend through the northern part of the Central Provinces, making, as we have explained, a corridor from one sidBot India to the other—a corridor known to every student of Indian history as a barricade of unserviceable country peopled by Bhils, Korkus, Gtonds and other like tribes which save for the pass of Asirgarh held apart the aggressive rulers of Hindustan and the rulers of the Deccan. The general altitude of the hills making the corridor is 6DD m. : towards the west they catch streamers of moisture passing over the Westsrn Shats.

The Sub-subregion Df Rain from the Bay Df Bengal ends northward at the fDDt Df the Himalaya, and extends as fingers to the head Df the Brahmaputra valley and into the Surma valley. Bengal has been further divided in Dur pages into Sub-sub-subregions as in *Bmgal Plants.*

The Himalaya.—We have divided the Himalaya into four parts because division is necessary, and admitting that as yet the natural divisions are not evident. The inner and drier parts we have not brought into our scheme : they are scarcely part of the Indian Monsoon Ren-iDn, but Palacarctic; and we dD not see a gDDd way Df classifying them.

Hooker divided the range into three parts, not troubling himself with that part to the west of the Indus. Engler added the warmer parts of the range to the hills Dn the east Df Bengal under the name" Tropical Himalaya." Drude assigned the drier end to the Region of the Mediterranean and Orient, and the portion from central Nepal eastward partly to Burma and partly tD Inner China.

The affinity of the eastern Himalaya with the Khasia Hills is certain, but the differences can scarcely be weighed yet. There is a contribution tD the question in the *Records of the Botanic Survty of India* |1D, 1925, p. 154) where it is shown that the Ab$_D$r Hills and the Khasia Hills share as many plants as the Abor Hills and the Sikkim Hills. More need scarcely be said here.

Dry Central Burma.—In the very heart Df Burma there is a small area where the annual rainfall is as IDW as 510 mm. DT 24 inches and the genus *Dioscorea seems* to be absent except where *D. alata* is planted and irrigated. The gToup of districts in which it is and which surround it—their names are t$_D$ be found in table 22—compose together Dry Central Burma. But the districts, with only two exceptions, extend back to hills which catch rain-, and when statistics are based Dn these administrative units, the effect of the decreased rainfall at the centre is obscured. We are unable to bring it out better.

ThB Shan Plateau is separated from the Chinese province of Yun-nan by no natural boundary and Drude regarded it as phytogeographically part of Yun-nan. Data do not exist yet for determining how distinct or how far wanting in distinctness it is. From Burma it appears satisfactorily parted. The separation of the Siamese Circle of Payap from the Sub-subregion which we call the Shan Plateau is artificial.

Eastwards the Shan Plateau passes into Laos ; and the boundary we use is political, i.e., a makeshift.

Siam.-We have divided the Kingdom of Siam into two parts, **Siam proper** and **Peninsular Siam.** The first has a climate which is characteristically monsoonal) : the second projects so far southward as to reach into an equatorial climate. Dn the difficulty of setting ūp the line between them we have touched |p. 510): some may think that we have gone tDD far in selecting an oblique line from the north of Tenasserim to the sea below Bangkok. We adopted it on observing how far north the cultivation of the typical Malayan fruit-trees can be carried. The East loves, for instance, the Durian : the Kings of Burma, unable t$_D$ get it to grow nearer than Tenasserim, supplied themselves with its rich and peculiarly odorous fruit by organizing a service of runners. Every expedient, we are convinced, to extend its range northwards was tried. The result was t$_D$ get it tD within a few miles $_D$f Moulmein. In the TavDy District it grows wild.

Across the Gulf Df Siam where the Cardamom Mountains, rising immediately behind the coast, fence off the colder winds and throw down a considerable amount of rain, it is cultivable also, the fruit at harvest selling inland at very high prices.

The Durian, again is in experimental cultivation in the Andaman Islands.

We have endeavoured tD add these Durian areas to our Subregion Malaysia. This as regards Tenasserim and Penisular Siam, WB have done by taking the administrative boundary of Tsnasserim in the north and that between the Siamese Circles of Nakawn Sawan and Rachaburi from where it cuts the Ten ass erim border to the Gulf of Siam. As regards the Cardamom mountains, it has been impossible to detach a part of Siam by any boundary sufficiently familiar.

The moisture-laden winds of the south-west monsoon carry a considerable amount of rain over the Main Range DfTenasserim whereby theheart of Siam is well-watered from the end of April to mid-November: but a second escarpment rising on the east of theMenam valley drains them anewso much that the north-eastern parts of Siam—the Circles DfUbon, Roiet and Udawn—make a dry nucleus comparable to Dry Central Burma, where the rainfall per annum is reduced tD B9D mm. or about 35 inches. Here we are near the lower limit of precipitation for the genus *Dioscorea*, under a hot sun, and this, aided by a porous and thirsty soil, excludes them almost entirely. But the node of mountains in the Circle of Prachinburi, rising to l,30D m. seems to have a climate very favourable to the genus.

The Cardamom mountains which are further south, rise to 8DD m. in a peak visible from Bangkok and further away to l,B40 m.

An account of the climate of Siam may be found in an official publication " *Siam, Nature and Industry* " |193D).

On the east of dry north-east Siam, the rainfall rapidly ameliorates (see the Rainfall maps in Grandidier, *Atlas des Colonies Francaiszs*, 1934, p. 34), the French Provinces beyond the Mekhong, which WB assign to Laos, having a better climate.

Cdhay.—This term will not be found in phytogeographic writings: we have used it with the purpose Df finding a word by which the more diverse regions of China could be excluded. From Dur Cathay we exclude the Provinces of the south, e.g., Kwang-tung and Kwang-si assigned tD Eastern Indo-China : Sze-chuan, Yun-nan and Kwei-chow to South-West China.

BiogeDgraphers are all agreed that the south-east of China deserves separation: they have issued maps indicating it, but have been vague and variable in laying down a line. Bentham suggested the neighbourhood $_{D}$f Hong Kong as a limit: Engler took it to the sea as far to the northward as Ning-po in lat. 3D^{D}N. Drude took it t$_{D}$ the sea north of Amoy at about lat. 25°N. Quite recently B. BurgDyne Chapman (Bull. 3, Coll. Agric. and Forestry, Nan-king, 1935) has suggested a climatic boundary reaching the sea at lat. 29^{D}N.

The Chinese Provinces at the coast in these latitudes are Che-kiang, Fo-kien and Kwang-tung : and as we find the Dioscoreas of FD-kien to be markedly unlike those of Kwang-tung, we bring the boundary a little further south and take that between these two Provinces, which touches the sea at lat. 23°N., for our purpose.

The relationship DH Chapman's climatic provinces t_D the administrative provinces, may be outlined. He suggests nine climates. His climate no. 1 covers most of Kwang-tung, Hwang-si and Fo-kicn : his climate no. 2, most of Cho-kiang, Kiang-su and Hu-nan : his HD 3 covers Hwei-chow and most $_D$f Yun-nan as well as a part $_D$f Hu-pch : his no. 4 covers central and most of eastern Sze-chuan : his no. 5 most of Kiang-su and Ngan-hwei together with central and eastern Hu-pch; his no. Smost of Shan-tung,Ho-pei, Ho-nan and the north-east part of Sze-chuan: his no. 7 the northern half of Shen-si and most of Shan-si : his no. 8 Kirin and Manchuria : his no. 9 all the western rim of China from northern Yun-nan t D th e Amur.

Climates nos. 1,3 and 4 are in the main outside our Cathay except in such measure as results from our inclusion of the whole Province of Fo-kien in Cathay.

The July isotherm of 27^{D}C. |8D^{D}F) collects within its ambit $_D$n the map the following Provinces • Che-kiang, Ngan-hwei, Ho-nan, Hu-peh, Hu-nan, Kiang-si and Fo-kien which together make our Mid-China, and Chapman's climates 2 and 5 spread over them. The winter isotherms separate these two climates. On the Tibetan and Siberian sides of the July isotherm of 27^{D}C. the summer temperatures fall so rapidly that if wehad no other data, we should suspect a boundary to lie along it. Climates nos. 6 and 7 are those of our Northern China.

Malaysia.—We have already commented Dn the boundary line adopted between the IndD-Chinas and Malaysia.

The Subregion is divisible into a western and an eastern half, the former being Sun da-land Molengraaf in a very clear exposition *Geogr. Jovrn.* 57, 1921, p. 95) shows how Sundaland, that is Malaya, Sumatra, Java, Borneo and the smaller islands adjacent, rises from a platform submerged so gently when the ocean rose over it that the old rivers can be traced by soundings : and its boundaries towards the east be traced from Bali along the east side of Borneo and round Palawan. Sundalani, so defined, is dotted with Tertiary strata indicative of submergence at times in one dirction or another: but clearly it has, also, been for aperiod one large block of land at a time not altogether remote.

Theremainder of Malaysia has had a morerestless history, its landsurfaces raised and then depressed, equally not as a whole, here a part and there a part, but with more rapid movements : and the channels between the land now above sea-level have been thrust deep Dickerson | *Handel, dsrde Ntdarl. Indisch Naturwetenszh. Congres,* 1924) has dwelt on this with maps, suggesting islands in the Philippine Archipelago of various a_{geS} with shore-outlines entirely unlike any now existing. Merrill |in *PUUpp Joum.* *„ ·, 23, 1923, p 1) by using the dispersal of the *Dipterocarpaceaz* has illustrated an effect of the contrast in geological history between the west and east of Malaysia.

But this is not all. Wallace as the result of his travels in Malaysia suggested that between Bali and Lombok the fauna changes rather abruptly. Huxley seized on the idea and |1BBB) called the line " Wallace's line," extending it north and round the Philippine Archipelago. Much attention became focussed on it and then criticism anent its importance in relation to other possible lines such as one on the east of Celebes by which this island, by W. L. and P. C. Sclater *{The Geography of Mammals,* 1899), was added bo the Indian Monsoon Region, or another proposed by Blandford *[Proo. Gzuhg. Soz.*

Land., 189D, p. 7B), realigned by Max Weber *Der Indo-austral. Archipel u. i. Geschichte seiner Tierwelt,* 19D2) to embrace Timor, the Kei Islands, and Deram, and to pass to the west of the Ternate Moluccas, and from the work of this zoologist named by Pilseneer *Bull. Acad. Boy. Belg.,* 19D4p. 11[)1) Weber's line.

Lydekker *TU Gzogr. Hist of Mammals,* 1895, p. 48) had already recognized both Wallace's line and Weber's line which, as accepted now, are marked on DUT map, plate 81.

Wallace's first suggestion arose from differences which he had observed between Bali and Lombok in the fauna : Setchcll has pointed Dut that the climates are such as might aid in bringing this about *Proc. 4th Pacific Science Congress,* 1929, p. 311), and advances his reasons. He would regard Wallace's line as partly climatic and partly geobgic in its origin. It may Dn the whole be a satisfactory line ; but it is only one Df several possible lines such as can be drawn about Dr through eastern Malaysia.

The climates Df Malaysia are exceedingly complex : Kendrew writes of " endless local peculiarities." Van tier Stok, attempting classification of those in the Netherlands Indies, fell back on latitude partly, but found he could segregate west from east, and defined three climatic provinces *i)* that influenced by the Indian Monsoon so that the maximum precipitation falls in August, being northern Sumatra to Northern Borneo-|n) that Dn either side Df the Equator where the seasonal effects are small, and *[Hi)* that to the south and east where most rain falls between November and 4pril. Th_e PITT ine Archipelago makes a fourth province. Van der Stok's third province is watered^the south-east trade winds, and Dn these winds the heated land-surface of Australia has a considerable drying effect SD that the province receives on the WIIDIB relatively little rain : but the maximum dryness in eastern Malaysia is not under the lee of Australia • it is at the southern extremity of Celebes. Lam **Jin** *Blumeu,,* 1934, TJ 1221 *h* s_ows this clearly by a map. Eastern Java moreover has dry patches and Wallace's line thDU h most of the drier parts are to the eastward of it and the wetter are to the westward according to van der Stok, is not a climatic parting.

Perhaps just as diverse as Eastern Malaysia are the Philippine Islands. Luzon like Anam, opposes a mountain chain to the north-east winds with the result that a oca_ climate is formed in the north-east. Then there are other climatic anomalies, so that McGregor has based on the bird fauna eleven sub-sub-subregions: but Merrill *Enum. Philipp. Flower. Plants,* 4, 1926, p. 71) says that the flora has a generll uniformity and that sub-sub-subregions are not sharply defined.

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