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Errata.

Page
19, line 16, for Wolffia read Wolffia.
53, lines 10 & 12, for Ward read nob.
56, line 38, "..."
59, lines 35 & 36, "..."
92, line 2 from bottom, for nodosum read nodiferum.
92, 2, for Cymella read Cocconeum.
96, 7, for Gay read F. Gay.
96, 2, for Roy. read Roy.
203, 3, for Rupprechtii read Principis-Rupprechtii.
229, 30, for pileatum read plicatum.
231, 16, for aculeatum read aculeastrum.
246, 2, for Cassus read Cissus.
252, 15, for Irissema read Tristemma.
288, bottom line, read Fillemann.
294, line 5, for dubia, read I. dubia.
294, 26, read 3, I. Meyeniana, Kunth, and delete I. ternata, Dunn.
300, 16 et sequ., see cancel-page, issued with No. 267.
333, 18, for brunonis read Brunonis.
354, 17, for fusca read fusata.
371, 6, for Brown read N. E. Br.
399, 7, for Bulicus read bulicus, Stapf.
410, 15, for sanguineus, Fr. read sanguineus, G. F. W. Meyer.
432, 31, for lavendulacea read lavandulifolia.
442, 27, for Dictospheria read Dictyospheria.
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(With 1 Text-figure.)

[Read 1st November, 1906.]

This interesting little plant from New Zealand was placed by Sir J. D. Hooker among the Portulacaceae, although he considered it to be allied to no other genus (in this Order), and was aware of its strong resemblance in habit to *Lyallia* among the Alsinoideae-Polycarpeae group of the Caryophyllaceae. Mr. Petrie collected a large quantity of this plant in flower and fruit, and forwarded the same to the late Baron von Mueller, who apparently was unable to subject the material to more than a superficial examination.

The fruits were unknown to Hooker, although Pax, in Engler’s ‘Pflanzenfamilien’ (iii. 1 b, p. 58), gives the carpels as containing 4 to 5 ovules, of which a fewer number ripen in the fruit.

The following is a verified and slightly modified description from the MS. of the late Baron von Mueller:

“Ripe fruit almost globular or somewhat turbinate, membranous, nearly as long as the sepals, and hence slightly shorter than the petals, retaining the style and stigmas for some time, bursting by irregular valves at the apex, and measuring about \( \frac{1}{4} \) of an inch. Ripe seeds 2 to 4, ovate roundish, slightly compressed, smooth outside, shining black, about \( \frac{1}{15} \) inch long. Endosperm scanty, curved embryo, the ends not meeting, and the cotyledons hardly longer than the radicle.”

Linn. Journ.—Botany, Vol. XXXVIII.
There is nothing in this description to connect *Hectorella* any more definitely with the Portulacaceae than with the Alsinoidae-Polycarpeae. The chief distinction lies in the fact that in *Lyallia* the pair of leaves just beneath the base of the perianth are considered to be prophylls, and in *Hectorella* sepals. The latter is, however, an error. Of the two supposed "sepals" one can usually be seen to arise at a slightly higher level than the other as in *Lyallia*, while the vascular bundles are inserted obliquely and distinctly below the origin of those which run to the perianth and stamens. In the figure here given the line *a* gives the point at which the perianth-segments usually separate, *b* the level of the thalamus. The "sepals" are inserted below *b*, and at or above *c*. The vascular bundles of the stamens and petals vary as regards their exact origin in different flowers, but always diverge abruptly at the apex of the flattened flower-stalk, forming a distinct group of bifurcations well above the point of origin of the vascular bundles of the sepals, and splitting up at once or after a slight preliminary branching in the fused base of the perianth. In the figure of the flower given by Pax (l. c. p. 53, fig. 20), the close relation of the prophylls to the flower is somewhat exaggerated, and the bluntly-pointed tips of the petals and their slight concavity are not shown, so that the flower appears more widely dissimilar from that of *Lyallia* than it really is.

In regard to the stamens, Pax doubts whether they really alternate with the perianth-segments, as stated by Hooker. The latter author is, however, correct, as the term is ordinarily understood, although when the vascular bundles of stamen and perianth-segment have a short common branch, that from the stamen may be seen to twist laterally and join the common branch from the inside, as though antipetalous, in cleared and mounted preparations showing no signs of lateral distortion. Out of the large number of flowers examined all but two had 5 stamens, the exceptions having 6 and 7 respectively, and the extra stamens being opposite to the "petals" at their junction with the perianth-tube. In regard to the stigmas, Hooker and also Pax give the number as from 1 to 3. Out of several dozen flowers examined, all but 1 had two stigmas only, the exceptional flower having one of its stigmatic
lobes partially split. Before the stigmas separate there appears to be one only, but Hooker’s 1 to 3 is probably a misprint for 2 (as in Lyallia), very rarely 3.

Altogether there can be no doubt that Hectorella cespitosa and Lyallia kerguelensis are closely related plants, the former being the more primitive type, and being still in a plastic condition as regards its flower. Hectorella is peculiar in having lost or never having developed its petals. In the former case an outer, and in the latter case an inner row of 5 stamens has probably been lost. In Lyallia the reduction is carried further, the seeds being reduced usually to 1, the stamens to 3, and the perianth-segments to 4, and being more distinctly united at their bases. It is worthy of note that gamophyllly, indicating as it does floral specialization, is very commonly coupled with a reduction in the number of stamens.

If we include Hectorella with the Alsinoideae-Polycarpeae along with Lyallia and Pycnophyllum, the question at once arises as to whether the “sepals” in the Portulacaceae as a whole are not capable of the same interpretation, in which case it would be difficult to avoid including the Portulacaceae as a sub-group of the Caryophyllaceae. That is, however, a matter for further discussion.

Platanthera Chlorantha, var. Tricalcarata, Hemsl.

By W. Botting Hemsley, F.R.S., F.L.S.

(Plate I.)

[Read 17th January, 1907.]

In June 1906, Miss D. R. Wilson, of Pax, Sherborne, Dorset, sent to Kew a painting of a British Orchid, which she at first took to be Platanthera bifolia, but she afterwards came to the conclusion that it could not be that plant, because it was so different in floral structure. Awaiting a reply, Miss Wilson had fortunately preserved the specimen in water, and offered to send it to Kew if required. Naturally the offer was accepted, and Miss M. Smith has made the more detailed drawings which I now exhibit and fully illustrate the nature of the morphological transformation which the flowers have undergone. But before describing it I will give Miss Wilson’s original note:—“I enclose a painting of an orchid which I found on June 12th, and which I cannot identify. It was growing among Butterfly, Tway-blade, and Spotted Orchis in a grass drive along the border of a wood. It is sweet-scented, like Habenaria bifolia, and at first sight I took it for that plant. On examination, however, I saw that it had three spurs, very narrow sepals, and the two lateral petals curved back like horns. The flowers are also tilted upwards, so that the lip turns up, the spurs down, and the central parts lie horizontal, not perpendicular as in other orchids.”
Well, there is no doubt that it is an abnormal condition or variety of *Platanthera bifolia*, as limited by some botanists; but I prefer treating *P. bifolia* and *P. chlorantha* as species, and I regard the plant in question as belonging to the latter, though the anther-cells are parallel. It presents a very rare kind of metamorphosis, namely the metamorphosis of the lateral or paired sepals into spurred organs of which the limb is unlike the lip. The only other similar instance I find recorded is of *Orchis pyramidalis*, L. (*Anacamptis pyramidalis*, Rich.), by Dr. Faggioli (Atti del Congresso Botanico Internazionale di Genova, 1892, p. 521, t. 19, ff. 11-13). I say similar, because the limb of the spurred sepals in the Orchis is enlarged, two-lobed, and the pose normal; that is, the ovary is twisted, so that the lip is lowermost.

Miss Wilson's specimen of *Platanthera chlorantha*, var. *tricalcarata* was about 22 cm. high, but only the inflorescence was saved. It bore ten flowers, all of which are modified in exactly the same way, and they are larger than ordinary *P. bifolia*.

**Description.**—Ovary straight. Odd sepal about 6 mm. long, broad in the lower part, then abruptly constricted and almost linear in the upper part, which is incurved over the column, with the margins recurved. Paired sepals spurred; spur cylindrical, acute, about 2 cm. long when stretched out, spreading at a right angle from the lip, curved upwards and towards the lip and forming almost a semicircle with the tip nearly as high as the orifice; limb horizontal in relation to the spur, sickle-shaped with the curve away from the lip, acute, about 1 cm. long. Petals very similar to the odd sepal, but oblique at the base with a rounded auricle extended in the direction of the lip, narrowed upwards and connivent with the odd sepal, tip incurved. Lip uppermost; limb ligulate, about 1 cm. long, nearly equal in width throughout, very obtuse and bearing one small tubercle on each side at the base; spur cylindrical or slightly compressed, about 2·3 cm. long, thickened below the middle, somewhat acute, curved away from the axis. Staminodia 2, small, adnate to the column at the base of each anther-cell, papillose at the top. Column relatively large and broad. Anther-cells distant, parallel. Caudicle nearly as long as the anther, attached to a circular gland.

From the foregoing description and the accompanying figures, it will be perceived that nearly all parts of the three-spurred flower are more or less modified, in response, apparently, to the chief modification, which occupies a larger basal area than the normal paired sepals. It is also evident that the abnormally modified flower presents one at least of the characters commonly supposed to be peculiar to *P. bifolia*, and that is the parallel anther-cells. But this modification may be a part of the general deviation from the normal condition, because the three-spurred variety has the long caudicle and circular gland of normal *P. chlorantha*.

The flowers of Orchids present probably a greater variety of deviations from the ordinary or normal structure than any other natural order of plants,
PLATANTHERA CHLORANTHA var. TRICALCARATA.
which may perhaps be accounted for by the fact that the ordinary structure is very unusual owing to the suppression of parts and the singular forms assumed by those developed. Theoretically the orchid flower consists of a perianth of six parts, in two series; of six stamens, in two series; and a tricarpellary pistil. In the great majority of orchids, including Platanthera, the six parts of the perianth are all developed, but they often differ very much in shape in the same series, and one of the inner series differs so much from the others that it has the distinctive name of lip or labellum. On the other hand, only one stamen is usually developed.

Returning to Platanthera bifolia in the broad sense, that is including P. chlorantha, many deviations from the typical floral structure are on record, which collectively support the theory explained.

The kind of deviation just described has been designated false or irregular peloria, because the parts concerned belong to different whorls; that is to say, two of the spurred organs belong to the sepal-series and one to the petal-series. True peloria of two kinds has been observed in Platanthera, namely lip-peloria and petal-peloria, in which the transformed organs, being of the petal-series, are either like the lip or the lip takes the shape and colouring of the other two petals. In some instances of petal-peloria six fertile stamens are developed, thus exhibiting a reversion, may we call it, to the ordinary monocotyledonous type. Many instances of imperfect peloria are on record, such as the conversion of one of the paired petals into a lip-like organ, or, as in some cases, only one half of an organ is affected. As I have no practical knowledge of anatomical development I will not attempt an explanation of these phenomena, but I must say that it seems to me very difficult to explain whence the sepals in the three-spurred Platanthera derive the material for their extra development, unless we may assume the foundation of surplus-spur-material. The staminodes being present, it is not from that source that material is diverted.

Miss Wilson has written again to say that she found only one spike of the three-spurred Platanthera, and that was on the fringe of a wood called The Holts, which lies along a ridge of hill north of the village of Bishop's Caundle, about five miles from Sherborne.

EXPLANATION OF PLATE 1.

Figures 1 to 3 are more or less diagrammatic and the pose is not quite natural, as the median longitudinal plane of the flowers was oblique to the axis.

Fig. 1. A flower attached to the axis, natural size.
Fig. 2. The same about three times natural size, front view.
Fig. 3. Back view of the same.
Fig. 4. Odd sepal, very much enlarged.
Fig. 5. A petal, very much enlarged.
Fig. 6. A pollinium and gland, very much enlarged.
The genus *Ptyssiglottis* was established by T. Anderson on *Rhytiglossa radicosa*, a plant described by Nees from specimens collected by Champion in Ceylon. *Rhytiglossa* comprised originally a few South African species. Subsequently the genus was considerably enlarged by the addition of other, mainly American, species, growing thereby rather heterogeneous, and at present its species are distributed over several genera. There is no doubt that T. Anderson was perfectly justified in separating the Ceylon species from *Rhytiglossa*, in whichever sense that genus may be taken. His description of *Ptyssiglottis* is, so far as it goes, unobjectionable. Unfortunately, however, he adopted Miquel's view that the Ceylon *Rhytiglossa radicosa* of Nees was identical with the *Rostellularia sarmentosa* of Zollinger, an identification that is difficult to understand, as the description of *Rostellularia sarmentosa*, and still more the comparison of the specimens, do not suggest any close relationship. Miquel's statement did not remain unchallenged. Bentham suggested that the *Rostellularia sarmentosa* of Java might be specifically distinct from *Ptyssiglottis radicosa*, and C. B. Clarke more emphatically stated that the former "does not belong here," viz. to *Ptyssiglottis*. Notwithstanding those critical remarks *Ptyssiglottis* was generally enumerated as a monotypic genus inhabiting Ceylon and Java, until, in 1896, Hallier fil. published two new species of *Ptyssiglottis* from Borneo and several more in the following year, also from Borneo. In referring those Borneo species to *Ptyssiglottis*, he relied on a rather incomplete specimen of *Ptyssiglottis radicosa* in the Buitenzorg Herbarium and Anderson's description of that plant. Subsequently he saw the specimens of *Ptyssiglottis radicosa* in the Kew Herbarium. Referring to them he said they were not sufficient to confirm the placing of his new species from Borneo in *Ptyssiglottis*.

When some years ago I was working out Haviland's and Hose's Acanthaceae from Sarawak, several species which were evidently congeneric with Hallier's *Ptyssiglottis* attracted my attention, but also convinced me of their generic distinctness from the *Ptyssiglottis* of Ceylon. This induced me to examine...
the whole group, which is fairly well represented at Kew. Through the
courtesy of Professor Radlkofer I had, further, an opportunity of seeing the
originals of Hallier's Ptyssiglottis so far as they are preserved in the Munich
Herbarium, whilst the late M. Drake del Castillo sent me a fragment of
Zollinger's original of Rostellularia sarmentosa, of which, moreover, an
excellent duplicate specimen was subsequently discovered by Mr. C. B. Clarke
in the Kew Herbarium, where it had been placed in Justicia.

Rostellularia sarmentosa was easily recognized as a species of Rungia, and
named R. sarmentosa by the late C. B. Clarke. All the Borneo plants described
by Hallier f. as species of Ptyssiglottis were found to be closely connected
members of a very homogeneous group, which, for reasons stated below, could
not well be retained in Ptyssiglottis. On the other hand, the only non-Borneo
Ptyssiglottis described by Hallier, P. pieta, a native of North-east Sumatra,
exhibited differences in the pollen, which suggested other affinities. The
material of this species in the Munich Herbarium was, however, too scanty to
warrant a more definite statement. But when last year Mr. C. B. Clarke
examined the Calcutta set of Acanthaceae from the Malayan Peninsula, he
found among them several species which he comprised under the new genus
Polytrema, and I have no doubt that Ptyssiglottis pieta will have to be referred
to it. If we exclude therefore Ptyssiglottis radicosa and P. pieta, all of
Hallier’s Ptyssiglottis appear confined to Borneo, and more especially to the
Kapuas Basin of West and Central Borneo. That area is considerably
extended through the accession of not less than ten additional species from
Sarawak, including Brunei and British North Borneo, and one species from
Mindanao. For this group, which thus includes eight species described by
Hallier and eleven to be described below, I propose the name Hallieracantha.
Compared with many other genera of Acanthaceae, it has the merit of being
very homogeneous and also of having a continuous and uniform distribution
area. It is more difficult to define its exact position in the family. Its
relationship with Polytrema is manifest, and botanists who prefer larger
genera with subgenera as subdivisions may feel inclined to reduce Polytrema
to a subgenus of Hallieracantha, as the two genera differ only in the shape of
the corolla, the attachment of the anther-cells on the connective, and the
structure of the pollen. On the other hand, the relationship of Hallieracantha
and Ptyssiglottis seems to be much more remote. Ptyssiglottis has been
placed by Lindau ¹ near Codonacanthus in Plseuderanthemceae, and I would
leave it there for the present; whilst Hallieracantha seems to have more in
common with the Justicieae (Lindau) than with the Pseuderanthemceae; and
Bentham ², who placed two of Motley's plants which I describe below as
Hallieracantha Motleyi and H. laxa in Dianthera, was not so far wrong. A
closer examination of the very heterogeneous genus Justicia (heterogeneous

¹ In Engl. & Prantl, Natürl. Pflanzenf. vol. iv. 3 b (1895) p. 33
also in regard to pollen-structure) will probably give the key to the phylogenetic position of *Hallieracantha*.

Before proceeding to the purely descriptive part of the paper, I would indicate the characters which distinguish *Hallieracantha* and *Ptyssiglottis*. They concern mainly the inflorescence, the corolla, and the pollen. The inflorescences of *Hallieracantha* are axillary or rarely pseudoterminal, loose or much contracted, and made up of dichotomously arranged dichasias. Those of *Ptyssiglottis* are terminal and represent few-flowered, more or less one-sided racemes. The corolla of *Hallieracantha* consists of a tube which is somewhat obliquely widened in the upper part and a typically bilabiate limb, in most species three to five times shorter than the tube. The upper lip is very shortly, the lower more deeply lobed, and the latter has two conspicuous vaulted ridges on the palate. On the other hand, the corolla of *Ptyssiglottis* is obliquely comuanulate, with a very short cylindrical tube at the base; it has a wide mouth, and the lobes of the limb are much less unequal than in *Hallieracantha*, nor is there a distinct vaulted palate. In *Hallieracantha* the stamens spring from the middle of the tube, in *Ptyssiglottis* the insertion is considerably lower down. The pollen of *Hallieracantha* is throughout ellipsoid, in *Ptyssiglottis* globose. I may add that the leaves of *Ptyssiglottis* are thin and of a texture such as does not occur in *Hallieracantha*. The characters given here for *Hallieracantha* are common to all its species, and it is their constant correlation that marks the genus as distinct from *Ptyssiglottis*.

**Hallieracantha**, Stapf.

*Calyx* fere ad basin 5-partitus (rarissime 5-dentatus), segmentis aequalibus linearibus vel subulatis. *Corolla* bilabiat; tubus limbo plerumque 3-5plo, rarius tantum 2plo longior, infra medium magis minusve cylindricus, superne sensim ampliatus; labium superum erectum, emarginatum vel breviter 2-lobum; labium inferum superum aequalis vel subaequalis, 3-lobum, lobis subaequilongis, lateralibus oblongis vel ovatis, intermedio latiore in alabastro extimo; palatum 2-plicato-fornicatum. *Stamina* 2, medio tubo vel paulo supra orta, e corollae tubo vix exserta; filamenta glabra; antherae 2-loculares thecis aequalibus vel rarius inaequalibus oblongis muticis subparallelis dorso connectivo angusto eadem altitudine (vel una quam altera paulo altius) adnatis subcontiguis. *Pollen* ellipsoides, poris 3 aequalibus plicis tenuissime polos haud attingenti impositis plerumque plicis accessorius utrinque singulis additis, exino tenuissime punctato vel raro laevi; staminodia nulla. *Discus* annularis vel breviter tubulosus, ovarium arces cingens. *Ovarium* glabrum vel parce papilloso-pilosulum; loculi 2-ovulati; stylus filiformis, glaber; stigma punctiforme vel paulo dilatatum. *Capsula* clavata oblonga, acuminata vel apiculata, ad fere medium solida, coriaceo-indurata. *Sema* lenticularia, tenuiter scrobiculata.—*Herbae* erectae vel procumbentes, simplices.
vel ramosæ, isophylle vel anisophyllæ vel specie alternifolii. Flores minores, albi palato pleurumque luteo. Inflorescentiae axillares vel pseudo-terminales, pleurumque dichotoma, ramulis apice dichasia 1-, rarius 2-flora gerentibus, laxæ vel admodum abbreviatae et tunc pleurumque ob bracteas dense imbricata strobilos parvos referentes.

Species 19, in Borneo et (una) in Insulis Philippinis.

Antherarum thece valde inaequalis; pollinis exinimium laeve; plantæ isophyllæ.

Calyx 5-dentatus; inflorescentia longe pedunculata, multiflora, capitulis formis; herba erecta, elata, undique molliter hirsuta .

Calyx 5-partitus; inflorescentia modice pedunculata, pauciflora, laxæ; herba prostrata, radicans, subglabra .................

Antherarum thece æquales; pollinis exinimium minute foveolato-punctatum.

Inflorescentiae paucifloræ, laxæ, graciliter pedunculata; folia tenuia, exsiccando viridia; herbae eximiae anisophyllæ vel specie alternifolii.

Folia normalia petiolata; folia redacta lamina distincta munita.

Folia redacta uti normalia late lanceolata .................

Folia redacta cordato-orticularia, a normalibus maxime diversa .................

Folia normalia subsessilia; folia redacta minuta, subulata ....

Inflorescentiae subsessiles vel breviter pedunculata, contractæ, sepe imbricato-squamata, pleurumque sub apice ramulorum florem 1-2 gerentes; folia firma vel crassiuscula (H. leptoneura excepta), sepsissime exsiccando fuscescentia vel nigricantia.

Isophyllæ.

Folia late vel elliptico-lanceolata, fuscescentia.

Folia 14-20 cm.: 5-6.5 cm., utrinque acuminate; caulis glaber .................

Folia 5-9 cm.: 2.3-5 cm., utrinque acute; caulis undique villosulo-puberulus .................

Folia anguste lanceolata, exsiccando fere atra; caulis glaberrimus .................

Anisophyllæ.

Folia redacta lanceolata vel subulata, sepe fugacia; herbae erectæ.

Folia normalia 5-13 cm. longa.

Folia lanceolata, acuminata.

Folia crassiuscula; caulis lineis binis puberulis rotata..

Folia tenuia; caulis glaber .................

Folia elliptica vel oblongo-elliptica, acuta vel sub-acuminata .................

Folia normalia 12-25 cm. longa.

Folia lanceolata, 3-4plo longiora quam lata, costa latiuscula et uti nervi subitus prominentibus.

Folia pallide viridia, subitus uti caulis (secus lineas binas) et calyx minute puberula .................

Folia saturea viridia uti tota planta glabra .................
DR. OTTO STAFF ON HALLIERACANTHA.

Folia elliptica vel elliptico-lanceolata, 2-2.5 pl longiora quam lata, costa nervisque tenuibus.
Petioli ad 5 mm. longi; calyx 4-4.5 mm. longus .......... 14. micropellinia.
Petioli 10-17 mm. longi; calyx 7-9 mm. longus.
Folia tenuiter caudato-acuminata; nervi laterales utrinque 6-10; venae tenues, laxe Anastomosantes .......... 15. caudata.
Folia redacta rotundata, cordato-ovata (imprimis parium superiorum); herbe procumbentes, radicantes.
Folia normalia oblongo-lanceolata, subacuminata .......... 17. dispar.
Folia normalia elliptica, apice obtusa.
Folia normalia basi obtusa, uno late acuta altero obtusa, triste viridia, exsiccata cystolithis granulata ........ 18. granulata.
Folia normalia basi oblique subcordata, nigrascencia, bullata, in bullarum centr is albo-maculata, exsiccata cystolithis striolata .......... 19. anisophylla.

1. Hallieracantha hirsuta, Staff.
Central Borneo: Upper Kapuas Basin, upper reaches of the Mandae River; near Nanda Raun, Hallier, B. 2589, and on Mount Liang Gagang, from the foot to 700 m., in damp shady virgin forest, Hallier, B. 2588!

2. H. auriculata, Staff.
Central Borneo: at the foot of Mount K’lamm near Sintang, in shady bamboo thickets, Hallier, B. 2291!

3. H. dulcamarioides, Staff (sp. nov).
Herba anisophylla in superiore quidem parte sica viridis vel fusco- vel fulvo-viridis. Caulis teres (juvenes exsiccando sulcatae), magis minusve anfractus, in lineis e commissuris decurrentibus minutissime fulvo-villosulus. Folia petioluta, lanceolata vel oblongo- vel elliptico-lanceolata, sepe obliqua, breviter acuminata vel minore sepe vix acuminato, basi acuta, majora 7-10 cm. longa, 2-4 cm. lata, minora 1.5-3 cm. longa, 0.6-1 cm. lata vel in paribus inferioribus multo majora, integra, vel obscure undulata, tenuia, utrinque glabra, cystolithis minute striolata, nervis utrinque circiter 6-8 tenuibus valde prorsus curvatis; petiolus gracilis, foliorum majorum 1-2 cm. longus. Inflorescentiae pedunculo ad 12 mm. longo tenui suffulte, plerumque bifurcate, dense vel laxe bracteate; bracteae ovato-lanceolatae, acuta, 1-1.5 mm. longae, papilloso-pilosulae; pedicelli tenues, ad 4 mm. longae,
A NEW GENUS OF ACANTHACEAE.

patule glanduloso-pilosula. Calyx fere ad basin 5-partitus, 5'-5'-6'-5 mm. longus, patule glanduloso-pilosulus, fusc-o-viridis; segmenta subulato-linearia. Corolla 9 mm. longa, extus papillosa; tubus 6 mm. longus; labium superum late ovatum, breviter 2-lobum; labium inferum supero sublongius, vix ad medium 3-lobum, lobis lateraliibus oblongis, intermedio latissimo rotundato. Staminum thecae æqualiter affixa, basi obtuse vel subacuta. Pollen 42-49 μ longus, 28-33 μ latus, plicis accessoris nullis, exinio tenuissime punctato.

SARAWAK: near Kuching, Hariland, 792! 3512!

4. H. Creaghii, Stapf (sp. nov.).

Herba erecta, anisophylla, sieca triste viridis. Caulis subteres, superne sulcatus, in lineis binis e commissuris decurrentibus minutissime puberulus, demum glabratus. Folia normalia petiolata, late lanceolata vel elliptico-lanceolata, utrinque acuminata, 12-18 cm. longa, 3-6 cm. lata, supra glabra, cystolithis striolata, subtus in nervis (basin versus quidem) minute papilloso-pubescentia nervis lateraliibus utrinque 7-8 uti venis tenuibus; petiolus ad 10 mm. longus, minute pubescens; folia redacta rotundato-ovata vel orbicularia, basi cordata, 3-4 mm. longa, subsessilia. Inflorescentia pallide virides, pedunculo gracili ad 2-5 cm. longo suffultae, bifurcatæ, laxæ, undique puberulse; bracteæ lineari-lanceolatæ, acutæ, ad 2-5 mm. longæ; pedicelli 3 mm. longi. Calyx fere ad basin 5-partitus, 4 mm. longus, glandulosopuberulus; segmenta lineari-subulata, acuta. Corolla 12-13 mm. longa, extus glabra; tubus 9 mm. longus; labium superum late ovatum, breviter bilobum; labium inferum supero æquilongum, profunde 3-lobum, lobis lateraliibus oblongis obtusis quam intermedio rotundato-ovato multo angustioribus. Staminum thecae æqualiter, una quam altera paulo altius affixa, subparallela, 1 mm. longæ, inferior basi acuta; pollen 50-53 μ longus, 35 μ latus, plicis accessoris tenuissimis utrinque vel in uno latere tantum singulis, exinio tenuissime punctato.

BRITISH NORTH BORNEO: Sandakan District, Creagh!

5. H. laxa, Stapf (sp. nov.).


Herba erecta, 15-35 cm. alta, ob folium alterum uniuscuiusque paris rudimentarium subulatum decidunt specie alternifolia, sieca late viridi. Caulis teres, glaber vel in lineis binis e commissuris decurrentibus tenuissimis brevissime villosulus. Folia normalia brevissime petiolata vel sessilia, oblonga vel elliptico-oblonga, interdum obliqua, acuminata, basi acuta, 9-13 cm. longa, 3-4'-5 cm. lata, glabra, tenuia, cystolithis inconspicuis striolata, nervis tenuibus lateraliibus utrinque circa 7 valde prorsus curvatis; petiolus nullus, raro 1-1'-5 mm. longus. Inflorescentia pedunculo tenui ad 2-5 cm. longo suffultæ,
plerumque bifurcatae, sepe laxae, ramis ad 12 mm. longis vel brevibus, inter-
nodis 1-4 mm. longis; bractee lanceolate, acute, 1-1½ mm. longe, virides, 
glabre; pedicelli ad 3-5 mm. longi. Calyx fere ad basin 5-partitus, ad 5 mm. 
longus, viridis, glanduloso-puberulus; segmenta subulata, acuta. Corolla 
20 mm. longa; tubus 7 mm. longus; labium superum late ovatum, breviter 
2-lobum; labium inferum supero paulo longius, ultra medium 3-lobum, lobis 
lateralibus oblongis quam intermedio rotundato-ovato multo angustioribus. 
Staminum thecae aequales, subaequaliter affixa, 16 mm. longe, basi obtusae. 
Pollen 45-46 μ longus, 25-35 μ latus, plicis accessoriis nullis, exinio tenuissime 
punctato.

LABUAN: Kolong Kolong hills, in deep shade, Motley! Barber, 334!

6. H. salicifolia, Stapf (sp. nov.).

Herba erecta, ramosa, isophylla, calycibus exceptis glaberrima, sicca 
nigricans vel fere atra. Caulis subteres. Folia petiolata, lanceolata, tenuiter 
longe acuminata, basi acuta, 7-12 cm. longa, 1.5-2-5 cm. lata, crassinucula, 
cystolithis inconspicuis multo-striolata, nervis lateralibus tenuissimus utrique 
6-7 valde curvatis; petiolus ad 1 cm. longus, gracilis. Inflorescentiae 
brevissimae, simplices vel furcatae, pedunculo ad 6 mm. longo suffultae, 
densissime bracteatae; bractee lanceolato-subulatae, acute, 3 mm. longae, 
nigricantes; pedicelli tenuissimae, circiter 2 mm. longi. Calyx fere ad basin 
5-partitus, 10-12 mm. longus; segmenta linearia, acuta, apice pilosa. 
Corolla 13-14 mm. longa, glabra; tubus 8 mm. longus, labium superum late 
ovatum, emarginatum; labium inferum supero quellongum, breviter 3-lobum, 
lobis lateralibus ovato-oblongis qua intermedio rotundato vix longioribus. 
Staminum thecae aequales, subaequaliter affixe, parallele, basi obtusae. Pollen 
49-55 μ longus, 35-36 μ latus, plicis accessoriis utrique singulis, exinio 
minutissime punctato. Capsula oblonga, acuta acuminata, stipite paulo 
breviore crassinuculo inclusa 12-14 mm. longa. Semina 2-5 mm. longa.

SARAWAK: Mount Buan, on limestone, Haviland, 2032!

7. H. lanceolata, Stapf.

(1898) p. 221, tab. 15, fig. 1.

WEST BORNEO: Delta of the Kapuas River, near Suka Lanting, in shady 
forest, Hallier, B. 82, B. 177.

SARAWAK: Niah, Haviland & Hose, 3546! Barum, Hose, 120! Haviland 
& Hose, 3548! Marudi River near Claudietown, Hose, 169! 285! 300!

I have not seen Hallier’s specimens, and their identification with those of 
Haviland and Hose rests therefore entirely on Hallier’s description and figure 
of Ptyssiglottis lanceolata. If I am right, Hallieracantha lanceolata is more 
variable than the other species of the genus.


West Borneo: near the Kapuas River, *Teysmann*, 7918; near the Melawi River (tributary of the Kapuas), *Teysmann*, 7923.

9. **H. Motleyi**, Stapf (sp. nov.).


*Herba* erecta, isophylla, sicc nigricans. *Caulis* circiter 18 cm. altus, subteres, undique villosulo-puberulus. *Folia* petiolata, elliptico-lanceolata, utrinque acuta vel apice subaeuminata, margine interdum subundulata 5-9 cm. longa, 2-3-5 cm. lata, supra glabra, cystolithis sepe inconspicuis striolatis, subtus in nervis minute fulvo-furfuraceis, nervis lateralis utrinque 4-6 prorsus curvatis; petiolus fulvo-furfuraceus, 2-4 mm. longus. *Inflorescentia* axillares vel pseudoterminales, simplices vel bifurcate, pedunculate, ob bracteae dense imbricatas strobiliformes, perpauciflorae; pedunculus ad 7 mm. longus; bractea ovariae vel lanceolate, acuta, 1-2 mm. longae, herbaceae, nigricantes, sparse furfuraceae; pedicelli 3-5 lin. longi. *Calyx* fere ad basin 5-partitus, ad 7 mm. longus, nigricans, furfuraceo-puberulus; segmenta subulata, acuta. *Corolla* 7-10 mm. longa, extus papillosa; tubus 4-6 mm. longus; labium superum late ovatum, emarginatum; labium inferum supero vix longius, fere ad medium 3-lobum, lobo intermedio rotundato lateralis multo angustioribus. *Staminum* thecae equales, inaequaliter affixe, basi obtusi, 1 mm. longae. *Pollen* 50 μ longus, 35 μ latus, plicis accessorius utrinque singulis, exinio tenuissime punctato. *Ovarium* minute papillosum vel glabrum (?). *Capsula* juvenilis appresse minute papillosa.

Labuan: near Sanjong Kubong, in deep shade, not uncommon, Motley, 123!; near Sungei Tragan, on damp, shady banks, Barber, 273!

Sarawak: Baram District, by the Entoyout River, near Claudetown, Hose, 460!

10. **H. Beccarii**, Stapf (sp. nov.).

*Herba* erecta vel basi prostrata, ob folium alterum uniuseniusque paris minutum mucroniforme vel subulatum deciduum specie alternifolia, siccus-fusco-viridis. *Caulis* subteres, in lineis binis et commissuris decurrentibus minuissime sparseque furfuraceus. *Folia normalia* petiolata, elliptica vel oblongo-elliptica, utrinque acuminata vel basi subacuta, interdum obliqua, magnitudine varia, ad 15 cm. longa, ad 6-5 cm. lata, integra, subulatula vel crenulata, supra glaberrima, subtus sparse adpresso papilloso-pubescentia, cystolithis inconspicuis, nervis lateralis utrinque 5-7 valde prorsus curvatis; petioli inferiores ad 1 cm. longi, superiores multo breviores vel fere nulli,
minute furfuracei. *Inflorcescentia* breviter pedunculatae, simplices vel bifurcateae, ob bracteas dense imbricatas strobiliformes, perpauciflores; pedunculus ad 4 mm. longus; bractee ovate vel lanceolato-ovatae, acutae vel acuminatae, 1–2 mm. longae, furfuraceae vel glabratae vel nigrescentes; pedicelli 1–2 mm. longi. *Calyx* fere ad basin 5-partitus, 4–4–5 mm. longus, nigricans, parce vel copiose papillosa-pubescentes; segmenta e basi paulo dilatatae subulatae. *Corolla* 11–13 mm. longa, extus papillosa; tubus 8 mm. longus; labium superum late ovatum, emarginatum; labium inferum superum vix aequans, breviter 3-lobum, lobis lateralibus ovatis intermedia rotundato multo latiore. *Staminum* thecae aequales, subaequaliter affixe, obtusa, 2 mm. longa. *Pollen* 45–50 μ longum, 38 μ latum, exinio tenuissime punctato, plicis longis accessoris utrinque 2. *Ovarium* glabrum.

**SARAWAK:** without precise locality, *Beccari*, 1053! *Hariland*, 571!

11. **H. psychotriifolia**, Stapf (sp. nov.).

*Herba* isophylla, sicea luride fusca. *Caulis* teres, glaber. *Folia* petiolata, late lanceolata, utrinque acuminata, apice obtusiuscula, 14–20 cm. longa, 5–6,5 cm. lata, margine obscure undulata, utrinque glabra, supra cystolithis striolata, nervis lateralibus utrinque 5–6 tenuibus valde prorsus curvatis; petiolus 3–4 mm. longus, supra canaliculatus, papillosus. *Inflorcescentia* pedunculatae, plerumque geminatae, interdum bifurcateae, ob bracteas densissime imbricatas tetrastichas strobiliformes; pedunculus ad 7 mm. longus; bractee ovate, acutae, 1–1,5 mm. longae, subglabrae, nigrantes; pedicelli tenues, ad 3 mm. longi. *Calyx* fere ad basin 5-partitus, 4–5 mm. longus, glanduloso-puberulus; segmenta subulatae. *Corolla* 12 mm. longa, extus parce minutissime papillosa; tubus 8–9 mm. longus; labium superum late ovatum, emarginatum; labium inferum superum subaequilongum, ad medium 3-lobum, lobis lateralibus oblongis intermedia rotundato-quadrato aequilongis. *Staminum* thecae aequales, subaequaliter affixe. *Pollen* 44–46 μ longus, 30 μ diametro, plicis accessoris utrinque singulis, exinio tenuissime punctato. *Capsula* oblonga, breviter acuminata, in stipitem subaequilongum attenuata, eo inclusa 16 mm. longa, parce minutissime papillosa.

**SARAWAK:** Brunei, near the Limbang River, *Hariland*, 576! *Hose*, 760!

- 12. **H. philippinensis**, Stapf (sp. nov.).

*Herba* parce ramosa, ob folium alterum uniusque sinusque paris rudimentarium vel suppressum specie alternifolia, sicea pallide luride viridis. *Caulis* obtuse quadrangularis, lineis bisinis e commissuris decurrentibus villosulcs, praeterea glaber. *Folia* normalia petiolata, late lanceolata, acuminata, basi acuta, 12–18 cm. longa, 2.5–5.5 cm. lata, obscure undulata, supra glabra, infra in nervis minute papilloso-pubescentes, utrinque cystolithis striolata, nervis lateralibus utrinque circiter 7 supra tenuibus subitus uti costa validiuscula.
prominentibus valde obliquis; petiolus crassiusculus, ad 7 mm. longus, superne canaliculatus, papilloso-villosulus. \textit{Inflorescences} axillares et specie terminales, plerumque geminatae, interdum bifurcatae, cylindraceae, strobiliformes, paniculatae, ad 1-5 cm. longae; pedunculus tenuis, 0-5-1-2 cm. longus; bractee ovatae, acute, 1-1-5 mm. longae; pedicelli ad 4 mm. longi. \textit{Calyx} fere ad basin 5-partitus, 8 mm. longus, glanduloso-puberulus; segmenta subulata, setaceo-attenuata. \textit{Corolla} ad 15 mm. longa, extus papillosa; tubus ad 12 mm. longus; labium superum late ovatum, emarginatum; labium inferum supero subaequilongum, fere ad medium 3-lobum, lobis lateralibus ovatis, intermedio rotundato–quadrato paulo longiore. \textit{Staminum} thecae subinaequilater affixa, aequales, basi obtuse. \textit{Pollen} 44–48 \(\mu\) longum, 32 \(\mu\) diametro, plicis accessoris utrinque singulis, exinio tenuissime punctato. \textit{Capsula} oblonga, acuta, papillosa, in stipitem aequi-longum attenuata, eo inclusu 13–14 mm. longae. \textit{Semina} lenticularia, vix 2 mm. longa, minute rugulosa.

**Philippines:** Mindanao, Zamboanga, Vidal, 3408!

13. \textit{H. procrisidifolia}, \textit{Staff}.  
West Borneo: at the foot of Mount K’lamu near Sintang, in high forest, Hallier, B. 2512.

14. \textit{H. micropollinia}, \textit{Staff} (sp. nov.).

\textit{Herba} ob folium alterum uniuscusiusque parvis minutissimum vel suppressum specie alternifolium, sicca fusco-viridis. \textit{Caulis} subteres, superne magis minusve anfractus, minute villosulo-pubescentes vel furfuraceus. \textit{Folia normalia} petiolata, oblique elliptica vel obovato-elliptica, longe acutaeque acuminatae, basi acute, 13–20 cm. longa, 5–9-5 cm. lata, integra vel crenulato-undulata, supra glaberrima, subitus in nervis parcissime papilloso-pubescentia vel glabrata, cystolithis inconspicuis, nervis lateralibus 6–8 valde prorsus curvatis; petiolus ad 5 mm. longus, minute furfuraceus. \textit{Inflorescences} plerumque plures in axillis foliorum, sessiles vel pedunculo communi ad 4 mm. longo suffultae ob bracteas plerumque dense imbricatas strobiliformes; bractee ovatae vel lanceolato-ovatae, acutae vel acuminatae, 1–2 mm. longae, parce minutissime papillosae; pedicelli 2–3 mm. longi. \textit{Calyx} fere ad basin 5-partitus, 4–4-5 mm. longus, parcissime papillosus; segmenta subulata. \textit{Corolla} ad 10 mm. longa, extus papillosa; tubus 5–6 mm. longus; labium superum late ovatum, emarginatum; labium inferum superum aequans, ultra tertiam partem 3-lobum, lobis lateralibus oblongis subdivaricatis, intermedio ovato-rotundato. \textit{Staminum} thecae aequales, subaequiliter affixe, basi obtusae, 1-5 mm. longae. \textit{Pollen} 35 \(\mu\) longum, 25 \(\mu\) diametro, plicis accessoris utrinque singulis, exinio tenuissime punctato. \textit{Capsula} oblonga, acuminata, in stipitem
subaequilongum attenuata, eo inclusu 14-16 mm. longa, superne papillosa. 
Semina 3 mm. longa, minute rugulosa vel scabra.

SARAWAK : Mt. Koum, Haviland, 1717!

15. **H. caudata**, *Stapf* (sp. nov.).

*Herba* ob folium alterum uniuseinusque paris rudimentarium subulatum specie alternifolium, sieca nigricans vel fere atra. *Caulis* teres, lineis binis e commissuris decurrentibus tenuibus tenuissime puberulis exceptis glaber. *Folia* *normalia* petiolata, elliptico-lanceolata vel oblonga, apice caudato-acuminata, basi acuta, 13-18 cm. longa, utrinque glabra, cystolithis minute striolata, nervis lateribus utrinque 6-10, valde prorsus curvatis; petiolus ad 1 cm. longus, glaber. *Inflorescentia* interdum etiam ex axillis foliorum rudimentariorum, subsessiles, solitarie vel plures ex eadem axilla, ob bracteas densissime imbricatas strobiliformes; bractee ovate, acute, glabra, 1-1.5 mm. longe; pedicelli vix uli vel ad 3 mm. longi. *Calyx* fere ad basin 5-partitus, 7-9 mm. longus, nigricans, glaber; segmenta linearia, 0.75-1 mm. lata, etiam in fructu plana, acuminata. *Corolla* ad 17 mm. longa, extus superne parce papillosula; tubus 12 mm. longus; labium superum late ovatum, emarginatum; labium inferum supremum sequans, breviter 3-lobatum, lobis lateralibus ovatis, intermedio rotundato latissimo paulo breviore. *Stamens* thece æquales, subequaliter affixe, oblonge, obtuse. *Pollen* 49-53 μ longus, 36-39 μ diametro, plicis accessoris utrinque singulis, exinio tennissine punctato. *Capsula* oblonga, subacuminata, in stipitem subaequilongum attenuata, eo inclusu ciriciter 18 mm. longa, glabra. *Semina* 3 mm. longa, minute scrobiculata.

SARAWAK : at the foot of Mount Gading, north of Landu, Haviland, 988!

16. **H. frutescens**, *Stapf*.


CENTRAL BORNEO : Upper Kapuas Basin, on Mount Gagang in high forest, *Hallier*, 2837, 3071!
WEST BORNEO : on Mount Biang, near the Kapuas River, Teysmann, 7920.

17. **H. dispar**, *Stapf*.

Syn. *Ptyxisglosis dispar*, Hall. f. l. e. p. 220, tab. 15. fig. 4.
WEST BORNEO : Landak, near Ngabang, Teysmann, 11495.

18. **H. granulata**, *Stapf* (sp. nov.).

*Herba* humilis, procumbens vel e basi prostrata ascendens, sieca viridis, in parte superiore eximie anisophylla. *Caulis* superne villosulo-pubescentes,
A NEW GENUS OF ACANTHACEÆ. 17

imprimis in lineis binis e commissuris decurrentibus, inferne glabrescens, viridis, e nodis sepe radicans. Folia normalia petiolata, valde obliqua, elliptica, utrinque obtusa, 5–7·5 cm. longa, 2–3·5 cm. lata, supra glabra vel subglabra, in parenchymate ob cystolithos granulares scabro-punctata, in nervis striolata, in margine subundulato pilosula, subitus in nervis papilloso-furfuracea, nervis lateralis utrinque 5–7 curvatis: petiolus 2·5 mm. villosulo-pubescent vel glabrescent; folia redacta inferiora normalibus similia, superiora sub-sessilia, rotundato-ovata, basi cordata, apice subacuta, 5–8 mm. longa. Inflorescentiae axillares vel specie terminalis, breviter pedunculata, simplices vel bifurcatae, ob bracteas dense imbricatas strobiliformes; pedunculus 2–3 mm. longus; bracteae lineari-lanceolate, subulato-caudate, 5 mm. longae, herbaceae, nigrescentes, ad margines parce pilosulae; pedicelli ad 4 mm. longi. Calyx fere ad basin 5-partitus, ad 5 mm. longus, nigricans; segmenta lineari-subulata, acuminata, sparse pilosula. Corolla 12 mm. longa; tubus 8 mm. longus; labium superum late ovatum, emarginatum; labium inferum supera paululo longius, fere ad medium 3-lobum. Stamina thecae equales, equaliter affixae, basi acuta, 1·8 mm. longae. Pollen 50 μ longus, 35 μ diametro, plicis polos fere attingentibus, accessoris nullis, exinio sublævi.

SARAWAK: Lundu, Haviland's coll., 993 !


WEST BORNEO: Landak, Teysmann, 11509.

CENTRAL BORNEO: Upper Kapuas Basin, on Mount Gagang and on the banks of the Sanai Stream on the foot of Mount Amai Ambit, common in shady forest in damp soil, Hallier, 3095 !; on the Kapuas near Nanga Era Hallier.

There are at Kew several more specimens which evidently belong to Hallieracantha, but are too incomplete for accurate determination. They include probably one or two distinct species and were collected in Northern Borneo.
General Report upon the Botanical Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904 and 1905.

By Dr. A. B. Rendle, F.L.S.

[Read 20th December, 1906.]

The following is an account of the plants collected by Dr. W. A. Cunnington in the three great Central African lakes in 1904–5. The main object of the expedition was the investigation of Lake Tanganyika, which, on one view of its origin and previous connections, might be expected to show in its flora and fauna evidence of a marine affinity.

Dr. Cunnington arrived at Lake Nyasa early in June 1904, and spent about three weeks there; one week at the southern end, a week in ascending the lake, and a week at Karonga at the northern end. He collected, as far as possible in the short time, specimens to illustrate the flora of the lake, including algae scraped from rocks, and tow-nettings containing diatoms and other plankton. He then crossed the intervening plateau to Lake Tanganyika, the southern end of which he reached early in July. About eight months were spent on and around Lake Tanganyika; the first two months at the southern end, the remainder in cruising about and visiting the most interesting and likely places on the lake-shore. As complete a representation of the flora as possible was collected, including scrapings from the rocks, submerged stems of plants, and tow-nettings made at various places, times, and seasons. Leaving Tanganyika on March 18, 1905, Dr. Cunnington reached Bukoba, on the western shore of the Victoria Nyanza, on April 16. During a stay of ten days here and during a short stay at Entebbe, representatives of the water flora of the lake were collected and a few tow-nettings were taken.

The collections include about 45 species of the larger plants and more than 400 species and varieties of freshwater Algae, including Peridiniaceae.

The seed-plants and fern-plants, numbering respectively 30 and 4, are of no special interest. They include a number of widely distributed aquatics, such as Najas marina, Potamogeton pectinatus, P. javanicus, Vallisneria spiralis, Pistia Stratiotes, Ceratophyllum demersum, Myriophyllum spicatum, Jussiaea repens, Trapa bispinosa and T. natans, some of which were not previously recorded from these lakes; and marsh-plants such as Juncellus lavigatus, Fuirena glomerata, and Equisetum ramosissimum. The most interesting from this point of view is Myriophyllum spicatum, an almost cosmopolitan water-weed; the genus had not hitherto been recorded from Tropical Africa. Other species found are more or less widely distributed in Tropical Africa: such are Najas horrida, Potamogeton Schurinsfurtii, Ottelia lanceolata, several species of Utricularia, Azolla nilotica, Pycreus Mundtii, and Populanthus Wahlbergii, the last two being marsh-plants.
A few species, such as *Potamogeton Livingstonei*, only known from Lake Nyasa, *Boottia scabra*, previously found in the Nile and Gazelle Rivers, and now brought from Tanganyika, and *Xyris multicaulis*, a marsh-plant found in swampy ground at Bukoba, Victoria Nyanza, and previously known only from Namasi, in Nyasa-land, have a more restricted distribution.

The only remarkable plant is a new variety of *Fimbristylis* stolonifera, described by the late Mr. C. B. Clarke from swampy ground near the harbour, Bukoba, Victoria Nyanza; the species has only been previously recorded from India and China (Yunnan).

As shown in the accompanying table (p. 28) (in which two species of *Chara* are included), 16 species were collected at Lake Nyasa, 16 at Victoria Nyanza, and 27 at Lake Tanganyika. The fact that the larger number found at Tanganyika bears a small proportion to the much longer time spent there, suggests that there was not very much more to collect in the way of aquatic seed-plants, ferns, and Characeae. It is surprising, however, that the margins of the lakes yielded no Lemnaceae, as several species of *Lemna* and *Wolffia* are recorded from British Central Africa; nor Alismaceae, such as *Limnophyton*, known from several localities in Nile-land and the Mozambique district. The characteristic tropical African water-weed *Lagarosiphon* is also unrepresented in the collection; we may note, however, that a species, *L. Nyassa*, has previously been described from one of the lakes. Mr. Bennett remarks on the paucity of the number of species of *Potamogeton* found in the margins and bays of these lakes.

A comparison of the aquatic plants (omitting the Algae) from Lake Tanganyika with those from Lake Nyasa and Victoria Nyanza throws no light on any theory as to a difference of origin or conditions, present or past, in the case of Tanganyika as compared with the other two lakes. The true aquatics which were collected only in Tanganyika are the following:

(1) *Najas marina*, a cosmopolitan submerged plant which occurs in two of the Norfolk Broads and at other reputed brackish localities, but is also a common freshwater weed, occurring in the Swiss lakes, and plentiful generally in the lakes and rivers of the Continent of Europe.

(2) *Potamogeton pectinatus*, also cosmopolitan and also found in both brackish and fresh water. The leaves are submerged.

(3) *Ottelia lanceifolia*, a freshwater species with both submerged and floating leaves; widely distributed in Tropical Africa.

(4) *Boottia scabra*, a freshwater species with submerged leaves; recorded from the Nile and Gazelle Rivers in Central Tropical Africa.

(5) *Nymphea Lotus*, a water-lily; recorded from North and Tropical Africa and Madagascar.
(6) *Jussiaea repens*, a floating plant, widely distributed in fresh water in the warmer parts of the whole world.

(7) *Utricularia ezoleta*, widely distributed in fresh water in the warmer parts of the whole world; leaves submerged.

(8) *Chara zeylanica*, a submerged plant common throughout the tropics.

The swamp and marsh plants are also widely distributed and afford no evidence of any peculiarity in the conditions associated with Tanganyika as compared with the other lakes. The freshwater Algae, on the other hand, have yielded a rich harvest, as ably set forth by Mr. G. S. West. They include representatives of 101 genera and 367 species, of which one genus *Sphinctosiphon*, belonging to the Palmellaceae, and 34 species are described as new. Mr. Lemmerman, of Bremen, has worked out the Peridiniaceae, which comprise representatives of 4 genera and 5 species; two of the latter are new. The plankton from Tanganyika is of special interest, partly from the fact that no work has been previously done on the plankton from this lake, but especially from the great difference from that of Lake Nyasa and Victoria Nyanza, and the striking marine affinity of some of its constituents. Several of the species are usually marine or brackish in habit, and others more nearly approach marine than freshwater species, indicating in Mr. West’s opinion that at one time the lake must have approached marine conditions in the salinity of its water.

The most interesting part of the report is, as I have indicated, Mr. West’s account of the freshwater Algae, which forms an independent paper. In the determination of the higher plants I have to acknowledge the help of Mr. E. G. Baker, Mr. Arthur Bennett, Mr. A. Gepp, Messrs. H. & J. Groves, Dr. Stapf, and the late Mr. C. B. Clarke.

The plants have been presented to the Department of Botany, British Museum, by the Tanganyika Committee through Professor E. Ray Lankester, F.R.S., F.L.S.

**DICOTYLEDONS.**

**POLYGONACEAE.**


Widely distributed in the tropics of the Old World.

*P. lanigerum*, R. Br., var. *africanum*, Meissn. Lake Tanganyika.—Marsh close to shore, Komba Bay, Oct. 11. No. 34.

Tropical and South Africa.

*P. glabrum*, Willd. Lake Nyasa.—From swamp, Kota Kota, June 20. No. 6.

Widely distributed in the tropics.
NYMPHÆACEÆ.

(Mr. E. G. Baker.)

*Nymphaea ovalifolia*, Conard, Monograph, 150. **Lake Tanganyika.**—Swampy pond at Mbete, Sept. 28. No. 31. (In flower.) **Lake Nyasa.**—Swamp at Kota Kota, June 20. No. 5. Flowers bright blue.

Mr. Drummond, who has paid special attention to this genus, states: “I cannot exactly match these with anything in Herb. Mus. Brit., nor does it recall any specimens at Kew. The forms it seems to approach most closely are *N. ovalifolia*, Conard, and (ex descr.) a specimen of A. von Meckow’s, referred but rather doubtfully by Conard to his *N. Heudelotii* type. Pending more material these interesting specimens might be referred to *N. ovalifolia*, Conard.”


Previously recorded only from the Island of Zanzibar.


Central and South-west Tropical Africa.


Leaves broadly elliptical, margin remotely undulate-dentate. Differs from the type in the shape and margin of the leaf. In the type the leaves are generally circular in outline and the margin much more distinctly subspino-dentate. But the anthers are numerous and the connective is absent or very short and obtuse as in the type. Dr. Conard in his Monograph excludes the Indian and American plants which have previously been regarded as belonging to this species. North and Tropical Africa and Madagascar.

**CERATOPHYLLACEÆ.**


Widely distributed in temperate and tropical regions.
HALORAGACEÆ.

**Myriophyllum spicatum, Linn.** Lake Nyasa.—Swamp, Kota Kota, June 20. No. 10. Lake Tanganyika.—Taken shore-wading and in about 4 feet of water, Niamkolo, Aug. Nos. 18, 24.

Almost cosmopolitan, but not hitherto recorded from Tropical Africa, from where the genus also has not hitherto been recorded.

ONAGRACEÆ.

(Mr. E. G. Baker.)

**Jussima repens, Linn.** Lake Tanganyika.—Swampy pond at Mbete, Sept. 28. No. 30.

Warmer parts of the whole world.


Tropical Africa and Asia.

**T. natans, Linn.** Victoria Nyanza.—Floating on lake in sheltered bay near Entebbe, May 1. No. 64. Also found in the Upper Nile at 2° N. latitude by Speke & Grant.

Central Europe and Temperate Asia.

LENTIBULARIACEÆ.

(Dr. Otto Stapf.)


East and West Tropical Africa.

**U. exoleta, R. Br.** Lake Tanganyika.—Among other water-weeds in shallow water, mouth of Malagarasi River, Jan. 16. No. 611.

Tropical and South Africa, and widely distributed in the warmer parts of the Old World.

**U. reflexa, Oliver.** Victoria Nyanza.—Floating on surface of river, Bukoba, April 20. No. 55.

East and West Tropical Africa.

**U. stellaris, Linn.** Victoria Nyanza.—Sheltered bay near Entebbe, May 1. No. 620.

East and West Tropical Africa; also in South Africa, Madagascar, India, and Tropical Australia.
OF THE THIRD TANGANYIKA EXPEDITION.

COMPOSITÆ.

Common in Tropics.

VERBENACEÆ.

A common tropical plant.

MONOCOTYLEDONS.

NAIADACEÆ.

Najas marina, Linn. Lake Tanganyika.—Dredged in a few fathoms, Niamkolo Bay, Aug. 3. No. 17. A form verging towards var. muricata, A. Br.
Var. muricata, A. Br. Lake Nyasa.—In about 4 feet of water at Kota Kota, June 20. No. 9.
N. marina is a cosmopolitan species with numerous forms and varieties; var. muricata is recorded from North Africa (Algiers, Egypt) and Albert Nyanza; and outside Africa, from Sicily, Ceylon, and Australia.

N. horrida, A. Br. Victoria Nyanza.—Shallow water in harbour, Bukoba, April 20. No. 50.
Widely distributed in Tropical Africa; recorded from Lake Tanganyika.

POTAMOGETONACEÆ.

(Mr. Arthur Bennett.)


P. Livingstonei, Arth. Bennett. Lake Nyasa.—In about 4 feet of water, Kambwe Lagoon, June 27. No. 12.
Known only from Lake Nyasa. No fruit has yet been seen.

These specimens show a greater variation as to leaves and nervation than the original ones; the broadest are 17-nerved, whereas in the original specimens 13 was the largest number of nerves observed.

Confined to East Tropical Africa.


The only other **Potamogeton** I have seen from Lake Nyasa is **P. crispus**, Linn., collected by Kirk “In Roangiva (Loangiva?) river.” The species is widely distributed in all warm and temperate regions. In these great masses of water it is surprising that around their margins and bays there are so few of this genus. L. Nyasa especially looks like providing them, judging by the large map issued for the Railway.

**HYDROCHARIDEÆ.**


Widely distributed in Tropical Africa.

**Boottia scabra**, Ridl. **Lake Tanganyika**.—Growing in shallow water, mouth of Malagarasi River, Jan. 16. No. 46.

Previously recorded only from the Central African Nile district (Nile and Gazelle Rivers).


Widely distributed in the warm regions of both hemispheres.


Vegetative shoots only.

The species is widely distributed in the warmer parts of the Old World; the variety is recorded from India and East Tropical Africa.
Previously recorded only from German East Africa and the Shiré Highlands (near Zomba).

*K. Buchanani, C. B. Clarke.* **Lake Tanganyika.**—Swampy ground, Kibwesi, Edith Bay, Dec. 20. No. 39. This specimen differs from all the *K. Buchanani* known to me, in having two spikes to the head, not one, and in having the nut narrowly linear-oblong. There are several admitted species very close.
Nyasaland, and also in South Africa.

Frequent from Algiers to the Cape of Good Hope.

*Juncellus laevigatus, C. B. Clarke.* **Lake Tanganyika.**—Swamp by river mouth, Kirando, Dec. 1. No. 36.
Widely distributed in Tropical Africa, and found in all warm and temperate regions.

Widely distributed in Tropical Africa, and in the warm parts of the Old World.

*Fimbristylis stolonifera, C. B. Clarke, var. africana,* var. nov.; bractea inferiore 9 mm. longa; nucis humeris a squamis rotundis minutis verrucosis.
**Victoria Nyanza.**—From swampy ground close to harbour, Bukoba, April 26. No. 61.
A remarkable find as the species is known only from India and Yunnan.
There are only two species of *Fimbristylis* (out of about 120) that have a creeping root. As regards the squamellae on the shoulders of the nut (which are not present in the Indian *F. stolonifera*) I esteem them of small importance; for in the closely allied *F. diphylla*, Vahl, nuts without and with such squamellae are abundant.

**AROIDEÆ.**

Widely distributed in Tropical Africa and in the warmer regions of both hemispheres.
XYRIDACEÆ.

*Xyris multicaulis*, *N. E. Br*. **Victoria Nyanza.**—From swampy ground close to harbour, Bukoba, April 26. No. 62.
Previously known only from Namasi, Nyasaland.

ERIOCAULACEÆ.

*Paepalanthus Wahlbergii*, *Koern*. **Victoria Nyanza.**—From swampy ground close to harbour, Bukoba, April 26. No. 63.
East and West Tropical Africa; also in the Transvaal.

COMMELINACEÆ.

A common weed in tropical and warm regions.

PTERIDOPHYTA.

(Mr. A. Gepp.)

Also in Mozambique district and Madagascar.

Widely spread in Tropical Asia and Africa.

East Tropical Africa.

*Equisetum ramosissimum*, *Desf*. **Lake Tanganyika.**—Close to shore, near mouth of Lukuga River, Jan. 4. No. 42.
Warm temperate and tropical zones.

CHARACEÆ.

(Messrs. H. & J. Groves.)

Recorded in Africa from Suez, Damietta, Kordofan, and Dongola; also specimens in Herb. Kew from Tanganyika Plateau collected by A. Carson.

Known also from India, New Guinea, and North Australia.


A very small, tufted form of this extremely variable species, in habit resembling small compact C. aspera. It does not quite agree with any of the varieties described by A. Braun. It is about 3 in. high, with short, somewhat connivent branchlets; the spine cells are rather numerous, not exceeding in length the diameter of the stem. Branchlets 8–9. Segments about 8, the last 1–2 ecorticate. Bract-cells whorled. Fruit at the 2nd and 3rd nodes, sometimes at the 4th, rarely at the 1st, about 9–95 mm. long × 48 through, showing 11–12 striae. Nucleus 62 × 35, almost cylindrical, black, with well-developed calcareous covering.

No. 22 from Mtondwe Bay, Tanganyika, is a larger state of the same form.

It is young and without fruit.

C. zeylanica appears to be the commonest Chara throughout the Tropics.

It also occurs northward to the United States and Bermuda, and southward to Australia, New Caledonia, &c.

In Africa it reaches from Egypt southward to Madagascar, and from Angola to Somali-land.

The following Fungi, determined by Mr. V. H. Blackman, were collected on the rotten wood-stays of the canoe on Lake Tanganyika:—Polystictus sanguineus, Meyer, a common species in warm countries; a second species of Polystictus, the material of which is insufficient for specific determination; and Schizophyllum commune, Fr., a cosmopolitan plant.

In the following table I have added a few names of species not collected by Dr. Cunnington. Of true aquatics I find little to add; the number of marsh-plants might probably be still further increased, but these are of less interest.
LIST OF PLANTS FROM THE THREE LAKES.
(Those in *italics* were not collected by Dr. Cunningham.)

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Nyasa</th>
<th>Victoria Nyanza</th>
<th>Tanganyika</th>
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<tbody>
<tr>
<td>Polygonum barbatum</td>
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<td>X</td>
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<tr>
<td>P. lanigerum, <em>var. africanum</em></td>
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<tr>
<td>P. glabrum</td>
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<tr>
<td>Ceratophyllum demersum</td>
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<tr>
<td>Myriophyllum spicatum</td>
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<td>Nymphaea ovalifolia</td>
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<td>N. nanzibarensis</td>
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<td>N. calyciflora</td>
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<td>N. Lotus <em>forma</em></td>
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<td>Jussiaea repens</td>
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<td>Trapa bispinosa</td>
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<td>T. natans</td>
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<td>Utricularia Thomsingii</td>
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<td>U. exoleta</td>
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<td>U. reflexa</td>
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<td>U. stellari</td>
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<td>Spilanthes Acmella</td>
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<td>Lippia nodiflora</td>
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<td>Najas marina</td>
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<td></td>
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<td>var. muricata</td>
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<td>N. horrida</td>
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<tr>
<td>Potamogeton pectinatus</td>
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<td>P. Livingstonei</td>
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<td>P. Schweinfurthii</td>
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<td>P. javanicus</td>
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<td>Ottelia lancifolia</td>
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<td>O. alismoides</td>
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<td>Boottia scabra</td>
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<td>Vallisneria spiralis</td>
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<td>Hydrilla verticillata</td>
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<td><em>Lagarosiphon Nyasse</em></td>
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<tr>
<td>Kyllinga chrysanthus</td>
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<tr>
<td>K. Buchanani</td>
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<tr>
<td>Pyoreus Munditi</td>
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<td>Juncellus laevigatus</td>
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<td>Fuirena glomerata</td>
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<tr>
<td>R. pochyrhiza</td>
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<tr>
<td>Fimbristylis stolonifera, <em>var. africana</em></td>
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<tr>
<td>Scirpus littoralis</td>
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<td>Piptia Stratiotes</td>
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<tr>
<td>Xyris multicaulis</td>
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<tr>
<td>Paeplanthus Wahlbergii</td>
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<td>C. zeylanica</td>
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<td></td>
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<td>&quot; Characeae</td>
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<tr>
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(With 4 Text-figures.)

[Read 21st March, 1907.]

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INTRODUCTION.

The recent progress in our ideas as regards the phylogeny of the Gymnosperms, and more especially of the present day Cycads, led us, in 1903, to begin an enquiry into the origin of Angiosperms. During the last three years we have devoted considerable attention to the living members of this group, for it was thought that the attack could be best begun by taking as broad a survey as
possible of their varied types of fructification, with a view to determining which among them exhibit features that strike us as being of a more or less primitive nature. Having completed this study, we have endeavoured to test the accuracy of our conclusions by an appeal to such evidence as is presented by fossil botany. The result has been that our previously ascertained notions, as to the constitution of the flowers of comparatively primitive members of the group, have been found to agree to a remarkable extent with the facts presented by the fructifications of some, now well-known, Mesozoic fossils. So close is this agreement, that the phylogeny of the Angiosperms in its broad outlines seems to us to be sufficiently clear to permit of the construction of a working hypothesis towards its solution.

It appears to us that although the direct ancestors of the Angiosperms are as yet unknown in the fossil state, this line of descent can now be traced back to the great group of Mesozoic Cycadophyta, and to a hypothetical race of plants nearly related to the Bennettitaceae. There would seem to be good reasons to connect the Cycadophyta themselves with the Fern-like Spermophytes, or Pteridosperms, of the Palaeozoic period, and thus the Angiosperms, on our hypothesis, can be derived ultimately from an as yet unknown, fern-like ancestor, existing at a very early geological period.

In this connection the publication of Wieland’s full account of the ‘American Fossil Cycads’ has furnished us with data with regard to the Mesozoic Cycadophyta which, until recently, we did not possess, and to the author of this magnificent volume we would gratefully express our indebtedness for the material which he has placed at our disposal.

We have from the first recognized that what is called the problem of the origin of Angiosperms is in reality a plexus of problems. In addition to the evolution of the flower, there is the puzzling type of Angiospermous foliage, and many other questions to be explained in connection with this group. At the time when we commenced a consideration of this subject, there could hardly be said to be a clue to the mystery in which these matters were shrouded. In presenting this, the first definite hypothesis with regard to the phylogeny of the race, we are aware that many of the main points of our argument are devoid of novelty. Others, notably Hallier, have already brought forward arguments or facts, of which we have made free use in this attempt to fashion our theory.

The subject is a large one, and the present communication is to be regarded as a brief résumé of a discussion which we hope to elaborate more completely elsewhere. For the present we have contented ourselves with a statement of the main features of the problem, and its solution, with brief evidence in support of our views.

We would take this opportunity of expressing our sincere thanks to Dr. D. H. Scott, F.R.S., for many suggestions during the past three years, and for the interest he has taken in the progress of the work.
HISTORICAL.

The great race of plants, commonly referred to as the “Flowering Plants,” differ so obviously from the rest of the Vegetable Kingdom, that they were recognized, comparatively early in the history of botanical study, as forming a distinct group, and for a long time attention was almost entirely concentrated on them.

The stamens and carpels were soon identified as the male and female organs respectively, and by the close of the 17th century Camerarius had shown that reproduction by means of seeds depends on the male element, the pollen, reaching the receptive part, or stigma, of the female organ; though what exactly happens in the process of fertilization remained mere guesswork until many years later. This establishment of the sexual theory of reproduction in Flowering Plants led to the subdivision of the Vegetable Kingdom, by Brongniart in 1843, into two great groups, the Phanerogams and the Cryptogams, the latter still being incorrectly regarded as devoid of sex, and as possessing a ‘cryptic’ type of reproduction.

The researches of Robert Brown led to the distinction of Gymnosperms as opposed to Angiosperms, though for many years the former were commonly looked upon as a detached group or appendage of the Dicotyledons, with the consequence that the terminology of the flower came to be applied to their very different kind of fructification. Hofmeister’s classical researches, published in the years 1849 and 1851, completely broke down the barrier separating the Phanerogams from the Cryptogams; in fact these terms were no longer applicable in their original sense, for their meaning had become reversed, since the Flowering Plant was found to be more ‘cryptogamic’ as regards its manner of sexual reproduction than the Fern. The alternation of generations, so clear in the Pteridophytes, was shown to be also present in both Gymnosperms and Angiosperms. The male and female prothalli of the heterosporous Vascular Cryptogams had their very reduced representatives in the pollen-grain and embryo-sac respectively of the Phanerogams.

These discoveries, followed so closely by the publication of Darwin’s ‘Origin of Species,’ gave a great impetus to the evolutionary hypothesis as applied to plants, and a great stimulus to phylogenetic speculations.

Though the various parts of the embryo-sac of the Conifer could be interpreted in terms of the female prothallus of a heterosporous Pteridophyte, investigations of the corresponding organ of the true Flowering Plant (either Monocotyledon or Dicotyledon) failed to show any such clear homologies. In other words the gap that originally existed between the Phanerogams and Vascular Cryptogams was now bridged, and in its place there appeared a wide gulf between the Conifers and true Flowering Plants, or more exactly between the Gymnosperms as a whole and the Angiosperms.
The subsequent tendency of various lines of research, until quite recently, has been on the one hand to draw closer together the ties of relationship existing between Gymnosperms and Pteridophytes, and on the other hand to increase the isolation of the Angiosperms. For instance, one of the most important embryological facts, recently brought to light, linking together the Gymnosperms and the Pteridophytes, is the formation of antherozoids in the pollen-tubes of Cycas and Ginkgo.

Much work has been done on the embryo-sac of Angiosperms, primarily with the hope of throwing light on the question of its homologies, and the line of descent of the group. Practically every Angiospermous family, which is of interest phylogenetically, has now been examined, including quite recently the Magnoliaceae. The outcome of the whole of this vast investigation has merely emphasized the great difference which exists between the Angiospermous and Gymnospermous embryo-sacs, and in addition the great similarity between those of the Dicotyledons and the Monocotyledons. Variations do occur, but these appear to us to be points of detail rather than of fundamental importance. In fact they are of such a kind that it is uncertain whether they should be best regarded as primitive or as recently acquired. This is particularly true of the antipodals, a group of cells more variable perhaps than any of the other constituents of the embryo-sac. Though the net result of these studies has so far not enabled us to bridge the gap between the Angiospermous and Gymnospermous embryo-sacs, and in addition the great similarity between those of the Dicotyledons and the Monocotyledons, yet additional discoveries of great interest have been made, e.g. double fertilization and chalazogamy. The former seems to increase rather than to diminish the difficulty of explaining the Angiospermous embryo-sac and especially its endosperm in terms of the fern-prothallus, or the female gametophyte of the Gymnosperm.

Turning now to palaeobotanical work, the main result has been the same. Remarkable fossils have been found connecting the Gymnosperms more closely with the Ferns, but anything of a like nature bearing on the Angiosperms has remained hidden. The rocks have been singularly silent as regards the origin of the latter group, now predominant in the vegetation of the world.

The existing Cycads, and less clearly the Conifers, have been linked up with the Ferns by means of the anatomical investigations of certain Palaeozoic petrified stems possessing fern-like characters, known as the Cycadofilices, and by the discovery of the seeds and male fronds of these plants. The old idea of connecting the Gymnosperms with the Lycopsods is now no longer tenable, at any rate so far as the Cycads are concerned. The Angiosperms, on the other hand, have been considered to have sprung from the Ferns; yet no work on the existing Filices has shown any direct connection between the two groups. It is true that Isoetes has been brought forward as revealing in the mode of origin of its stem, root, and first leaf, as well as in its adult

* Strasburger (1905).
† Campbell (1891) pp. 253-254.
the origin of angiosperms.

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Vegetative features, points of close resemblance to certain Monocotyledons, but to build a relationship upon such slight evidence appears to us hardly worthy of serious consideration. In fact Campbell himself says*: "There is, however an immense interval between the flower of the simplest angiosperm and the porophylls of Isoetes, and it would be rash to assume a relationship unless more evidence can be produced on the side of the angiosperms to warrant this.

It is generally held that when we first meet with fossil Angiosperms in the Mesozoic rocks, the leaf-impressions closely resemble those of existing genera. Whence they sprang has hitherto remained a complete mystery.

Saporta and Marion †, some twenty years ago, in their work entitled L'Évolution du Bâge végétal, brought into use the term Proangiosperms for a hypothetical group of extinct plants which gave rise to the modern Monocotyledons and Dicotyledons. They went even further, and included such fossils as Will blomonia among the members of this group. These suggestions we think were particularly happy, considering the material then at their disposal. I the main palaeobotanical science at the present time supports them.

A brief reference must be made to the supposed connection between the Angiosperms and the Gnetaceae. Of all the existing Gymnosperms, this particular group has long been considered to show the largest number of features in common with the true Flowering Plants. Attempts, however, to establish a clear relationship have not met with much success.

Lotsy ‡, from an embryological study of Gnetum, came to the following conclusions. The group appears to be of very ancient origin, it probably arose independently of the other Gymnosperms direct from the heterosporous Pteridophytes, and, moreover, has not given rise to any single Angiosperm.

Lignier §, more recently, from a general examination of the Gnetacean fructifications, also decides against any direct relationship. He says that such a complex inflorescence as that possessed by the Gnetaceae cannot be held to show any affinity between this group and the simplest Angiospermous flower. Hence he concludes that the Gnetaceae are not intermediate between the Gymnosperms and Angiosperms.

Miss Benson ||, on the other hand, since the publication of these two memoirs, has endeavoured to bring the floral morphology of this group into line with that of the Angiosperm. She suggests that the suppression of the internodes in the inflorescence of Gnetum may have been carried still further, so that the whole is reduced to a conical torus, that is to a structure resembling the receptacle of a flower like Liriodendron. This seems a complicated, and hardly justifiable hypothesis, for there is no evidence to

* (190) p. 254. † Saporta & Marion (1885).
‡ Lotsy (1899). § Lignier (1903).
|| Benson (1904).

Linn. Journ.—Bot. Any, Vol. XXXVIII.
show that such simple flowers as those possessed by the Magnoliaceae are in reality compound structures, i.e., very compressed inflorescences. Everything points in the other direction, namely that the sporophylls (stamens and carpels) are borne directly on the main axis of the floral shoot.

Hallier *, quite recently, has suggested a possible connection between the Gnetaceae and the Loranthaceae. Though agreeing in the main with his phylogenetic views respecting the Flowering Plants as a whole, we are inclined to regard this as a somewhat rash, though ingenious speculation; especially because it necessitates, as he admits, the nucellus of Gnetum being regarded, not as a single ovule, but as a placenta bearing several ovules.

Finally, then, we may conclude that the study of the Gnetaceae does not, and does not seem likely to, help us in understanding the phylogeny of existing Angiosperms. It would appear more probable that a knowledge of the descent of the latter, obtained from other sources, will itself shed light on the relationships of the former.

From a discussion on the vascular structure of seedlings, at the last meeting of the British Association at York †, the inference may be drawn that some help will be forthcoming from this line of study towards solving the problem of the origin of the Angiosperms. So far, the examination of the "transition" phenomena in seedlings has led Mr. Tansley and Miss Thomas to regard the simple type met with in the Dicotyledons, and most of the Coniferae, as derived by reduction from the more complicated one found in the Cycads and the Araucariae.

Thus, by way of summary, it may be said that no definite theory, as regards the origin of the Angiosperms, has up to the present been elaborated. The views put forward from time to time have been more of the nature of casual suggestions. The problem has not yet been separately treated as a whole, in all its bearings. The morphologist has perhaps hitherto inclined only to a comparison between living members of the race, with neglect of the fossil evidence. The palaeobotanist, in approaching the subject, does not appear to have arrived at any clear conception of what may be considered the primitive features of living Angiosperms.

In concluding this section of the paper, it is interesting to note that this unsolved problem has its parallel in the Animal Kingdom. The origin of the highest group, the Mammalia, still remains largely problematical.

PRINCIPLES OF EVOLUTION.

Before discussing what we regard as the primitive forms of the various organs of the Angiospermae, we would emphasize briefly certain principles connected with evolution to which we attach considerable importance when attempting to trace the phylogeny of living or extinct races.

* Hallier (1905).
† Anonymous (1906) p. 182.
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The Law of Corresponding Stages in Evolution.

If we study the stages in evolution reached by the different organs of a seed-plant at any one period, we shall find that they are dissimilar. Some are obviously more highly evolved than others. Corresponding stages in the evolution of the various members of a seed-plant are not contemporaneous in point of time. Conversely, at any one period in geological time, one organ or set of organs will be found to have reached a far higher stage of evolution than another.

The study of fossil botany has afforded numerous instances of the truth of this principle. The foliage of the Pteridospermeae, as also the habit of the stem, is essentially fern-like, though the female organ is a seed. The male organs (Crossotheca) of Lyginodendron are obviously far less highly evolved than the female (Lagenostoma). The former is essentially a simple fern-like fructification, the latter a highly evolved seed.

Or, again, to turn to the Bennettitaceae, the Mesozoic descendants of the Pteridospermeae, the microsporophylls are still essentially fern-like fronds, while the megasporophylls are of an extremely advanced type. The trunk habit of these plants also shows scarcely any modification as compared with that of a Paleozoic tree-fern.

Or to turn to recent plants. The fern-like foliage of the Cycad Stangeria is associated with highly-evolved strobili. Again, the female sporophyll of Cycas is more primitive than the male, and its fern-like origin is still traceable.

Other instances might be quoted*, but the above may suffice. It follows from this law that there was never in existence such a plant as a really primitive Angiosperm, in the sense that all its organs were equally of a primitive nature. On the contrary, the earliest Angiosperms were no doubt characterised by possessing some members much more highly evolved than others. There is reason to believe that the Angiosperms were derived from other seed-plants, but that the seed, in itself a highly evolved structure, originated at a much more remote period.

We believe that the application of this principle will be found to be of great service in such considerations as the present. At a later stage (p. 70) we propose to demonstrate by its aid the probability that the earlier Angiosperms still retained the megaphyllous foliage of their ancestors; a supposition which will explain several puzzling facts.

Homoplasy.

It is well recognised that one of the great difficulties to be faced in attempting to trace the phylogeny of living groups lies in the tendency to error, arising from laying stress on certain features as indicative of close

* See Wieland (1906) p. 244, who has also discussed this law.
relationship, which are more probably simple expressions of parallelism of development. Sometimes the issue is so obscured by numerous instances of homoplasy, that it is difficult to arrive at any sure conclusion. The broad question of the phylogeny of Angiosperms, however, seems to us to be remarkably free from embarrassment in this respect.

Mutation.

While we regard the course of evolution as for the most part a slow and gradual process of variation, we are prepared to admit that, now and again, abrupt and discontinuous phases * occur. The same conclusion holds in regard to theories connected with inorganic evolution. Catastrophism has been replaced by uniformitarianism, which in turn is succeeded by a theory, which admits that, at certain periods, the forces of nature may have been working at a greater intensity than they are to-day.

There is a bare possibility that mutation may have been concerned with the evolution of the Angiosperms themselves, for the suddenness with which this group rises to the position of a dominant type in the flora of the Cretaceous and Tertiary periods is perhaps difficult to explain on any other hypothesis, unless we accept the theory of the imperfection of the geological record in this instance.

One of the great difficulties which arises from our still highly imperfect knowledge of the Mesozoic floras is that at present, in the great majority of instances, we are familiar only with the foliage of these plants. Among such leaf impressions, the absence of any conspicuous intermediate forms combining features common to the Angiosperms and any other group is remarkable, and this evidence, though not perhaps of great importance, may admit the possibility of mutation rather than of gradual variation (see p. 71). On the other hand, too free a use of this principle is not to be favoured, else there is a distinct danger that mutation may become the last resort of the phylogenetically destitute.

PRIMITIVE FEATURES AMONG LIVING ANGIOSPERMS.

THE STROBILUS THEORY OF THE ANGIOSPERMOUS FRUCTIFICATION.

The basis of our theory as to the nature of a typical Angiospermous flower is that such a fructification consists essentially of a strobilus or cone †. We regard the simpler, unisexual flowers, including apetalous forms, as derived from an amphisporangiate ‡ strobilus by reduction. The term "flower" has

* De Vries (1901, 1905).
† Coulter & Chamberlain (1904) p. 9.
‡ The terms "bisporangiate" and "ambisporangiate" have been used by Wieland and other authors. We regard these terms as open to objection, and propose to adopt "amphisporangiate" in their place, as the antithesis of "monosporangiate."
been used in a great variety of senses*. We would, however, restrict its application to the Angiosperms alone, since it was from these plants that the idea expressed by the word originally arose. In our opinion extra-seminal pollination, in which the carpel or carpels play the chief part in the pollen collection, is the essential feature of a hermaphrodite, or female flower. We regard a flower as typical when it possesses both micro- and megasporangia, as well as a perianth which in many cases has an attractive function.

A flower, on our view, is a *special form* of a type of strobilus, which is common both to the Angiosperms and to certain Mesozoic plants, and which may be termed an *anthostrobilus*. The anthostrobilus of hypothetical Mesozoic ancestors of the Angiosperms, and of their supposed near relatives the Bennettitea, differed from the flower of the Angiosperm in certain important respects, especially in the presence of direct pollination, in which the megasporophyll played no part. It may perhaps be useful to distinguish it as a *Pro-anthostrobilus*, and the Flower proper, a term here restricted, as an *Eu-anthostrobilus*.

\[
\text{Anthostrobilus} \left\{ \begin{array}{l}
\text{Pro-anthostrobilus of Mesozoic Ancestors and Bennettitea.} \\
\text{Eu-anthostrobilus (Flower) of Angiospermea.}
\end{array} \right.
\]

The necessity for these new terms arises from the fact that the word "flower" has been applied in many different senses, for instance even to the strobili of the Coniferales. Also because, as we hope to show here, the Angiosperms are descended from Mesozoic ancestors nearly related to a group of fossil plants, whose fructification is now well known, and indeed has been, though as we think inaccurately, termed a flower.

We shall discuss at some length at a later stage the evidence for the derivation of the Eu-anthostrobilus from the Pro-anthostrobilus—types of cones which we believe represent different stages in the evolution of the fructification of one and the same line of descent.

The strobilus or cone is of course a very ancient type of fructification, common to many distinct, and only very remotely related lines of descent. Other forms of strobili were borne by plants which flourished at a very much earlier period in geological time than the anthostrobilate races discussed here. The anthostrobilus is distinct from any of these, and it is, in all probability, the newest modification or creation of the strobilite form of fructification, in point of geological time. It differs from all other strobili in that it is typically amphisporangiate, by the megasporophylls being invariably aggregated on the axis of the strobilus above the microsporophylls (i.e. nearer the apex of the cone), and by the presence of a distinct perianth, below the fertile sporophylls, whose function is apparently wholly, or partly, of a protective nature. In

* Coulter & Chamberlain (1904) p. 9.
other words, the protective office, which in the strobili of many Pteridophyta is performed by the aggregate of the fertile sporophylls themselves, is, in the anthostrobilus, localised towards the base of the cone, and performed by sterile members. In order to bring out more clearly the essential features of the anthostrobilus, we may compare it briefly with a heterosporous cone of an ancient type, such as that of Lepidodendron Hibbertianus, Binney *, from the Lower Carboniferous of Scotland.

<table>
<thead>
<tr>
<th>Elongated axis</th>
<th>L. Hibbertianus, Binn.</th>
<th>Anthostrobilus.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megasporophylls situated</td>
<td>basally as regards the microsporophylls.</td>
<td>apically as regards the microsporophylls.</td>
</tr>
<tr>
<td>Protective function performed by</td>
<td>distal extremities of both types of fertile sporophylls.</td>
<td>sterile, basal, leaf-like organs.</td>
</tr>
</tbody>
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**ENGELER'S THEORY.**

The Strobilus Theory of the nature of the typical Angiospermous flower is not by any means a new one †, though it differs in toto from that generally accepted by systematists at the present time. According to current notions, widely but not universally adhered to, the primitive type of Angiospermous fructification is to be sought for among the unisexual Apetalae, which, on our view, are forms reduced from amphisporangiate strobili, in each case possessing a perianth.

This prevailing opinion, for which Engler ‡ is largely responsible, has been too readily accepted § as a self-apparent axiom, before careful examination of its truth has been made.

In a recent authoritative discussion of this question, Coulter and Chamberlain || state that as a consequence of the now "discarded doctrine of metamorphosis . . . it has been a very prevalent conception, therefore, that flowers of simpler structure than the assumed type are reduced forms. There are certain cases in which this seems clear . . . but the vast majority of simpler flowers are better regarded as primitive than as reduced forms."

On the other hand there have not been wanting others ¶, especially Hallier **,

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* See Scott (1900) p. 162, fig. 65.
† Coulter & Chamberlain (1904) pp. 9 & 10.
‡ Engler (1897) p. 358.  § Chamberlain (1897).
|| Coulter & Chamberlain (1904) p. 10.
¶ Henslow (1893) p. 485; Čelakovský (1897).
** Hallier (1901, 1901', 1903, 1905).
who have already upheld the view maintained here. Goebel *, in particular, regards the amphisporangiate condition as primitive, and the monosporangiate as derived from it.

It will be necessary here to examine somewhat at length the evidence for the assumption that certain naked flowers may be regarded as primitive, and the consequent corollary that their near relatives, with insignificant perianth, are derived from them.

The main departure of Engler's and Eichler's systems of classification from that of Bentham and Hooker consists in the abolition of the large group Monochlamydeae or Incompletae, and the distribution of its families among the Polypetale, making one large series, the Archichlamydeae or Choripetale; without question a move in the right direction. At the same time both Engler and Eichler cease to regard the Ranales (Polycarpaceae) as the starting point of existing Dicotyledons. They commence their systems with plants possessing flowers composed of few parts, especially the Piperaceae and its near allies, and also with the Amethystiferous families. Their scheme of classification then gradually advances from plants with naked flowers to others possessing an insignificant sepaloid perianth, and finally to such orders as the Caryophyllaceae with a well-marked calyx and a conspicuous corolla. From this point of view, the gradual evolution and differentiation of a perianth can be traced in a general way.

Three objections of considerable weight can be advanced against this theory. In the first place, it must be assumed that the perianth is evolved de novo, and is an organ sui genera. Secondly, in many of the groups regarded as primitive, e. g., Piperales, Amentifere, and Pandanales, the inflorescence is a sharply defined and often a highly complicated structure. Lastly, such a theory has so far proved barren from a phylogenetic standpoint, especially when the attempt is made to bring into line evidence derived from the study of fossil plants.

We may now briefly examine the cohorts which Engler regards as showing primitive features.

**Piperales.**

This cohort is placed first in Engler and Prantl's system, and includes four orders, of which only the Piperaceae is well represented by the species of two genera *Piper* and *Peperomia*. A survey of its members suggests that its flowers are fashioned, for the most part, on the trimerous plan, with two whorls of stamens and three carpels. No one would argue that a species of *Piper* with only two stamens has preceded one with six, nor that one with three carpels has been derived from an ancestor with a single carpel. Nor is it to be supposed that a genus like *Chloranthus*, with a single tepal, has given rise to one

---

* Goebel (1905) p. 528.
like *Lacistema*, with a complete perianth whorl. It is much more natural to suppose that the other members of the whorl have been aborted, and that such genera as *Piper* and *Peperomia* have been evolved by further reduction, during which the perianth has disappeared altogether. In the monotypic genus *Lactoris*, placed by Engler in the Ranales, but by Bentham and Hooker, among others, in the Piperaceae, can be found a synthetic type linking these two cohorts together *.

Thus, in our opinion, the more obvious and plausible view is that the Piperales branched off, probably at an early period, from the Ranales, and, as in the case of many other Angiosperms, have suffered considerable reduction in the individual flower, so much so that in many instances they have lost their perianth. This line of evolution appears to have progressed side by side with a tendency to aggregate the flowers into dense spikes; the bracts assuming more and more the functions originally performed by the perianth. In a few of the Piperales the grouping of the flowers has advanced a stage further. In the Peppers of the section *Potomorpha* the spikes are arranged in umbels. Such compound inflorescences surely are hardly characteristic of "plants of low organisation" †.

Both the recent studies of the seed-development of the Piperales by Johnson ‡, and of the seedling-structure by T. G. Hill §, have led these authors to conclude that this is not to be regarded as a primitive cohort.

Amentiferae.

The term Amentiferae is used here, for the sake of convenience, to include those families of trees characterized by unisexual flowers—or at least the male flowers—crowded together into very dense and definite inflorescences known as catkins; a type of inflorescence which is shed entire, and thus functions largely as a single flower. In some families, e.g., those included in Engler's cohort Fagales, the catkin is of a highly complex and compressed nature—a feature hardly suggestive of primitiveness, but rather of a reduction in the component parts. In such, a suppression of the perianth might naturally be expected.

*Salicaceae.*—This family consists of two genera only, *Salix* and *Populus*, the one entomophilous, the other anemophilous. Divergency of opinion exists as to whether the entomophilous habit of *Salix*—an almost unique occurrence amongst the Amentiferae—is to be regarded as a primitive feature, or one derived from a Poplar-like ancestor by a change in the method of pollination.

Chamberlain ‖, from an embryological study, concluded that the genus

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* Hallier (1901). † Willis (1904) p. 515. ‡ Johnson (1905).
§ Hill, T. G. (1906). || Chamberlain (1897).
Salix is primitively unisexual, dioecious, and naked. Robertson *, on general grounds, considers Populus the more recent genus.

On the other hand, the opposite view has been maintained, and has quite recently received strong support from Haines'† descriptions of two new species of Indian Poplars. One of these, Populus glauca, Haines, frequently possesses hermaphrodite flowers with an undoubted perianth.

To us it appears to be the more reasonable view to regard Populus as the older genus, and Salix as derived from a Poplar-like ancestor at a more recent period. On this view, Populus glauca has retained more primitive features than the other species, and thus departs less from the ancestral type, while the entomophily of Salix is but a recently acquired character. It also implies the derivation of a flower such as that of Salix, which has only two stamens and never more than two carpels, by reduction from a plant like Populus, possessing many stamens and sometimes more than two carpels. At the same time, we regard Populus itself as not primitively anemophilous, but derived originally, with the other Amentiferous families, from entomophilous ancestors.

Another fact to be taken into consideration in this connection is that, at the present day, the genus Salix is largely represented by species, whereas Populus contains comparatively few. The former thus appears to be a plastic up-grade type, as is further emphasized by the ill-defined nature of many of its species. The re-adoption of entomophily has possibly been the saving of the Willows.

Casuarina.—For those who uphold the view that some of the present day Angiosperms without perianth are primitively naked, this genus has been perhaps the most promising. In several features it strongly suggests the retention of archaic structures. Attempts have been made to separate it entirely from the rest of the Dicotyledons. Treub's‡ suggestion, based on the initial discovery of chalazogamy, broke down when the fact was ascertained that many of the Amentiferae, as well as other groups, also exhibit this mode of fertilization. On the other hand, Engler § regards Casuarina, which he places in a new cohort Verticilata, as the most primitive of Dicotyledons, from the fact that many megaspores are found within the nucellus. In the light, however, of recent research this conclusion is by no means justified, for Chamberlain || finds that more than one megaspore occasionally occurs in Salix. Still more recently Shoemaker ¶ has shown that in Hamamelis several megaspores are found. Frye's** study of the embryo-sac of this genus has demonstrated that it is quite of the usual type, and does not differ as regards

* Robertson (1904). † Haines (1906).
¶ Shoemaker (1905). See also Coulter & Chamberlain (1904) p. 242.
** Frye (1903).
the presence of antipodals, or the time of endosperm formation, from that of other Dicotyledons, as Trevb supposed. It has been further suggested, within the last year, on embryological evidence, that *Casuarina* is closely related to *Carpinus*, and may be placed within the Betulaceae as a group of equivalent rank with the Corylaceae *.

Consequently, on such arguments as have been brought forward, we fail to find conclusive evidence that the flower of *Casuarina* is essentially of a primitive nature. Nor does the position of the group now appear to be isolated.

**Fagales.**—The perianth of the female flower, when present, is superior and somewhat gamophyllous. These are not likely to be the characters of a primitive perianth. Besides, the syncarpous inferior ovary does away with any idea of primitiveness as regards the whole flower. The inflorescence is also especially complicated. Similar considerations apply equally to the Juglandales.

We are inclined to adopt Hallier’s † view, that this group can be connected with the Hamamelidaceae, and thus with ancestors possessing hermaphrodite flowers and biseriate perianths. On this supposition, the perianth of the Fagales may probably be regarded as a survival of the calyx, the corolla having disappeared completely.

**Monocotyledons.**

Among the Monocotyledons we find certain genera which may very possibly be ancient types, without, or with a only very insignificant perianth. Hence the question arises whether these plants were originally without such an envelope.

**Pandanales.**—To this group, regarded as among the most primitive by Engler ‡, and also by Coulter and Chamberlain §, we think the same arguments apply as in the case of the Piperales and Amentiferous families. The inflorescence is of a very dense and sharply defined nature. In the Pandanaceae the individual flowers are difficult to make out, bracts and bracteoles being absent. It seems much more probable that in this case the perianth of the individual flowers, as well as the bracts and bracteoles of the inflorescence, have totally disappeared, and the internodes of the floral axis become greatly reduced, with the result that the individual flowers, especially the male, have become so merged together that they can hardly be distinguished from one another. Consequently we are inclined to think that the Pandanaceae branched off at some early period from the main line of the Monocotyledonous descent, and are thus capable of being derived from an ancestor with hermaphrodite flowers and a well-developed perianth.

**Araceae.**—In the interpretation of the Araceous flower we are in general agreement with Engler. He regards those members of the family with few

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* Benson, Sanday & Berridge (1906) p. 43. † Hallier (1903).
‡ Engler (1897) p. 380. § Coulter & Chamberlain (1904) p. 228.
floral parts as reduced. Here the gradation from hermaphrodite flowers with a complete perianth to unisexual naked types presents all stages of reduction. At the same time we can trace the evolution of a complicated inflorescence. The attractive function of the perianth in a less highly evolved genus, such as *Acorus*, is transferred in many of the higher members to the spathe, which may become petaloid and envelop the whole inflorescence. In fact the inflorescence practically comes to function as a single flower.

Here we find our opponents adopting the very views which we, in common with Hallier and others, urge as applicable to all such cases where naked flowers are aggregated in dense inflorescences. If *Acorus* and its near allies were non-existent, would this interpretation of the family have met with equal acceptance? Because these stages cannot be so easily traced in other groups such as the Piperales and Amentiferae, the absence of a perianth in these flowers has been too readily accepted as a primitive feature.

Though Engler regards the hermaphrodite flowers of a genus like *Acorus* as the most primitive types in the order, Campbell *, on the other hand, has decided that the unisexual flower, with a single carpel and a solitary basal ovule, e.g., *Spathicarpa*, *Adonoeama*, and *Nephtthytis*, is really the least highly evolved. This conclusion, based on embryological considerations, appears to us to rest on far too slender evidence, especially in view of the fact that no general agreement exists as to which features presented by a study of the embryo-sac may be regarded as primitive.

The Primitive Form of the Organs of the Eu-anthostrobilus or Flower.

We have seen that Engler and others regard certain orders, where the flowers are devoid of perianth and often unisexual, as the more primitive members of both existing Dicotyledons and Monocotyledons. But it must not be overlooked that Engler’s Theory, like the Strobilus Theory discussed here, is but a working hypothesis, the truth of which is to be sought for in its application. The, at present, prevailing view has the merit of simplicity. We start with something simple, and from it derive the more complicated types of flowers, possessing a biseriate perianth, and at the same time the hermaphrodite or amphisporangiate condition. But its application as a working hypothesis does not assist us in our search for a clue to the phylogeny of the Angiosperms as a whole. Nor does it help to bring this group into line with any of those now known to us in the fossil state. On the other hand, the Strobilus Theory, which postulates that the monosporangiate Apatæ were derived by reduction from an amphisporangiate strobilus possessing a distinct perianth, leads us back naturally to a great group of Mesozoic plants, the Bennetiteæ, which afford the key to the ancestry of the race in question.

* Campbell (1905).
In trying to arrive at some conclusion with regard to the primitive form of the various organs of the Angiospermous strobilus, we have found it helpful to endeavour to conceive a mental picture of a flower in which all the members were alike primitive. We, however, by no means wish to infer that such a flower ever existed, for, as we have pointed out above (p. 35), this would be contrary to the general trend of evolution, since corresponding stages in the differentiation of the various organs of a seed-plant, at any one point of time, are dissimilar. Such a strobilus (see fig. 1) would consist of a large, elongated, conical axis bearing megasporophylls above and microsporophylls below. At the base of the cone, a well marked perianth would be found, consisting of sterile, leaf-like members, affording protection to the cone as a whole, and playing some part in the mechanism for insuring cross-fertilisation by adding to its conspicuousness. All the organs of the cone would be of large size, numerous or indefinite in number, and spirally arranged. The cone would be solitary, borne either terminally or axillary.
The gynaeceum would consist of an indefinite number of carpels forming apocarpous, monocarpellary ovaries, each containing several ovules, with marginal placentation. There would be no style. The stigmatic surface would be more or less confined to the apex of the carpel, and would probably be of a sticky nature, or the apex of the carpel may have remained slightly open, as in the modern Reseda. The ovule would be orthotropous, with two integuments. The carpel would dehisc by the ventral suture, and the seeds be distributed by simply falling from the carpel, or being shaken out of it by the wind. The embryo would germinate within a short period after fertilisation, and would possess two epigal cotyledons.

The androcium would comprise an indefinite number of stamens, with long anthers. The filaments would be short, and the connective produced beyond the anther as a slight expansion.

The perianth would consist of numerous, spirally arranged members, either all similar in form, colour, etc., or somewhat differentiated, with an inner petaloid series serving both as an attractive and protective organ.

The mode of fertilisation would be by means of entomophilous, the pollen-collecting mechanism being performed by the carpels.

It will thus be seen that we regard polypetal, hypogynous, and apocarpy as primitive conditions, antecedent in point of time to the more highly evolved states, in which cohesion and adhesion of similar or dissimilar organs is to be found.

As we have pointed out, there is no reason to believe that any Angiosperm with a complete assemblage of primitive floral characters is to be found to-day, nor indeed that such a flower ever existed. On the other hand, there are many Angiospermous flowers which retain one or more primitive features. According to our view, the greatest number are exhibited in the families Magnoliaceae, Ranunculaceae, Nymphaeaceae and Calycomaceae, amongst Dicotyledons; and Alismaceae, Butomaceae and Palmaceae, amongst Monocotyledons.

Magnoliaceae.

In this family we find an elongated receptacle, bearing an indefinite number of stamens and carpels, which are spirally arranged. The form of the stamen, with its long and broad connective, continued below as a very short filament and above as a sterile apex, is also a primitive feature. The perianth of the members of the two tribes Schizandreae and Illiciaceae consists of many tepals, spirally arranged. In the tribe Magnoliceae however, it is cyclic, and sometimes in three definite whorls; a stage obviously derived from the preceding. In the allied Anonaeeae this arrangement is generally characteristic.

* See also Bossey (1897).
Certain members of this alliance also retain a primitive feature in the homosxyloous character of the wood, e.g., *Drimys, Tetracentron* and *Trochodendron* *. This family has already been instanced by Hallier † and others as showing a comparatively large number of primitive characters. The recent study by Strasburger ‡ of the embryo-sac of *Drimys* has shown, however, that it practically does not depart from the stereotyped form common to nearly all Angiosperms.

*Ranunculaceae.*

Some members of this family present primitive features in the form of the receptacle and perianth, as well as in the fact that the numerous stamens and carpels are spirally arranged. The perianth of this group is also in many cases of a primitive nature, though often petaloid and sometimes clearly differentiated into calyx and corolla. In addition, honey-leaves, the homologues of fertile microsporophylls, may be present.

*Nymphaeaceae.*

In the members of this family, especially in the genus *Nelumbium*, we find numerous stamens of a similar form to those of the Magnoliaceae, as well as certain features in connection with the perianth, which we regard as fairly primitive.

*Calycanthaceae.*

The numerous, spirally arranged stamens and carpels, and the large number of perianth members may be regarded as primitive features.

*Monocotyledons.*

*Alismaceae and Hutomaceae.*

In some members of these closely-allied families the stamens are indefinite in number, and the carpels numerous and apocarpous, features which, from our point of view, may be regarded as primitive.

*Palmaceae.*

In this large family, in many instances, the unbranched habit § and the free carpels are primitive features.

*Harms (1897).*
*Hallier (1903).*
*Strasburger (1905).*
*See Morris (1883).*
The Origin of Angiosperms.

The Megasporophylls and Megasporangia.

The dictum of Goethe that the carpel is a fertile leaf, more or less modified, has stood unshaken, and there appear to be such ample evidences of its truth that it need not be considered further here. Among the Angiosperms, the condition of apocarpy seems to us to be primitive. The spiral arrangement of the monocarpellary ovaries on a long receptacle, a state of affairs which still survives in the Magnoliaceae, and in certain other members of the Ranales, may be regarded as a primitive feature of the flower. From this we derive, by suppression of the internodes, the whorled arrangement so characteristic of the great majority of Angiosperms, and often common to all parts of the strobilus. We regard the verticillate grouping as due partly to a tendency to cohesion and adhesion, which has always been marked among the Angiosperms, and partly to a proneness to a dissimilarity in the size and shape of the different organs of the strobilus. The fact that the protective function is, in this type of cone, relegated to sterile members at the base may also have had some bearing on the question; more efficient protection being perhaps afforded where the axis is reduced in length, and the various organs arranged in whorls. The result has thus been a tendency to a horizontal rather than a vertical distribution of the organs.

There are numerous instances shown by many families, e.g., Ranunculaceae, Crassulaceae, and Rosaceae, of how syncarpy has arisen from apocarpy. In the great majority of the Angiosperms there has been a distinct bias in this direction, with various modifications, the significance of which is to be sought for in the fruits. Bi- and multicarpellary ovaries have been the result.

We regard the carpel as a megasporophyll, present in the ancestor of the Angiosperms as an open leaf, bearing several ovules on its margins, and not unlike the megasporophyll of Cycas. With the shifting of the pollen collection from the seed itself to the carpel, it became possible for the latter, both to afford more efficient protection to the developing seeds, by completely closing over them, and also, at the same time, to fulfil its new duties as a pollen receiver, by adopting some mechanism for the purpose at the apex. The necessity for some protection for the ovule is well seen in Bennettites, where, however, it is effected in a totally different manner. The style, probably non-existent at first, may be looked upon as a later adaptation, connected with the perfection of the method of insuring cross-fertilisation. The stigmatic surface was, in the early stages, simply a localised portion of the carpel, adapted possibly by some sticky secretion for the collection of pollen.

It need hardly be mentioned that we are in agreement with Bessey*, and other recent writers, in deriving all syncarpous ovaries from apocarpous

* Bessey (1897).
ancestors, and all inferior ovaries from ancestors in which these organs were superior.

The ovule in the primitive Angiosperms was orthotropous. This view is also that commonly held*. From this primitive type were derived the campylotropous and anatropous types.

We are inclined to regard the primitive carpel as multi-ovulate †. There is, however, a constant tendency to reduction in the number of ovules among monocarpellary ovaries. This is especially well seen in an order such as Ranunculaceae. The significance is to be found in the fruits, which commonly become indehiscent and one-seeded, i.e., achenes.

The Microsporophylls and Microsporangia.

The type of microsporophyll and microsporangium, found almost throughout the living Angiosperms, is a very constant one on the whole, and this indicates that these are organs which have become fixed, although in many cases there is a strong tendency in the direction of abortion, suppression, or transformation. We regard the stamen as a sporophyll, equivalent to the modified foliar organ, which can be shown to have existed in the case of the Pteridospermeae or Palaeozoic ancestor. This sporophyll bears two synangia, each, in some respects, similar to the male organ of a Pteridosperm, e.g., Crossotheca. The synangial view of the stamen is by no means a new one, but hitherto no attempt has been made to link it with an ancestor, also possessing this type of microsporangium. We shall endeavour to show at a later stage (pp. 67, 68) that such a view is tenable.

Among living Angiosperms, we regard the androecium as primitive in such an order as the Magnoliaceae, especially as regards the spiral arrangement, the indefinite number, and the form of the microsporophylls and microsporangia. The shortness of the filament, the length of the connective, and its continuation beyond the anther as a sterile tip, are important features in this connection. We are thus in general agreement with Hallier ‡ as regards the microsporophylls of Angiosperms. From such a type of stamen, later stages in evolution have involved modifications of the connective and filament, resulting in the basifixed and versatile types of anther.

The Perianth.

It has been already shown that Angiosperous flowers without a perianth, or those in which this organ is insignificant, occur in plants possessing dense inflorescences. Solitary naked flowers, with many stamens and carpels, are almost unknown to us. In consequence of these two facts, we believe that

* Coulter & Chamberlain (1904) p. 57.  † Prantl (1888).  ‡ Hallier (1903).
all existing Angiosperms are descended from forms with a conspicuous perianth, and that, in those plants where it is not present, its absence is due to abortion. We are thus inclined to postulate for the group a primitive perianth, which was completely differentiated, from the sporophylls on the one hand, and from the foliage leaves on the other, before the existing Angiosperms came into being. Hence we can hardly seek for its origin among their present-day representatives. At the same time we agree that the modern perianth may have, in certain instances, acquired additional members, either from above by the sterilisation of microsporophylls, or from below by the modification of foliar organs.

On this supposition, let us endeavour to arrive at some idea, from a study of living forms, of what may have been the characters of this primitive perianth, possessed by the immediate ancestors of the existing Angiosperms. Naturally we turn first to the Ranales, for in this group of families, as we have already seen, a number of primitive features appear to be retained in the andræcium and gynæcum. The special points presented by the Ranalian perianth as a whole, which strike us as primitive, are the inconstant number and spiral arrangement of its members, as well as the absence of a marked separation into calyx and corolla. The perianth of the Magnoliaceæ is of special interest from this point of view, as showing transitions towards a definite number of tepals, arranged in whorls, and a differentiation into a calyx and corolla. In Illicium, there is a gradual passage from sepaloid to petaloid tepals. In Drimys, the distinction between the protective and attractive parts of the perianth is more marked, though they are still spirally arranged. In Magnolia, and its close allies, the perianth tends to assume a cyclic arrangement, and the tepals become reduced to a definite number. M. grandiflora, L., and M. stellata, Maxim., for example, have as many as thirteen perianth members, all much alike. In M. Yulan, Desf., they are reduced to nine, arranged in three fairly similar whorls. M. oborata, Thunb., and M. glauca, Linn., have likewise the same number, but the three outer ones are quite small. The tendency then in this family may be said to be towards a definite perianth, comprised in three whorls. Such a floral envelope, in which as a rule the outer whorl is sepaloid and the two inner petaloid, is a constant feature of the closely allied, but more highly evolved family, the Anonaceæ.

The Ranunculaceæ are perhaps the next most interesting Ranalian family from this point of view, but the perianth here, on the whole, appears to be hardly so primitive, and is complicated by the occurrence of the so-called "honey-leaves," which we regard, in agreement with Prantl *, as recent modifications of some of the outer stamens. We should be inclined to view

* Prantl (1888).

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the many-leaved floral envelope of *Trollius*, with its spirally arranged and largely petaloid members, as a primitive perianth.

Without going into further details as regards the Ranales, we believe their perianth can be best explained on the assumption that their ancestors possessed one composed of an indefinite number of members spirally arranged, of which the outer were sepaloid and the inner petaloid, but with no marked separation between the two. Since we regard the Ranales as the most primitive group, we should expect the immediate ancestors of the Angiosperms, as a whole, to have possessed this type of perianth.

Without attempting to follow fully the evolution of the perianth in the higher cohorts of the Dicotyledons, a few tentative remarks here may not be out of place. It might be inferred from the above hypothesis of a primitive perianth, partly sepaloid and partly petaloid, that we would consequently derive the floral envelopes of the higher Polypetalae and the Gamopetalae by a marked separation of the sepaloid and petaloid members into two distinct, usually pentamersous whorls, corresponding respectively to the calyx and corolla of these sub-classes. This of course is a possible, and besides a simple view, but there may be other explanations, which appear equally plausible. A. P. De Candolle long ago suggested that all floral leaves are derived from the sterilisation of sporophylls. Čelakovský*, from an exhaustive study of the perianth, finally came to the same conclusion. For the petals, at any rate, this view is supported by the Ranunculaceae, where the evolution of a “corolla” of honey-leaves, by a modification of stamens, can be traced.

A third origin of the biseriate perianth occurs to us, on the supposition of a primitive floral envelope. The latter may have become wholly petaloid, and persisted as the corolla, whereas the calyx may have been a new structure, derived from foliage leaves.

In the Ranales we believe it is possible to trace the origin of a double perianth in conformity with each of these three theories. As regards the first method—viz., the differentiation of the original simple perianth into a definite calyx and corolla,—the flowers of *Drimys*, and of members of the Anonaceae, may be instanced. As regards the second, the direct origin of the corolla from stamens may be followed in *Ranunculus*; and with respect to the third—viz., a calyx derived from below through a modification of foliage leaves, or, their direct homologues, bracts,—attention may be drawn to *Anemone Hepatica*, Linn., *Paonia*, and genera of Dileniaceae †.

In fact, the Ranales may be considered an experimental group so far as the formation of a distinct calyx and corolla is concerned, some members progressing in one direction, and some in another.

*Čelakovský (1897) Part II. p. 46.
† Placed in the Cohort Ranales by Bentham and Hooker.
FOSSIL EVIDENCE.

In the foregoing pages we have emphasized certain features exhibited by living Angiosperms, which appear to us to be of a more or less primitive nature. We may now turn to fossil botany to inquire whether we can there gather any evidence of a race of plants, which combines any of these peculiarities.

There occur in the Mesozoic rocks a large number of fossils, which in many respects have much in common with the living Cycads. These plant-remains have been often spoken of as Mesozoic Cycads, and the idea has to some extent become ingrained that, whatever else they may have been, they were essentially Cycads. This conclusion, we believe, is incorrect. It partly arises from the fact that these fossils were for many years, and are perhaps even now, best known to us by impressions of their detached fronds, which are admittedly of the same general type as those of modern Cycads.

Even Wieland* in his quite recent work, in many respects the most important which has ever been done in this direction, has labelled his book ‘American Fossil Cycads,’ and speaks of the extremely interesting members of the genus Cycadeoidea as Cycads. This conclusion we hold to be incorrect, and one which is liable to give rise to a false impression as to the nature of these fossils, many of which we regard as standing nearer to the Angiosperms than to any other group.

For some years past, it has become more and more fully realised, in certain directions, that, among this great plexus of Mesozoic fossils, there were many which could not be called Cycads in the sense that we apply the term to the living plants. It was for this reason that Nathorst†, in 1902, proposed the name Cycadophyta, as a general and non-committal designation for this extensive Mesozoic plexus.

It has also become clear that this group was complex. It includes some plants which were true Gymnosperms, and so nearly allied to the modern Cycads, that, in all probability, they may be regarded as the ancestors of that race. These true Gymnosperms naturally fall within the group Cycadales. As illustrations, we may mention the fact that the type of female fructification exhibited by the living genus Cycas is apparently an ancient one. Several examples‡ of carpellary leaves like those of Cycas, in some cases even with seeds attached, are known in the fossil state from rocks of different ages§. Also strobilat fructifications, similar to those of other genera of living Cycads, have been described||.

* Wieland (1906) Chapter IX.  † Nathorst (1902) p. 3.
‡ Nathorst (1902) p. 6, pl. 1. fig. 11. § Solms-Laubach (1891) p. 86.
|| Seward (1895) p. 109, pl. 9. figs. 1-4; Nathorst (1902) p. 5, pl. 1. figs. 1-4.
Apart from such fossils as may well be included within the term Cycadales, there are others, differing in toto as regards the type of fructification. During the last thirty-six years we have gradually come to know more of these Mesozoic plants. The earliest account of their structure relates to Williamsonia gigas, described by Williamson *, in 1870. This was followed immediately by the important work of Carruthers † on Bennetmites and other genera, also founded on British material. Solms-Laubach ‡, some years later, added considerably to our knowledge of this group, from British and Italian specimens of the latter genus. Lignier § has also contributed further information with regard to Williamsonia and Bennetmites, from French material.

From these researches it has become clear that neither of these genera can be regarded as members of the Cycadales, but must be placed in a new group of ordinal rank, the Bennetitaceae ||.

But by far the fullest, and from our point of view the most important work, which has been carried out on these fossils, is that of Wieland †† on the magnificent material of Bennetmites (Cycadeoideae) ** collected from the Jurassic and Cretaceous rocks of the United States. The earlier, preliminary papers †† of this author have now been supplemented by a complete account, published in the sumptuously illustrated volume, entitled ‘American Fossil Cycads,’ which appeared last autumn. It is to this work that we are specially indebted for the first adequate description of the amphisporangiate strobilus of the genus, as well as for much further information on the subject of the habit and structure of these fossils. Wieland’s work has also cleared up many points which were left obscure by the British, French, and Italian material, earlier examined.

This study of the American Bennetitaceae has further emphasized the fact that not only did there exist a great abundance and variety of Cycad-like Mesozoic plants, which cannot be included in the Cycadales, but that some of them warranted the distinction of being regarded as more closely related to the Angiosperms than to Gymnosperms. In fact the Mesozoic Bennetitaceae, as we now know them, appear to afford the long sought for clue to the phylogeny of the Angiosperms, especially on our view of the primitive features of the flower, already discussed.

* Williamson (1870).
† Carruthers (1870).
‡ Solms-Laubach (1890); Capellini and Solms-Laubach (1891).
§ Lignier (1894, 1901, 1903, 1904).
|| This term is now employed in a much wider sense than that originally intended by Carruthers. Engler (1897) pp. 5, 341, adopts the derivative Bennettitales.
¶ Wieland (1906).
** We regard these generic names as synonymous, though we express no opinion as to priority.
†† Wieland (1899, 1901).
It is only proposed here to recapitulate briefly the main points in the morphology of the fructification of *Bennettites*. For a full account the reader is referred to Wieland’s excellently illustrated monograph.

The structure of the strobilus is illustrated by figs. 2 & 3 taken from Wieland’s book*. As Dr. Scott† has pointed out, it is evident that “in approaching this subject we must divest our minds of all preconceptions drawn from a knowledge of existing Cycadean cones.”

Fig. 2.

Diagrammatic sketch of a longitudinal section through the amphi sporangiate cone of *Bennettites (Cycadeoidea) dacotensis*, Ward. About natural size. (After Wieland.)

The species, which may be regarded as typical from our point of view, is *Bennettites (Cycadeoidea) dacotensis*, Ward, from the Black Hills of South Dakota. As is invariably the case in this genus, the fructifications are borne laterally, wedged-in between the persistent leaf-bases of the stem. In all the examples, so far obtained, the cone is quite mature, and has reached the fruiting stage.

* Wieland (1906) text-figs. 87 & 88 on pp. 164–5.
† Scott (1900) p. 454.
The strobilus, which has a length of about 12 cm., consists of an elongated conical axis, bearing several series of bract-like structures below, between which is packed a copious ramentum. Above these bract-like organs, recognised in figs. 2 and 3 by their hairy surface, and attached to the axis in a hypogynous manner, is a structure known as the "disc," formed by the basal cohesion of 18–20 bipinate fronds, the male sporophylls. In fig. 2, one of the latter is seen in the incurved condition, and the other, as expanded when fully mature. In fig. 3 several of the microsporophylls are indicated in the unexpanded state. The bipinnate frond bears many, very reduced pinnules, each supporting two sessile synangia. The microsporophyll is bent inwards in the young state, for about a third of its length, and the secondary rhachides are folded inwards in pairs, lying in the plane of the primary rhachis.

At the apical portion of the strobilus, at a later stage when the
microsporophylls have been shed, a large number of orthotropous seeds are found, mounted on long pedicels, arising directly from the axis. The seeds contain dicotyledonous embryos. Between the seeds, a still larger number of somewhat club-shaped organs, known as the interseminal scales, occur, also attached directly to the receptacle. Distally these scales are all coherent by their apical margins, thus completely covering in the seeds, which the orifice directly above each seed, through, leaving, however, an micropylar tube projects. Thus, in the fruiting stage, the interseminal scales form a complete investment or pericarp, and the whole of the macrosporangiate portion of the cone appears to be of the nature of a single fruit. In figs. 2 and 3, the scale is too small to show the young seeds and interseminal scales clearly. Their position, however, lining the apical portion of the axis, is indicated.

Further points in relation to the structure of the fructification of Bennettites will be discussed subsequently. We will, however, only add here that Wieland's elucidation of the amphisporangiate cone of Bennettites has incidentally extended our knowledge of the earlier described genus Williamsonia, in which the fructifications are borne on long peduncles, among the leaves forming the crown at the apex of the stem. It is possible that Williamsonia, in these features, is more primitive than Bennettites.

Previous Interpretations of the Bennettitean Strobilus.

Before beginning a discussion of the origin of the Angiospermes from ancestors nearly related to the Bennettites, we would endeavour to make it clear that we do not consider any known member of the latter group to be exactly on the main line along which the Angiosperms have advanced. They, however, diverge so slightly, that we believe there is now little difficulty in perceiving how the Angiosperms may have originated.

We may commence by considering the interpretations which have been arrived at with regard to the strobili of the known members of the group. In thus reviewing some of the earlier work, it must be remembered that, until recently, the evidence has been very incomplete.

It is curious in this connection to find that in one of the earliest descriptions of the strobili of Williamsonia, read by Yates* before the Yorkshire Philosophical Society in 1847, the fructification was interpreted as consisting of "a number of scales, resembling sepals, petals, or perhaps dilated stamens, all growing from the top of the fruit-stalk, and overlapping one another." Yates also points out how very different this cone is, both externally and internally, from the flowers of the Cycads.

Williamson†, working with very incomplete material of the genus Williamsonia, distinguished two types of fructification as male and female, which he compared with the cones of living Cycads. Although we know now that this

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* Yates (1855) p. 40.
† Williamson (1870) p. 672.
was not a correct conclusion, it was hardly to be expected that a closer approximation to the truth would then have been possible.

Carruthers *, discussing the cone of *Bennettites* in relation to those of the living Cycadeae, states that "the points of difference are more obvious than those in which they agree .... The fossil is truly gymnospermous, the pollen having access to the embryo-sac through the tubular openings in the covering of the seed, and not through a style developed from an investing carpellary organ. The most remarkable difference is to be found in the compound fruit of the fossil. ... It must be considered to hold the same relation to the other Cycadeae that *Taxus*, with its succulent, cup-shaped pericarp, does to the cone-bearing Coniferae."

Saporta † regarded the fructification of *Williamsonia* as the fruit of a primitive Monocotyledon, and more especially as belonging to a member of the Pandanaceae. The same author ‡, in conjunction with Marion, recognised in the interseminal scales the homologues of carpels, and concluded that the inflorescence is similar to a spadix, bearing unisexual flowers, found in certain Monocotyledons.

Solms-Laubach §, when discussing the fructification of *Bennettites Gibsoniannus*, Carruth., in 1890, states that its closest affinities among living plants are with the Cycadeae, though he is not altogether disinclined to accept Saporta's argument that the genus may be found to show analogies in the direction of the Angiosperms. The same author also outlines three hypotheses as to the homologies of the female portion of the strobilus. Either the seed-pedicels and interseminal scales are all carpels, the one fertile and the other sterile; or the scales are of the nature of shoots without leaves, and the pedicels shoots ending in a flower reduced to a single ovule; or, again, the scales are leaves subtending uniovulate shoots. On the whole he inclines to the last of these interpretations.

Similarly, Lignier ‖, in describing the structure of *B. Morierei*, Sap. & Mar., in 1894, concluded that, so far as the female cone is concerned, it is of the nature of an inflorescence, the bracts and interseminal scales being the leaves of the main axis, the seed-pedicels being fertile leaves which belong to unifoliate buds of a higher order. He regards the group as descended from ancestors common to the Cycadeae, but not from the Cycads themselves, and further suggests that eventually the Bennettitae and Cordaitales may be found to have a greater affinity than is at present supposed.

In March 1899, Wieland ¶ described, for the first time, the male flower of *Bennettites (Cycadeoidea) ingens*, Ward, and showed that it differed entirely from the male cones of the living Cycads. However, as the author ** sub-

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* Carruthers (1870) p. 698.
† Saporta (1875) p. 56.
‡ Saporta & Marion (1881) p. 1187; Saporta (1891) p. 88.
§ Solms-Laubach (1890) pp. 830, 832, 843.
‖ Lignier (1894) pp. 69 & 73.
¶ Wieland (1899) p. 224.
** Wieland (1901 and 1906).
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...he edited out, this strobilus is really amphisporangiate, a fact which
of them recognised. In this later communication, Wieland calls attention
to the resemblance of this fructification to that of the Angiosperms on the
one hand, and to that of the Cycadofilices on the other.

Dr. Scott, in his 'Studies in Fossil Botany' *, sums up the views with
regard to the homologies of the Bennettitean cone. He says, "that the axis
of the inflorescence is a modified branch of the stem is clear, the enveloping
bracts are obviously modified leaves or leaf-bases (B. Morierei), and likewise
present no difficulty. We might well compare them to the scale-leaves, in
which the young cone of an ordinary Cycad is enwrapped." With regard to
the seed-pedicels and interseminal scales, "the simplest view, then, would be
to regard them as modified leaves, the fertile pedicels being the sporophylls,
and the interseminal scales representing either abortive sporophylls or a
special kind of bract. But we might also interpret both organs as reduced
shoots, or might limit this view to the seed-pedicels, continuing to regard the
interseminal scales as bracts, comparable to the paleae found among the florets
on the receptacle of some Composite."

It must be remembered that, when these views were expressed, our know-
ledge of the Bennettiteae was much less advanced than it is at the present
time, thanks to the researches of Wieland.

In a later paper, Lignier † adheres to his interpretation of the nature of
the female strobilus of the Bennettiteae, mentioned above, and discusses the
morphological value of the cone of Bennettites (Cycadeoidea) ingens. He
suggests that the male portion may be of the nature of a flower, that is to
say, composed of staminiferous fronds borne on the main axis, though the
female is an inflorescence. He also criticises Wieland's comparison of this
strobilus with that of the Cycadeeae and Angiosperms. He appears to derive
the latter from the Cordaitales ‡. In a later note the same author § discusses
the morphology of the interseminal scales.

We now pass to consider the interpretation given by Wieland, who alone
has so far had before him the complete evidence of the strobili of the
American Bennettiteae. That author ‖ describes the amphisporangiate axis as
a flower homologous with that of an Angiosperm. He speaks of it as follows:—
"The flower or strobilus thus borne on a short and heavy peduncle consists
in a terminal ovulate cone surrounded by an hypogynous staminate disc and
an outer series of enveloping bracts, followed by the old leaf-bases of the
armor" …. Comparing this cone with the flower of the Angiosperms, the
same author ** concludes:—"It appears that organization into a disc

* Scott (1900) pp. 475-76.
† Lignier (1903') p. 44.
‡ Lignier (1903) diagram on p. 49.
§ Lignier (1904).
‖ Wieland (1906) Chapter VII. & p. 143.
¶ Wieland (1906) p. 165, also p. 235.
** Wieland (1906) p. 230, also p. 79.
preceded by spirally arranged bracts with the subsequent prolongation of the main floral axis, either as that of a simple terminal cone (or an inflorescence), or as that of a simple terminal cone (or an inflorescence), is, in later geological time, mainly an angiospermous juxtaposition, although it may yet prove that its seemingly isolated occurrence in gymnosperms is largely due to an imperfectly known and understood fossil record.

Discussing the evolution of the Bennettitaceae, contrasted with the Cycads, he says *:—“In the one case the much greater change went on in the megasporophylls, and there was evolved a form of true flower exactly suggestive of the types of change in reproductive organs that resulted in the angiosperms. In the other” [the Cycads] “both types of sporophylls were seized upon and carried forward through the same stages of reduction, save for that single, wonderful, and marvelous survival from the Paleozoic, that analogue of the staminate frond, the carpophyll of Cycas.”

The present Interpretation of the Fructification of the Bennettitea.

Having briefly reviewed previous opinions as to the homologies of the Bennettitean cone, we may pass on to state our own interpretation, which differs considerably from nearly all those previously advocated. According to our view, this cone is a simple strobilus, and not an inflorescence. Its parts are homologous with the carpels, stamens, and perianth of a typical, amphipsorangiote, Angiospermous flower. In other words, the simple cone of the Bennettiteae is an anthostrobilus (see p. 37), differing from the anthostrobius of the Angiosperm in several important features, especially in the presence of a seminal pollen-collecting mechanism, and in the form of the microsporophylls. Such a fructification may be distinguished as a pro-anthostrobilus (p. 37).

It will readily be seen that this interpretation has all the merit of simplicity. Yet, like most theories, it has certain difficulties peculiar to itself, which will be discussed here. We propose to show that it is possible to institute a very close comparison between the eu-anthostrobilus of the Angiosperm and the pro-anthostrobilus of the Bennettiteae. Further, the agreement between these two types of anthostrobili is so close that the conclusion that the Angiosperms sprang from Mesozoic ancestors, nearly related to the Bennettiteae, is rendered extremely probable.

On the view that the pro-anthostrobilus is a simple cone, the term “bract” can no longer be applied to the outer, enveloping, foliar organs. On our interpretation, these constitute a primitive perianth, and are of the nature of sterile leaf-members. The male organs, the 10–20 bipinnate, Marattiaceous-like fronds, are collectively homologous with the androecium of the Angiosperms, the stamens of the latter being derived from them by reduction. The position of the microsporophylls on the axis, with regard to the other

* Wieland (1906) p. 66.
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organs of the strobilus, is similar to that of the andrœcium of a typical Angiospermous flower, and, with the exception of Welwitschia, is peculiar to this line of descent. The female organs consist of seeds, mounted on long pedicels, and interseminal scales. We regard the latter as homologous with the carpels of the Angiosperms, despite the fact that they subtend, and do not bear the seed-pedicels. The obvious difficulty which arises from this fact will be discussed later (p. 66). It is this feature, interpreted on the axioms of rigid morphology, which has hitherto biased opinion in favour of interpreting the ovulate portion of the pro-anthostrobilus as an inflorescence. On our view, the carpels of the Bennettites are to a certain degree syncarpous, and this represents a stage in evolution antecedent, in this case, to the method of enclosing the seeds by the infolding of the carpels on themselves. We regard this feature especially as one in which the known Bennettites depart from the direct line of descent of the Angiosperms. In their basal cohesion and cyclic arrangement, the male organs show a like early departure.

We regard the fructifications of the Bennettites as having been essentially amphisporangiate, though we recognise the possibility that in this group, as in their descendants the Angiospermes, there has been a strong and constant tendency to reduction to the monosporangiate condition, with the corollary of the monococious and dioecious states. This view has been emphasized so admirably, and at such length by Wieland *, that it is unnecessary to do more than add the following quotation:—“The condition in the great majority of the cones thus far examined is such that one is forced to the conclusion that all the known Cycadeoidea are descended from bisporangiate forms, and that of all the considerable number of fruits of Cycadeoidea and Bennettites Gibsonianus or allied species, far the larger portion were actually bisporangiate and discophorous.” We may add, in discussing this point, that it must be remembered, that in the majority of the known cones of the Bennettites, the fruits are more or less mature, and often possess a well-developed embryo. At such a stage the microsporophylls would most likely have died down, or, as Wieland expresses it, “wilted,” or have been shed altogether, as that author has pointed out at some length. Remnants of the “hypogynous disc,” formed by the basal cohesion of the 10–20 microsporophylls, usually remain as sole evidence of the amphisporangiate nature of the cone, except in some 25 known cases, including Bennettites (Cycadeoidea) Jenneyana, Ward, B. (C.) ingenus, Ward, B. (C.) dacotensis, Ward, where these organs are preserved. Even in Williamsonia, such “discs” have been long known, though their precise nature has only recently been explained by Wieland’s work.

That the fructification of the Bennettites presents features recalling those of the Angiosperms has been already pointed out by previous authors.

* Wieland (1906) p. 114, also pp. 130, 137, 169, 174, 184.
Saporta *, in 1871, referred Williamsonia to the Monocotyledons on the supposed similarity of the female portion of the strobilus to the fruit of certain Pandanaceae. In subsequent memoirs this author †, in conjunction with Marion, included the genus in a new class, the Proangiospermæ, or primitive Angiosperms. Although the evidence for this attribution was then very imperfect, and the deduction by no means warranted or strictly accurate, yet Saporta, in our opinion, was perfectly correct in his happy guess as to the near affinities of this Mesozoic fossil.

In 1880, Nathorst ‡ came to the conclusion that the supposed fruits of the Bennettitæe really represented parasitic plants analogous to the Balanophoræae.

Solms-Laubach's § conclusions have been already mentioned (p. 56). In the English translation (1891) of his 'Fossil Botany,' the following passage occurs:—"It is possible that the seed-stalks may prove to be carpophylls of a peculiar kind; in that case we should be obliged to separate the Bennettitæae altogether from the Cycadææ, and to regard them as an intermediate group between Gymnosperms and Angiosperms."

Dr. Scott || remarked in his 'Studies,' published in 1900, that the fruit of Bennettites "comes very near to being angiospermous," but "only in the sense that the seeds were enclosed within a coherent pericarp." The same author concluded that "the Bennettitææ may well be called pro-angiosperms, to use Saporta's name, if by that we simply mean to indicate plants with a near approach to angiospermous structure, without implying any relationship to the Class Angiosperms as now existing. On the present evidence such a relationship is altogether improbable."

It must, however, be pointed out that it was only in 1901, or, more strictly speaking, during the last year, that the full evidence as to the fructification of Bennettitææ has become available, and consequently these conclusions, founded on imperfect material, could not be other than provisional.

Wieland ¶ in 1901, when describing in a preliminary note the amphisporangiate strobilus of Bennettitææ, emphasized the following suggestion, made in a previous communication: "While the staminate disk surrounding the ovulate axis of Cycadeoidea indicates primarily an evolution terminating, so far as now possible to trace, in the Gymnosperms, the juxtaposition of parts is exceedingly suggestive of the possibility, if not the manner as well, of angiosperm development directly from pteridophytic forms. For in these strobili the sporophylls are organized into a flower, . . . . foreshadowing distinctly the characteristic angiospermous arrangement of stamens inserted on a shortened axis about an ovulate center, apical and sometimes strobilar as seen in Liriodendron."

* Saporta (1875) p. 56.
† Saporta & Marion (1885) vol. i. p. 246, and Saporta (1891) p. 87.
‡ Nathorst (1880).
§ Solms-Laubach (1891) p. 97.
¶ Scott (1900) pp. 462, 477, & 478, also p. 523.
|| Scott (1900) pp. 462, 477, & 478, also p. 523.
¶¶ Wieland (1901) p. 426.
In 1903, Lignier * criticised Wieland's views with regard to the possible relationship of the amphiisporangiate strobilus of *Bennettites* to the Angiosperms, and rejected this theory on the ground that the fructification could not be correctly interpreted as a simple cone.

Of more importance are the opinions expressed by Wieland † in presenting the full evidence with regard to the fructification of *Bennettites*, recently published. He concludes that "it would be most extraordinary if at the present day the angiosperm line of descent could be laid down, except on the broadest lines. It would be most extraordinary, we say, if a mere half-dozen well-understood great plant types scattered over vast periods of time, and representing but a few of a vast array of unknown evolutionary steps, should be exactly the ones enabling us to say, for instance, that certain lines (Cycadeoidece) led into the Cycadales and Ginkgoales, and sent off a branch which yielded Cycadeoidian stock first, then the Cordaitales, or vice versa, and that from these latter the angiosperms sprang." This author ‡ also expresses his conviction that primitive seed-ferns gave rise "to such types as the Mesozoic *Cycadeoideae*, and, as I believe, at much the same time or a little later than these the early angiosperms."

He defends § the analogy which he previously suggested between the Cycadeoidian flower and that of *Liriodendron*. He says: "Also, in the case of the sole remote type of which we have now gained a fortuitous knowledge, striking analogies to living angiosperms are suggested, no difference whether, laying histological structure somewhat aside, we fasten our attention upon one set of characters and *Liriodendron* be called to mind, or upon another with the result that the male and female catkins of Amentaceous first suggest themselves, or upon a third set that call to mind some other hint of characters that must have been present in the countless members of a great proangiosperm complex, just as the monocotyl *Pandanus* thus suggested itself to Saporta. We should not ask too much of isolated evidence, nor yet be content with a scant interpretation of highly suggestive facts."

Further he adds ‖: "For the purposes of broader generalization, fern-like fronds upon which were doubtless borne the pollen of *Lyginodendron*, the staminate fronds of *Cycadeoideae* of true Marattiaceous type, the mega- and microsporophylls of *Cycas*, the stamens of *Cordaites* and *Ginkgo*, and finally of *Ricinus* and *Liriodendron*, all belong to a series." The same author ¶ also points out other analogies between the *Bennettitae* (*Cycadeoideae*) and the Angiosperms.

It will be seen from this short résumé of previous opinion that, so far as the full structure of the cone of the *Bennettitae* has been disclosed, there

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* Lignier (1903) p. 45.  † Wieland (1906) pp. 243–44.
† Wieland (1906) p. 243.  § Wieland (1906) p. 245.
have already been recognised, on many sides, indications of Angiospermous affinity, and thus support is afforded to the theory maintained here.

Only one discussion of the affinities of the Bennettitean strobilus has appeared, so far as we are aware, since Wieland's full results were disclosed last autumn. Professor Oliver *, in a short paper on this subject, has stated some of the main points of the argument, to which we had arrived independently. He says: "We now come to the question of the morphological interpretation of this fructification, whether it is to be regarded as 'an axis beset with sporophylls,' i. e. a flower, or whether, on the other hand, it is really a much more complex structure, i. e. an inflorescence or branch-system showing extreme reduction. . . . . The view taken by Dr. Wieland, that we have here a hermaphrodite flower, will meet with very general agreement. Looked at broadly and having regard to the pteridospermous affinities of the Bennettiteae this interpretation seems irresistible. To take the other view and read a 'cyathium' into its structure seems to verge on the gratuitous."

The same author adds: "Whatever else one may think of this flower it cannot be regarded as that of a quite typical Angiosperm. . . . Its great interest and value seem to be that whilst just missing the Angiosperm it shows how close the Cycad line could come to realising it. It is indeed the key to the Angiosperms; when that is recognised the rest is easy . . . . It is possible, no doubt, though it seems almost incredible, that a flower with perianth, stamens, and gynaeceum in proper relative position as in Cycadeoidea should have been produced except in a line very closely related to that which led to the Angiosperms."

THE HEMIANGIOSPERMÆ.

According to our view, the Tertiary and Recent Angiosperms are directly descended from a group of Mesozoic plants to which we apply the new term Hemiangiospermeæ. This group at present is entirely hypothetical. Nothing is known as to the fructification of any of its members, but we believe that its cone approximated so closely to the pro-anthostrobilus of the Bennettiteae, that the latter, although somewhat removed from the direct line of descent, demonstrates emphatically the type of strobilus which gave rise to the eum- anthostrobilus, or flower of the Angiospermeæ. This cone (fig. 4), like that of the closely related Bennettiteæ †, was an anthostrobilus of the pro-anthostrobiloid type. It was also essentially a Gymnospermic fructification, the pollen collection being performed by the ovule itself. Yet it agreed with the typical flower of the Angiosperm on the one hand, and with the strobilus of the Bennettiteæ on the other, in the juxtaposition of the mega- and microsporophylls, a feature which is peculiar to the cones of this line of descent,

* Oliver (1906) pp. 239-40.
† Hallier (1901’) p. 105, (1905) p. 154.
as well as in the possession of a primitive perianth. It differed from the Bennettitean strobilus in that the megasporangia were seated on the margins of the carpels, the homologues of the interseminal scales, which were free from one another and not united at the apex. Also the microsporophylls were spirally arranged, and perhaps more reduced than those of that group. Such a strobilus would be all but Angiospermic, were it not that the task of pollen collection was still performed by the ovule, and that it lacked the precise form

Fig. 4.

The pro-anthostrobilus of the hypothetical Hemiangiospermeae. Diagrammatic representation of a longitudinal section through the cone, showing perianth, microsporophylls and megasporophylls.

of microsporophyll which is termed a stamen. The general form of megasporophyll would correspond more closely with that of the living genus Cycas, than with the corresponding structures presented by the known Bennettiteae. That this assumption is a natural one may be inferred from the known antiquity, and frequent occurrence of such a type of megasporophyll in the ancient rocks. *

* See Solms-Lauber (1891) p. 80.
The fact that such a cone appears to be wholly unknown at present should not militate against the theory, if we bear in mind that the total number of Mesozoic fructifications of Gymnospermous affinity at present discovered is extremely small, as Wieland has emphatically pointed out in the passages quoted above.

It might be asked why we have not adopted Saporta's term, Proangiospermea, if some such name is really required. It must, however, be remembered that this name was given to fossils, which were regarded as primitive Angiosperms, combining characters common to both Dicotyledons and Monocotyledons, whereas the hypothetical forms, which we are discussing, were the ancestors of these primitive Angiosperms, and were Gymnosperms. Further we do not agree that the Bennettitae, in the light of the recent researches of Wieland, can be referred to the Proangiospermea of Saporta, as the latter author concluded, for the same reason that their mode of fertilization was essentially Gymnospermic.

THE ORIGIN OF THE ANGIOSPERMEAE.

We may now proceed to outline the steps by which the typical strobilus of the Angiospermeae was evolved from that of the hypothetical Hemiangiospermea. We have already (pp. 44-45) indicated what we regard as the primitive form of the various organs which compose the flower.

The amphisporangiate cone of the Bennettitae was identical, so far as the juxtaposition of the mega- and microsporophylls is concerned, not only with that of the Hemiangiospermea, but also with that of the Angiosperms themselves. The hypogynous arrangement of the parts, as in the Bennettitae, was also a primitive feature of the Angiosperms, from which the perigynous and epigynous states have been more recently evolved, as indeed has been pointed out by several writers.

In the cone of the Bennettitae, all the organs are spirally arranged with the exception of the microsporophylls. In the cyclic grouping of the latter, these plants may be regarded as showing evidences of an early departure from the main line of descent of the Angiosperms. In the strobilus of the hypothetical Hemiangiospermea, the organs were all arranged spirally (see fig. 4), and this primitive feature is still to be found preserved to some extent.

* Saporta & Marion (1885) vol. i. pp. 220 & 222.
† This term is also open to the objection that many fossils have been included under it, the nature or affinities of which are wholly doubtful.
‡ The term 'Angiocycad,' provisionally suggested by Oliver (1900) p. 240, does not appear to us to be free from objections, for we regard the fructification of this ancestor as, in the first place, Gymnospermic, and, in the second, very far removed from that of the living Cycad.
among Angiosperms, as for instance among certain members of the Magnoliaceae. With the Angiosperms generally, just as with the Bennettitese, there has been a constant tendency, by suppression of internodes, to derive a cyclic arrangement of the parts of the cone from the primitive spiral type.

The first step in the immediate evolution of the Angiosperms was the transference of the pollen-collecting mechanism from the ovule to the carpel or carpels, with consequent localisation of the stigmatic surface. It was this act which called the Angiosperms into being, as we shall endeavour to emphasize more fully at a later stage in this consideration.

We may therefore first consider the gynaeceum.

The Gynaeceum.

We regard the Bennettitese, so far as the megasporophylls of the cone are concerned, as departing considerably from the main line of descent of the Angiospermea. The orthotropous ovule or seed, enveloped by what was probably a single integument *, may be regarded as a fairly primitive structure. In the anthostrobilus of the Angiospermea, the primitive condition of the ovule was undoubtedly orthotropous, and probably there was a distinct funicle, a feature which may, or may not, be homologous with the seed-pedicel of the Bennettitese. The origin of the second integument does not appear to us to present any great difficulty. It is absent in many living Angiosperms, especially among the Gamopetalae, and several members of the Ranunculaceae, an order which we regard as having retained a comparatively large number of primitive features in the strobilus †. Moreover, we regard an integument as a structure which may arise de novo, and one without close homologies among those plants which do not bear seeds. That this is the case is evident in such a seed as that of the Palaeozoic Lycopod, Lepidocarpon ‡, and in certain arils found among living Angiosperms.

The seeds of the Bennettitese show a close approximation to those of the Angiosperms in the fact that the embryo of Bennettites, and presumably of the Hemiangiospermea, possesses two cotyledons, and that, unlike the Cycads, and in all probability the Pteridospermea, these seeds germinated after a comparatively short resting period, both of which we regard as primitive features among the Angiospermea.

The structure of the unfertilised ovule of the Bennettitese is still practically unknown, for in all the specimens examined so far, the ovule has apparently already become a mature seed. We are, therefore, ignorant of the precise anatomy of the micropylar end of the ovule. Did it possess a pollen chamber, comparable to that of Lagenostoma, or was the pollen-collecting mechanism confined to the micropylar region of the integuments? On this point

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* Wieland (1900) p. 234.
† Prantl (1888).
‡ Scott (1901) p. 317.
Wieland * gives no clear information. But the fact that the integument, enclosing the micropyle, is produced † beyond the united outer surfaces of the interseminal scales for some 2 mm., or, as Wieland describes it, "projects stigma-like a little beyond the pericarp," seems to show that the latter, whatever their homologies may be, played no part in the pollen-collecting mechanism, a duty no doubt performed by the ovule itself. This also lends probability to the view that pollination was effected by means of anemophily. These points appear to us to be of great importance, since we regard the likelihood that, in the Bennettitae and the Hemiangiospermeæ, the pollen-collecting office was performed by the ovule itself (as in the Coniferales and the Pteridospermeæ), and the additional probability that the microspores were brought into position, as it were, by the wind, as being two features eminently characteristic of these groups, as opposed to the Angiospermeæ.

With regard to the precise homologies of the seed-pedicels and interseminal scales of the Bennettitean fructification, there are already several theories in the field. Lignier's conclusions have been mentioned (p. 56) and Wieland's † views will be found discussed at length in the IXth Chapter of his book. We do not intend to pursue the matter at length here. On our view, the homologues of the interseminal scales of the Bennettitae in the cone of the Hemiangiospermeæ were simple carpellary leaves, bearing several ovules on their margins, much like the megasporophylls of the living genus Cycas. We conceive that the ancestors of the Bennettitae themselves also possessed this type of sporophyll, though in Bennettites this structure has become highly modified, perhaps even divided; for there is a possibility that the seed-pedicels may, in part, represent a lobe of the carpellary leaf. Also the megasporophylls, or portions of them, have become united to form the pericarp of the fruit. In these features we recognise clearly that the strobilus of the Bennettitae departs considerably from the lines along which the Angiospermeæ have descended. The evolution of the pericarp of the Bennettitæ represents one path of advance, and one wholly gymnospermic. On the other hand, the Angiospermeæ, with their closed carpels, form another line of descent, called into being by the adoption of the entomophilous habit, in conjunction with a shifting of the mechanism for pollen-collection from the megaspore itself to the closed megasporophylls.

Since the adoption of entomophily, by means of closed carpels, as the mode of fertilisation, evolution has taken place in many different directions, and thus the great cohorts, families, and orders of Angiospermeæ have been called into being. Among the more important changes have been reduction and suppression in the number of the floral members, leading in extreme cases to the monœcious and dioecious conditions, often, as we have pointed

[*] Wieland (1906) p. 122, fig. 63.  
[†] Wieland (1906) p. 230, &c.  
[‡] Wieland (1906) pp. 121, 234.
out, correlated with increased complexity of the inflorescence; the general replacement of the spiral by the cyclic arrangement in the parts of the flower; cohesion and adhesion, especially the evolution of the perigynous and epigynous states from the primitive hypogyny; and alterations in symmetry, notably the evolution of zygomorphic structures. Further in many cases there has been a return to the primitive anemophilous habit, often accompanied by diclinism, and complicated inflorescences.

The Androecium.

Perhaps the most striking contrast between the pro-anthostrobilus and the flower or eu-anthostrobilus, is to be found in the nature of the microsporophylls. In the Bennettitalee, these are bipinnate fronds of the fern type, coherent at the base, bearing greatly reduced pinnules, which in turn bear synangia. The connection between such organs and the androecium of the Angiosperms is not at first sight obvious. If, however, we compare parallel stages in the evolution of the androecium and the gynaeceum, we may perhaps arrive at a clearer insight on this point.

The seed itself is an exceedingly ancient organ, dating back far beyond the period at which we first became acquainted with fossil plants. In other words, it was a highly evolved structure at a very remote period in geological time. The seed of the Pteridosperms, the earliest stage in the line of descent under discussion with which we are at present familiar, was long antecedent to the evolution of the stamen. The male organs of the Pteridosperms, so far as we have been able to recognise them, were simple synangia-like structures, not dissimilar to those of the Eusporangiate Ferns in certain particulars, and were borne on fern-like fronds. In another Palaeozoic group, the Cordaitales, an organ, in some respects closely similar in organisation to a stamen, existed contemporaneously with the fern-like male organ of the Pteridospermea, but this line of descent, on our view, has, at the most, only a remote connection with that discussed here. Thus we find that an organ in some respects like a stamen was in existence in the Palaeozoic period, although in the Angiosperm line of descent it was not evolved until quite late in geological time.

The fructifications of the Pteridospermea, both male and female, were borne in a lax manner, on fronds similar in structure to the sterile fronds, or on leaves in which the lamina was more or less greatly reduced. There is no indication, in any known member of the group, that there was any attempt to aggregate either the male or female fructifications in the form of a strobilus or cone.

* Coulter & Chamberlain (1904) p. 13. † Coulter & Chamberlain (1904) p. 15.
† Wieland (1900) p. 165, &c., describes the microsporophylls as "once pinnate." They are, however, obviously bipinnate.
In the case of the Bennettiteae, however, the Mesozoic descendants of this group, we find both the male and female organs aggregated into an amphi-sporangiate strobilus, and further that the megasporophylls are of a highly advanced type, and have undergone great reduction, as well as possibly other extreme modifications. The stage reached in the evolution of the microsporophylls is obviously greatly behind that of the megasporophylls. They show hardly any marked advance beyond the condition of affairs met with in the Pteridospermae. The microsporophylls are still essentially compound, fertile fronds. Any progress in evolution is confined to the synangium, which is still the dominant type of male fructification, and perhaps more highly evolved in the Bennettiteae than in any known Pteridosperms. The stamen, *per se*, is quite a recent innovation, so far as this line of descent is concerned. But the adoption of entomophily, by means of closed carpels, which in the ultimate analysis will, we believe, be found to be the real influence which called the Angiosperms into being, no doubt involved considerable modification in other parts of the flower, and among these the male organs. The incoming of this type of pollination, thereby effecting an immense saving in the amount of pollen production necessary to ensure cross-fertilization (see p. 74), seems to have been the signal for considerable reduction in the male fronds of the pro-anthostrobilus. Eventually a much simpler structure has been evolved, consisting of a sporangiophore bearing two synangia.

Although we regard the microsporophyll of the Angiosperms as derived originally from a highly branched organ, by reduction, there would seem to be very few cases among living members of the group in which a survival of this ancient feature can be traced. It is just possible that such may occur among the Myrtaceae, e. g., *Calothamnus*, and possibly also in *Ricinus*, where the stamens are pinnately branched, but in the Polypetalous orders, such as Capparidaceae, Dilleniacese, Resedaceae, Hypericaceae, Cistaceae, Malvacceae, &c., in which so-called branched or divided stamens are found, this phenomenon is of a different nature *, and has no direct bearing on this discussion. On the other hand, it is admitted that the gap between the male organs of the Bennettiteae and the Angiosperms is a big one, and that we are not at present able to trace the various stages in the reduction of the microsporophyll.

The Perianth.

The Bennettitean cone possesses a basal, spirally arranged series of sterile, leaf-like organs, which form an integral part of the strobilus. We imagine that the pro-anthostrobilus of the Hemiangiospermae also possessed this feature, which we interpret as an undifferentiated, primitive perianth. With the assumption of entomophily, and the consequent evolution of the Angio-

* Goebel (1905) p. 535.
sperrmee proper, concomitant changes in the form and function of the primitive perianth may well have taken place. To the original protective function of this organ would be added an attractive office, in connection with the entomophilous habit. The changes involved may have affected the perianth as a whole, or only the higher series of its members. While we may suppose that, in some cases, the primitive perianth became differentiated in this way into an outer series the calyx, and an inner series the corolla, it is unlikely that all corollas, or, for that matter, all calyces have originated in this manner. The study of the homologies of the members of the floral envelopes among living Angiosperms is a very difficult one, as we have already pointed out (p. 50). In some cases, e. g., Nymphaea, the petals may be modified stamens, i.e. degraded fertile sporophylls, as Grant Allen* long ago suggested. In others, foliar structures, not originally forming an integral portion of the cone, may have come to function as a calyx. A well-known example occurs in the case of the involucre of Anemone Hepatica, L.†.

While therefore, we reserve for the present a fuller discussion of the homologies of the various types of floral envelopes found among living Angiosperms, we may conclude that at least a part of the modern perianth was derived originally from the ancient primitive perianth of the Hemiangiosperms.

The Angiospermous Type of Foliage.

If our view is correct that the eu-anthostrobilus or flower of the Angiospermeae has been evolved from the pro-anthostrobilus of an unknown ancestor, allied to the Bennettitese, then we may imagine that this evolution would be correlated with a marked change in the habit of the whole plant, especially as regards the branching and leaf-form. We believe, however, that this latter modification took place at a considerably later geological period than the evolution of the flower. In other words, we conceive that the earlier Angiosperms may have retained, for the most part, the unbranched habit, and also the Cycadean type of foliage of their ancestors, for some considerable time after the fructification had become a typical eu-anthostrobilus or flower.

One of the most difficult of the lesser problems which make up the plexus of problems, which we call the origin of Angiosperms, refers to the evolution of the typical form of Angiospermous foliage. The leaves of this group are greatly varied both in form and size, but the majority of them exhibit certain peculiarities of shape and nervation, which, though hard to define, readily permit us to recognise at sight the affinities of such plants, even when we have only their detached foliage to guide us.

* Allen (1882) p. 11.
† Goebel (1905) p. 550.
What, then, is the origin of this type of foliage? We believe the solution to the question is to be sought for in a study of the branch-habit. Wieland* has shown clearly that the Bennettiteae possessed stems of restricted vertical growth, either unbranched or branched only to a limited extent. The same also seems to have been true of the Pteridospermeae, their ancestors. On the other hand, one of the great characteristics of the Angiosperms, as a whole, is their free branching, whether of the monopodial or the sympodial system. With this change in habit was probably correlated a general alteration in the character of the foliar organs. The Pteridospermeae, with their unbranched, or tree-fern-like habit, obtained a considerable assimilatory surface by means of very large leaves. Probably, for mechanical reasons, the increase in the size of the leaf as a whole would have to be accompanied by much subdivision of the lamina. Hence the highly compound fronds of the Palaeozoic period. The large, but simpler foliage of the Bennettiteae, and of the Cycadophyta generally, can easily be derived from this type of leaf, and is likewise correlated with a non-branched or feebly branched habit. The association of megaphyll and a simple stem is found in certain living Angiosperms, e.g., the Palms, where it may perhaps be regarded as an ancient feature.

Thus in the Angiosperms as a class, free branching and small leaves have been substituted for a simple unbranched habit and large leaves. One can readily understand how, as the tendency to branching increased, the necessity for microphyll would arise and smaller foliage be evolved. In the one case branching takes place, as it were, in the leaf, in the other, in the stem. Both represent efficiency from a physiological standpoint attained by different methods.

The theory that the origin of the Angiospermous type of branching and consequently the prevailing leaf-form, took place some considerable time after the evolution of the primitive flower is in harmony with the axiom (see p. 35) that corresponding stages in the evolution of the various organs of a seed-plant are not reached contemporaneously. It also explains certain facts which have hitherto been regarded as highly mysterious. When we attempt to summarise the existing data relative to the first appearance of Angiosperms in Neocomian rocks, we are led to three remarkable conclusions. In the first place, the Angiosperms appear to arise very abruptly or suddenly. In the second, judging by their detached leaf-impressions, our sole evidence at present, they belong to highly evolved, and still existing natural orders. There appears to be nothing primitive about these early forms. In the third place, from their first incoming, they are the dominant types in the vegetation of the Cretaceous and Tertiary periods.

* Wieland (1906) Chapter II.
These conclusions are easily explained on the supposition that the earlier Angiosperms still retained the Cycad-like type of foliage of their ancestors; and as our knowledge of the Mesozoic floras is in great part, if not almost entirely, derived from detached leaf-impressions, and not from fructifications, it is not surprising that we have been puzzled by the facts as presented by the geological record. The so-called “sudden appearance” of the Angiosperms in Neocomian times may have no significance as regards the phylogeny of the group, but may well express the fact, that this group, already highly evolved and diversified, then assumed the free-branching habit and consequent microphyll. This hypothesis also explains why this race appears to be dominant over other groups even in the Neocomian period, for the subsidiary incoming stage of the life-line would be masked by the retention of the Cycad-type of foliage.

But, apart from these considerations, the great problem remains as to how the microphyllous foliage of the Angiosperms was derived from the Cycadean type. On this point we are at present unable to offer any suggestion unless we call mutation to our aid (see p. 36). So far we are not aware that fossil botany has afforded evidence of transitions from the type of foliage peculiar to any Mesozoic group to that of the Angiosperms.

THE ORIGIN OF MONOCOTYLEDONS.

It is still a matter of keen debate whether the Dicotyledons or the Monocotyledons are geologically the older group. The arguments are derived, partly from our knowledge of their living members, and partly from a study of fossil impressions. But it may be doubted whether either of these lines of attack afford sufficient data at present to settle the question quite beyond doubt.

Some * have regarded the Dicotyledons as derived from the Monocotyledons, while others†, including Hallier‡, hold the converse, in some cases with the reservation that the Monocotyledons branched off from the main Angiospermmous line, i.e. Dicotyledons, at a very early period. With the latter view we entirely agree.

So far as the fossil evidence is concerned, we doubt if it is possible to show that either group is really more ancient than the other. We agree with the opinion, now generally held, that the earliest fossil remains, which in the present state of our knowledge we can recognise as clearly belonging to the

* Lyon (1901, 1905).
† Sargent (1903), Mottier (1905), Chrysler (1906), Plowman (1906).
‡ Hallier (1905).
Angiosperms, are those of the Neocomian (Lower Cretaceous) of Portugal and the United States. In these rocks, what appear to be Dicotyledonous and Monocotyledonous leaf-impressions occur together. There have, of course, been many attempts to show that Monocotyledonous leaves are to be found in Mesozoic sediments of pre-Cretaceous age, or even in the Palaeozoic. None of these, however, appear to us to afford trustworthy evidence, and in many cases such fossils have been already claimed as members of other groups, such as the Cycadophyta and Cordaitales.

It seems evident that the earlier Angiospermous fossils afford practically no help in attempting to trace the ancestry of the race. Such plant remains consist almost entirely of detached leaf-impressions, which furnish little or no trustworthy evidence, beyond the fact that they are of undoubted Angiospermous origin. In the Tertiary rocks, seeds and fruits, also detached, occur on certain horizons, but impressions of flowers are almost unknown, or at least extremely rare. On the other hand, petrified woods, showing the typical structure of Dicotyledons and Monocotyledons, especially Palms, are found in the Upper Cretaceous and Tertiary formations. These fossils are usually of considerable size, but on the whole hardly advance our ideas in respect to the phylogeny of the group.

On the other hand, the Bennettitae, the near relatives of the hypothetical Hemiangiospermeae, afford some evidence in this connection. As was first pointed out by Solms-Laubach some years ago, the embryo of Bennettites has two cotyledons. We imagine that the Hemiangiospermeae also possessed two cotyledons, and that the Dicotyledonous type was thus more primitive than the Monocotyledonous.

Turning to the living Monocotyledons, we regard this race as one which has become largely specialised, in part to a geophilous, and in part to a hydrophilous * habit. The best explanation of the monocotyledonous embryo is, in our opinion, that put forward by Miss Sargent †. We consider that it is more than probable that the single cotyledon of Monocots, and also of some Dicots, is due to the fusion of the two cotyledons originally present, in response to the geophilous habit.

During the course of evolution there would seem to have been considerable "play upon," or modification of, every unit of the flower. And this appears to us to be true also of the embryo. Late, or far from primitive adaptations are to be found among embryos, just as among flowers. The cotyledonary tubes of some Ranunculaceae and other families, and the division of labour exhibited by the cotyledons of certain geophilous Peperomias, recently described by Mr. A. W. Hill ‡, appear to us to be cases in point.

In regarding the Angiosperms as a whole as monophyletic, we are in

* Gardner (1883), Henslow (1893) p. 527. † Sargent (1903, 1904, 1905).
‡ Hill, A. W. (1906).
agreement with Hallier* and Bessey † among others, though the contrary view has been recently upheld by Coulter and Chamberlain‡. In our opinion, the similarity to be found between the general structure of the amphisporangiate strobili of both Monocotyledons and Dicotyledons, especially in those cases which we regard as preserving primitive features, and the general identity exhibited by the gametophytes, is almost conclusive in this respect. The supposition that such resemblances are due to homoplasy, as Coulter and Chamberlain assert, does not appeal to us, for the chances of such complete parallelism of long duration must be almost infinitely small.

Some evidence also has been recently brought forward to show that the polycotylous embryo may have been derived from a dicotyledonous ancestor, by the splitting of the two seed-leaves §. This, in conjunction with the fact that Bennettites, as also Ginkgo and living Cycads, possess two cotyledons, inclines us to the view that the dicotylous condition was a primitive feature of the great majority, if not all Spermophyta.

ENTOMOPHILY.

We have already indicated that, on our view, it was a radical change in the method of cross-fertilisation which called the Angiosperms into existence. It is not perhaps safe to assume that the Bennettitae, or still more the Hemiangiopermeae, were wholly anemophilous, though we think there is a strong probability that such was the general method of pollination. At first we may imagine that such insects as visited the Mesozoic ancestors would be attracted to the male sporophylls for the sake of the pollen. In such amphisporangiate strobili as those of the Hemiangioperms, cross-fertilisation would be likely to result occasionally through insect visitors, owing to the close proximity of male and female sporophylls. In a monosporangiate strobilus, however, the male cones would probably alone be visited, hence there would be no tendency to cross-fertilisation. Consequently the evolution of entomophily may be expected to have arisen in anthostrobiloid plants. In the case of the Angiosperms such primitive entomophily was preserved, and rendered permanent by a transference of the pollen-collecting mechanism from the ovule itself to the carpel or megasporophyll, and by the closure of this organ.

Such a view is in accordance with that expressed by Robertson ||. The question, however, remains as to why this change in the manner of fertilisation should have necessitated the inrolling and union of the carpels. Robertson has recently asked this question, at the same time pointing out that a single ovule could hardly be pollinated any better, and that more than one could not be fertilised as well by the anemophilous method. It might,

* Hallier (1901, 1905).
† Coulter & Chamberlain (1904) p. 283.
‡ Bessey (1897).
§ Hill & de Fraine (1908).
|| Robertson (1904).
however, be argued that the closed condition would be as effective for wind pollination as the open carpel. A definite, receptive part of the closed sporophyll could catch the pollen wafted by wind as easily as the ovule of an open one. True, but on the supposition of a multiovulate carpel, the closed state would not be so effective for anemophily, since the chances are that insufficient pollen would reach the stigmatic surface to fertilise all the ovules. By entomophily, on the other hand, large masses of pollen, sufficient for the fertilisation of all the ovules, would be deposited on the carpel, as the result of a single visit. This view is borne out by the fact that most anemophilous Angiosperms have uniovulate carpels.

There is this further consideration that, by the closing in of the carpel, more efficient protection is afforded to the developing ovules and seeds, and at the same time the chance of their being pollinated is increased by the localisation of the collection mechanism. The insect has only to leave the pollen on one part of the carpel, whereas to fertilise each ovule of a multiovulate open carpel it must be deposited on or near each ovule.

Though agreeing so far with Robertson, we part company with him when he suggests that honey, and not pollen, first attracted insects to flowers. The converse seems to us the more probable, and besides offers a better explanation of how entomophily arose. Otherwise how are we to account for the evolution of floral nectaries? The secretion of honey previous to insect visitation does not appear likely. Afterwards, of course, the plant would gain by substituting this cheaper food-material in the place of pollen. It could then exercise considerable economy in the production of the latter, quite apart from the fact that entomophily in itself is less wasteful in this respect than anemophily. It is unnecessary here to trace further the evolution of the Angiospermous flower under insect influence. This study belongs to a special branch of botany, the main results of which are general knowledge.

While we regard the entomophilous condition as a primitive feature among Angiosperms*, there are numerous instances in which a return to the older, anemophilous habit has, more recently, taken place. These are frequently associated with the more extreme cases of reduction from the amphisporangiate to the monosporangiate condition, accompanied by suppression, often complete, of the perianth. Against the view that such anemophilous plants are primitive may be urged the fact that the inflorescence is almost invariably of a dense, complicated type, while the style, and especially the stigma, are obviously highly evolved structures, fashioned on the same plan as pertains in entomophilous flowers.

* Henslow (1893) p. 266; Wallace (1889) pp. 323-4.
GENERAL CONCLUSIONS AND SUMMARY.

From a general survey of existing Angiosperms, we have arrived at the conclusion that the Apetalous orders without perianth, such as the Piperales, Amentiferous families, and Pandanales, cannot be regarded as primitive Angiosperms. We thus dissent entirely from the current view, advocated especially by Engler. Engler’s theory is criticised on three grounds. Firstly it presupposes that the perianth must arise de novo, and be an organ *sui generis.* On the contrary, we surmise that the perianth is an ancient structure, present in the fructification of the immediate ancestors of the Angiosperms. In the second place, the so-called primitive flowers of the above orders are invariably accompanied by a complicated and highly-evolved inflorescence, which we are unable to regard as a primitive character. Thirdly, such a theory is phylogenetically sterile, for, while it has the merit of simplicity, it does not afford any clue to the ancestry of the group, nor does it tend to bring the living Angiosperms into line with the fossil plants of the past. On our view, the primitive and typical Angiosperous fructification is a special form of amphisporangiate cone, distinguished by the peculiar juxtaposition of the mega- and microsporophylls, and by possessing a well-marked perianth. A strobilus exhibiting these features we term an *Anthostrobilus.*

The word “flower,” which in our opinion should be restricted to the Angiosperms, is used in a great variety of senses. The flower of members of this group is regarded as a special form of the Anthostrobilus, and may be distinguished as an *Eu-antlantostrobilus,* of which the distinctive features are the presence of the special type of microsporophyll termed a stamen, and of closed carpels. On our view, however, an earlier form of Anthostrobilus is to be found among Gymnosperms, where, however, the megasporophylls are not closed, and the microsporophylls have not the form which can be called stamens. We designate this latter type a *Pro-anthostrobilus.* This is the form of cone possessed by the Mesozoic Bennettiteae, and also we believe by the hypothetical, direct ancestors of the Angiosperms, or, as we here term them, the *Hemiangiospermeae.*

On the strobilus theory of the primitive Angiospermous fructification, we find, when we turn to the fossil evidence, that it is possible to trace the descent of living Angiosperms in its broad outlines. The direct ancestors of this group (the Hemiangiospermeae) are unknown as yet in the fossil state. But on this theory we recognise in the Pro-anthostrobilus of the Mesozoic Bennettiteae, which we regard as closely related to the Hemiangiospermeae, features which enable us to restore in some measure the missing fructification of the ancestor. We are helped in this task by what we have termed the law of corresponding stages in evolution, which states that equivalent stages in the evolution of the different organs of one and the same seed-plant are not contemporaneous in point of time. This has proved
especially valuable in the consideration of the origin of the Angiospermous type of leaf, which we suggest was initiated by a change in the branch habit.

We regard the Angiosperms as essentially a monophyletic group, the Monocotyledons having branched off from the Dicotyledonous stock at an early period, probably from the Ranalian plexus. In both these groups entomophily was a primitive feature. We consider that the change, from the assumed generally anemophilous habit of the Mesozoic Hemiangiospermea, and the Bennettiteae, to entomophily, by means of a shifting of the pollen-collecting mechanism from the megasporangium to the megasporophyll, and the consequent formation of an ovary, has supplied the “motive force,” which not only called the Angiosperms into existence, but laid the foundation of their future prosperity.

If these conclusions have weight, then it is now possible to trace back the line of descent of the Angiosperms to a very early geological period. This may be shown in tabular form as follows:

<table>
<thead>
<tr>
<th>Number</th>
<th>Ancestral Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Homosporous Fern-like Ancestor.</td>
</tr>
<tr>
<td>2.</td>
<td>Heterosporous Fern-like Ancestor.</td>
</tr>
<tr>
<td>3.</td>
<td>Pteridospermee (unknown fossils).</td>
</tr>
<tr>
<td>4.</td>
<td>Hemiangiospermee (unknown fossils).</td>
</tr>
<tr>
<td>5.</td>
<td>Angiospermee</td>
</tr>
</tbody>
</table>

5. Angiospermee

5. Angiospermee Mesozaic and Tertiary (Recent),—

Eu-anthostrobiliteae.

4. Hemiangiospermee (unknown fossils).—

Mesozaic,—Pro-anthostrobiliteae.

3. Pteridospermee


1. Homosporous Fern-like Ancestor.

Numbers 1, 2, and 4 are unknown fossils, but the key to numbers 1 and 2 is given by the Pteridospermee (No. 3), and to number 4 by the Bennettiteae. Numbers 3, 4, and 5 were Spermophytes.

Such a theory of descent will permit us to venture rather further afield. In both the homo- and heterosporous, primitive, fern-like ancestors, there is every reason to believe that the sporophylls were arranged in a lax manner, and not aggregated into definite strobili. This condition still remained a feature of the fern-like seed-plants, or Pteridospermee. From this Palaezoic plexus, however, strobilate lines of descent were probably evolved in Mesozoic times by two distinct methods. In the one, like sporophylls were aggregated into monosporangiate cones. In the other, both male and female sporophylls were massed in one amphisporangiate strobilus, the sporophylls however, for a time at least, retaining their primitive, fern-like form, as is clearly seen in the male organs of the Bennettiteae. The monosporangiate Strobilaleae led to the modern Cycads. This conclusion receives support from the fact that, in the genus Cycas itself, only the male sporophylls are aggregated into cones. The female may be regarded as having remained more or less in their ancestral condition, especially with regard to their distribution on the axis. Such a case would be difficult to explain on the
supposition that, in the modern Cycads, the monosporangiate condition was originally derived from a amphisporangiate strobilus. On the other hand, the amphisporangiate Strobilatea gave rise to other groups, such as the Bennettitae and the Angiosperms, in the manner indicated in the following table:

**Table of Angiospermous Relationships.**

<table>
<thead>
<tr>
<th>Recent</th>
<th>Tertiary</th>
<th>Mesozoic</th>
<th>Palaeozoic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monosporangiatesae</td>
<td>Diplosporangiatesae</td>
<td>Pro-anthostrobilateae</td>
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**BIBLIOGRAPHY.**


INTERNATIONAL CATALOGUE OF
Scientific Literature.

The Royal Society has been engaged for some years past in arranging for
the publication of an International Catalogue of Scientific Literature,
beginning from the 1st January, 1901. Each science is represented in
an annual volume containing lists arranged under authors and subjects, of
all books and papers published during the year; these are contributed
through official channels of information—abroad, by direct control of the
respective governments—at home, by means of the various Societies which
devote themselves to particular sciences; those Societies whose domains
overlap having arranged for mutual cooperation.

The collection of title-slips for the United Kingdom of Great Britain
and Ireland as regards

BOTANY

has been undertaken by the Council of the Linnean Society, and they appeal
to all botanic workers for support in their endeavour to compile a complete
record, by sending notices promptly of all botanic issues to the undersigned.

The fifth volume, for 1905, will shortly be issued.

B. DAYDON JACKSON,
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The Apartments of the Society will be closed during the month of August.
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Report on the Freshwater Algae, including Phytoplankton, of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905. By G. S. West, M.A., F.L.S., Lecturer on Botany, Birmingham University. (Plates 2–10.) ........................................ 81
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I. INTRODUCTION.

The Algae collected by Dr. Cunnington during his expedition to the large African lakes, in 1904–5, were submitted to me for examination by Dr. Rendle, Keeper of the Botanical Department of the British Museum. Dr. Cunnington's collections were of an extensive nature, and consisted largely of plankton obtained from the three great lakes, Nyasa, Victoria Nyanza, and Tanganyika. A portion of the material was collected in swamps and swampy pools, and a few of the most interesting Algae were obtained from among the finely divided leaves of certain species of *Utricularia*.

The plankton from Tanganyika is for several reasons of the greatest interest. In the first place, no plankton has previously been reported on from this lake, although accounts have appeared on plankton from both Lake Nyasa and Victoria Nyanza. The species of the phytoplankton are likewise of a very noteworthy character, and the phytoplankton as a whole presents several peculiarities which may be of some slight assistance in the elucidation of the Tanganyika problem.

During recent years a considerable amount of work has been done on the freshwater Algae of Tropical Africa, but our knowledge of their distribution throughout this vast area still remains very fragmentary and incomplete. No collections have as yet been sufficiently representative, and the published records are both few in number and from districts widely remote from one another. Until much more collecting and systematic examination has been accomplished, it is quite impossible to draw any definite conclusions concerning the geographical distribution of the Algae in the fresh waters of Tropical Africa.

It would appear that the study of the family Desmidiaceae is likely to give more valuable evidence regarding a definite region characterized by African types than the investigation of any other family of Algae, and therefore future collections would have most value if made largely from the permanent and long-standing swamps. Notwithstanding the cosmopolitan nature of no
small number of Desmids, these plants show more decided geographical peculiarities than are to be found among the members of any other large group of Algae. Even with the present state of our knowledge there is evidence which indicates a very definite Indo-Malayan region, extending to North Queensland, and characterized by certain well-marked types; a second one comprising much of North America and N.W. Europe; and also a third, South-American region, which possibly extends into the South Australian area. The African region may probably embrace Madagascar, and there is also much similarity between some of the Madagascar Desmids and those of Ceylon. More collections of Algae from Tropical Africa are urgently required consisting of material obtained by carefully squeezing and stripping the aquatic phanerogams and submerged mosses of the swamps.

Only a small proportion of Dr. Cunnington’s material was from swamps, and much of that which had been collected from such situations consisted merely of floating Algae. This at once explains the fact that the Desmidiaceae recorded in this paper are in no way striking, or, with few exceptions, particularly representative of the African region. Those which may be regarded as of a distinctly African type are the following:—

- *Euastrum hypochondroides*, W. & G. S. W.
- *E. personatum*, W. & G. S. W.
- *E. pseudopectinatum*, Schmidle.
- *Cosmarium glyptodermum*, W. & G. S. W.
- *C. planum*, W. & G. S. W.
- *C. subauriculatum*, W. & G. S. W.
- *C. multiordinatum*, W. & G. S. W.
- *C. subomnistrictum*, Schmidle.
- *Staurastrum limneticum*, Schmidle.
- *S. gracile*, Ralfs, var. subornatum, Schmidle.

Five Desmids and two filamentous Conjugates I have described as new species.

Of the Chlorophyceae other than the Conjugate, *Eedogonium Kurzii*, Zeller, and *Chodatella subalba*, Lemm., are both very interesting species, and seven others I have described as new; one—*Sphinctosiphon polymorphus*, from the plankton of Victoria Nyanza—having had to be regarded as the type of a new genus. Of the other new forms of green Algae, *Calostrum compositum* differs from all other described species of the genus in the composite grouping of its cells.

The Diatoms were both numerous and peculiar, ten species not agreeing with any previously described. The Diatoms of the plankton are particularly noteworthy, especially those of the family Surirellaceae.

Numerous Myxophyceae (or blue-green Algae) were present both in the plankton and the other collections. The genera *Anabaena*, *Calothrix*, *Lyngbya*,
*Phormidium* and *Oscillatoria* were very well represented, and eleven species of various genera have been regarded as new.

The collections were preserved in formalin, and taken as a whole the material was in very good condition for examination.

Considering the somewhat special character of the plankton, and the fact that it constituted one half of the material collected, I have dealt with it separately in the next chapter.

The principal publications on Freshwater Algae from Tropical Africa, which are particularly important in conjunction with the present paper, are the following:

- G. v. Lagerheim: Chlorophyceen aus Abessinien und Kordofan. La Nuova Notarizia, ser. 4, 1893.

II. THE PHYTOPLANKTON.

General remarks.—The observations on the phytoplankton of Lake Nyasa, Victoria Nyanza, and Lake Tanganyika are largely concerning the occurrence of certain species, and it has been a matter of no small difficulty to identify with certainty some of these plankton-forms. With regard to the species which were present in the collections, the examination of the material has been fairly exhaustive, but owing to the restricted explorations little can be said about the periodicity, or concerning any maximum development which these species may attain. In Lake Nyasa the material was collected in
June 1904, and is chiefly interesting in comparison with material collected by Dr. Fülleborn (1898–1900) and reported upon by Schmidle *. In Victoria Nyanza the material was collected in April 1905, and again the chief interest lies in a comparison with Schmidle’s report † upon material collected by Dr. Stuhlmann in Oct. 1892. From Tanganyika, however, the collections were much more extensive, ranging from July 1904 to Feb. 1905, and this is the more gratifying as there are no previous records of phytoplankton from this lake.

The phytoplankton of these large African lakes is at once peculiar in the absence of many genera which are a dominant feature of the European lake-plankton. Most noticeable in this respect are the genera Dinobryon, Asterionella, Tabellaria, Rhizosolenia, and Closterium. Schmidle has already commented ‡ upon the absence of Dinobryon from Lake Nyasa, and it is similarly absent from both Victoria Nyanza and Tanganyika. In temperate Europe and N. America this genus is one of the most conspicuous of plankton-organisms, having a well-marked maximum period, and it also occurs in abundance in the lakes of more northern latitudes. Its absence from the plankton of the tropics is perhaps due to unsuitable conditions of temperature, as this genus appears to attain its maximum in the European plankton at a temperature below 15° C., whereas the mean temperature of Tanganyika is about 24° 7° C. The absence of Asterionella and Rhizosolenia may be due to the same cause, viz., too high a temperature, the latter genus attaining its maximum in certain European lakes at a temperature below 10° C. The genus Tabellaria is absent from the plankton, but Tabellaria floculosa has been observed from other situations in Angola, W. Africa.

Sphaerocystis Schroeteri is also absent from the collections of phytoplankton which have so far been made in these great African lakes, and as Schmidle has also commented upon its absence from the plankton of Lake Nyasa §, even from collections extending over a period of ten or eleven months, it would appear that the Alga in question is entirely absent from this lake. It is likewise absent from the Tanganyika collections, which are fairly representative of eight months of the year; but, strange to say, it occurred in great abundance in two samples of plankton from the Lofu River which runs into Tanganyika.

The Desmidiaceae are poorly represented in the plankton of Tanganyika and Lake Nyasa, but in the plankton of Victoria Nyanza Desmids play a conspicuous part. This was not only the case in Dr. Cunnington’s material collected in April 1905, but also in Dr. Stuhlmann’s material collected in October 1902 ‖. The plankton of Victoria Nyanza thus compares favourably

† W. Schmidle, l. c. xxvi. (1896).
‡ W. Schmidle, l. c. xxxii. (1903) p. 8.
§ W. Schmidle, l. c. xxxii. (1903) p. 8.
with that of the British lakes with regard to its Desmid-flora. Moreover, the most abundant Desmid is *Staurastrum limneticum*, Schmidle, a species of a similar type to *S. Ophiara*, Lund., which latter is generally distributed in many lakes of the western areas of the British Islands.

The Surirellaceae are well represented, and certain handsome species of *Surirella* seem to have firmly established themselves in the plankton. This is again strictly comparable to the establishment as plankton-species of several large *Surirella* in the Scottish and Irish lake-plankton.* Cymatopleura Solea* seems also in many cases to have become a plankton Diatom, and in the plankton of Victoria Nyanza there is a large species which I have named *Cymatopleura Nyanza*.

Species of *Celosphaerium*, which constitute no small amount of the European lake-plankton at certain seasons of the year, appear to be quite absent from these African lakes.

As in the European plankton, there is a tendency among certain of the Algae to a spiral growth, which results in the production of close-coiled filaments. In the Scottish and Irish plankton this feature was principally confined to the filaments of *Anabaena Flos-aquae* and *A. circinalis*, to certain of the small species of *Mougeotia*, and to the disposition of the frustules in the colonies of *Asterionella* and *Tabellaria*. In the African plankton a spiral twisting is a conspicuous feature of the *Anabaena*-filaments, but the spirals are of a more regular type and the filaments relatively much shorter. In *Lyngbya circumcreta* the same tendency to spiral growth has resulted in the formation of short spiral filaments which have the appearance of little coils of wire. The same spiral character is exhibited by *Lyngbya contorta*, Lemm. Ostenfeld has described and figured from a lake in Iceland, and Volk has mentioned as occurring in the Elbe, a similar coiled condition of the filaments of *Melosira granulata*.

It has already been suggested that the development of this coiled condition is a limnetic character, and it is certainly of great interest to find this character in so many different species and genera of the phytoplankton. Lemmermann attributes the curvature of the *Melosira*-filaments to the movements of the water. This may be so, but how is it that the majority of *Melosira*-filaments met with in the plankton are quite straight? The filaments

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† C. H. Ostenfeld, in Botanisk Tidsskrift, xxvi. (1904) p. 233, fig. 5 (p. 232).

‡ R. Volk, Hamburgische Elb-Untersuchung I., Hamburg, 1903, p. 113.


of *Melosira granulata* and of *M. nyassensis* in the African plankton were either quite straight or almost straight, and the same remarks apply to the species of *Melosira* in the Scottish and Irish plankton. Ostenfeld points out that the *Melosira*-filaments are straight in the Danish plankton*, but commonly coiled in plankton he examined from a lake in Iceland.

I am not aware of a definite spiral character, such as the one just mentioned, having been developed by any Algae other than limnetic species †, and another equally well-marked limnetic feature is exhibited by certain of the smaller species of *Syedera*, in which there is a tendency to assume a colonial character owing to the grouping of the frustules in radiating clusters ‡.

Special characters of this nature, which appear only to be fully acquired in the plankton, are most probably directly concerned in increasing the floating-capacity of the species; and the rearrangement of the mucus enveloping all these plants to a greater or less degree, which must be caused by the acquirement of such peculiarities, may also assist their capabilities of suspension.

A strict comparison between the phytoplankton of the three lakes is not possible from the present material, owing to the fact that the collections from each lake were not made at the same seasons of the year. Nevertheless, considerable differences exist which are in no way due to seasonal variations of the plankton-organisms, and these differences are of a highly interesting character. A more complete comparison can be made between Tanganyika and Lake Nyasa than between either of these lakes and Victoria Nyatiza, as collections from the two former lakes extend over a corresponding period of about eight months.

The table immediately following has been constructed to show all the species which have been observed in Dr. Cunnington's plankton-collections; after which are paragraphs relating to the peculiarities of the plankton of each lake, Tanganyika receiving rather fuller treatment than the others.

* Cf. also C. Wensenberg-Lund, 'Studier over de danske Siøers Plankton,' Kjøbenhavn, 1904.

† In the genera *Spirulina* and *Arthrospira* the filaments are usually very much longer and the spirals of much less diameter than in the limnetic spirally-twisted forms. *Spirulina laxissima*, a new species from the plankton of Tanganyika, is particularly interesting, as in correlation with its limnetic existence the filaments are short and the spiral twists of much greater diameter than usual.

‡ Lemmermann has created a subgenus "Belonastrum" for the plankton-species which form these stellate or radiating clusters. *Cf.* Ber. Deutsch. Bot. Ges. xviii. (1900) p. 30. In this subgenus of *Syedera* Lemmermann places four species (*S. actinastroides*, *S. berolinensis*, *S. rectilinius*, and *S. limnetica*) and several varieties, of which he gives a summary in the same Journal, xxiv. (1906) pp. 537, 538.
<table>
<thead>
<tr>
<th>Species</th>
<th>Nyasa</th>
<th>Victoria Nyanza</th>
<th>Tanganyika</th>
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<tbody>
<tr>
<td><strong>Chlorophyceae.</strong></td>
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<tr>
<td>Closterium Leibleinii, Kütz.</td>
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<td>Cosmarium depressum, (Nag.) Lund.</td>
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<td>contractum, Kirchn., var. ellipsosideum, (Elfr.) W. &amp; G. S. West.</td>
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<td>moniliforme, (Turp.) Rals</td>
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<td>Arthrodesmus Incus, (Bréb.) Hass., forma</td>
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<td>brevispinum, Bréb., var. inerme, Wille</td>
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<td>alternans, Bréb.</td>
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<td>setigerum, Cleve, var. Nyasae, Schmidle</td>
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<td>tohopelagiforme, Wolle</td>
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<td>leptocladum, Nordst., forma africanaum</td>
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<td>gracile, Rals, var. subornatum, Schmidle</td>
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<td>var. protractum, var. n.</td>
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<td>var. Nyasae, var. n.</td>
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<td>austinum, Cooke &amp; Wills, var. subglabrum, var. n.</td>
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<td>limneticum, Schmidle</td>
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<td>var. aculeatum, Lemm.</td>
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<td>Sphaerococcum excavatum, Rals</td>
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<td>Hyalothece mucosa, (Dillw.) Ehrenb.</td>
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<td>Pediasastrum simplex, Meyen</td>
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<td>forma Sturtii, (Reinsch) nob.</td>
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<td>var. cloathratum, (Schröt.) nob.</td>
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<td>forma microporum</td>
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<td>duplex, Meyen</td>
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<td>Boryanum, (Turp.) Menegh.</td>
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<td>Species</td>
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<td>Victoria Nyanza</td>
<td>Tanganyika</td>
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<td><strong>Chlorophyceae</strong> (continued).</td>
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<td>Closteriopsis longissima, Lemm.</td>
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<td>Kirchneriella obesa, (West) Schmidle</td>
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<td>Oocystis lacustris, Chodat</td>
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<td>&quot; Parva, W. &amp; G. S. West</td>
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<td>Dictyosphaerium pulchellum, Wood</td>
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<td>Botryococcus Brainii, Kütz.</td>
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<td>Ineffigia neglecta, W. &amp; G. S. West</td>
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<td>Tetracoccus botryoides, West</td>
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<td>Sphinctosphon polymorphus, gen. et sp. n.</td>
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<td><strong>Bacillariæ.</strong></td>
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<td>Stephanodiscus Astraea, (Ehrenb.) Grun.</td>
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<td>&quot; var. spinulosus, Grun.</td>
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<td>&quot; var. minutula, (Kütz.) Grun.</td>
<td></td>
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<tr>
<td>Synedra Acus, Kütz.</td>
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<td>&quot; var. delicatissima, (W. Sm.) Grun.</td>
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<tr>
<td>&quot; var.? (= S. revaliensis, Lemm.)</td>
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<tr>
<td>&quot; actinastroides, Lemm.</td>
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<tr>
<td>Cocconeis Pedicula, Ehrenb.</td>
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<tr>
<td>&quot; Placentula, Ehrenb.</td>
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<tr>
<td>Navicula Tanganyika, sp. n.</td>
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<tr>
<td>&quot; elliptica, Kütz.</td>
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<td>&quot; Popula, Kütz.</td>
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<td>&quot; mutica, Kütz.</td>
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<td>&quot; Crucicula, (W. Sm.) Donkin</td>
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<td>&quot; bahustenis, Grun.</td>
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<td>&quot; radiosa, Kütz.</td>
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<td>&quot; rhychosphaia, Kütz.</td>
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<tr>
<td>&quot; distincta, sp. n.</td>
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<tr>
<td>&quot; Gastrum, Ehrenb.</td>
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<tr>
<td>Schizostauron Crucicula, Grun.</td>
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<tr>
<td>Gyrosigma attenuatum, (Kütz.) Cleve</td>
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<tr>
<td>&quot; nodiferum, (Grun.) nob.</td>
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<tr>
<td>Cocconeis grossestriatum, (O. Müll.) nob., var. Tanganyika, var. n.</td>
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<tr>
<td>&quot; cymbiforme, Ehrenb.</td>
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<tr>
<td>&quot; Cistula, (Ehrenb.) W. Sm., var. maculata, (Kütz.) Cleve.</td>
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<tr>
<td>Species</td>
<td>Nyasa</td>
<td>Victoria Nyanza</td>
<td>Tanganyika</td>
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<tr>
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<td>Amphora ovalis, Kütz.</td>
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<td>Epithemia turgida, (Ehrenb.) Kütz.</td>
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<tr>
<td>Rhopalodia gibba, (Kütz.) O. Müll., var. ventricosa, (Grun.) O. Müll.</td>
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<tr>
<td>Nitzschia Tryblionella, Hantzsch, var. littoralis, (Grun.) Van Heurck.</td>
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<tr>
<td>Nitzschia Pyrhythmella, Hantzsch, var. intermedia, O. Müll.</td>
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<tr>
<td>Malombe, O. Müll.</td>
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<tr>
<td>Nyassa, O. Müll.</td>
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<td>plana, sp. n.</td>
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<tr>
<td>constricta, Ehrenb., var. africana, O. Müll.</td>
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<tr>
<td>obtusangula, sp. n.</td>
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<tr>
<td>Tanganyika, sp. n.</td>
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<tr>
<td>striatula, Turp.</td>
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<tr>
<td>Gymatopleura Solea, (Kütz.) W. Sm.</td>
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<tr>
<td></td>
<td>var. laticeps, O. Müll.</td>
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<tr>
<td>Nyanza, sp. n.</td>
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**Myxophyceae**

<table>
<thead>
<tr>
<th>Species</th>
<th>Nyasa</th>
<th>Victoria Nyanza</th>
<th>Tanganyika</th>
</tr>
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<tr>
<td>Nostoc piscinale, Kütz.</td>
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<tr>
<td></td>
<td>var. carneum, Ag.</td>
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<tr>
<td>Anabena Flos-aquae, (Lyngh.) Bréb., forma.</td>
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<tr>
<td></td>
<td>var. circularis, var. n.</td>
<td>x</td>
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<tr>
<td></td>
<td>sp.? (fil. rigidissim.)</td>
<td>x</td>
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<tr>
<td></td>
<td>Tanganyika, sp. n.</td>
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<td>x</td>
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<tr>
<td></td>
<td>sp.? (fil. contort.)</td>
<td>x</td>
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<tr>
<td>Plectonema Wolfei, Parlow.</td>
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<tr>
<td>Lyngbya bipunctata, Lemm.</td>
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<tr>
<td>circumcorta, sp. n.</td>
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<td>timmetica, Lemm.</td>
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<td>perelegans, Lemm.</td>
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<td>Phormidium tenue, (Ag.) Gom.</td>
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<td>angustissimum, W. &amp; G. S. West</td>
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<td>Oscillatoria princeps, Vauch.</td>
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<td>Tanganyika, sp. n.</td>
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<td></td>
<td>tenuis, Ag.</td>
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<td>Spirulina laevisima, sp. n.</td>
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<td>Gloostrichia longispiculata, sp. n.</td>
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<td>natans, (Hedwig) Rabenh.</td>
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<tr>
<td>Dactyloccopsis africana, sp. n.</td>
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</table>
Phytoplankton of Nyasa.—This lake lies between 9° 30' and 14° 25' S. lat., its long axis running almost north and south. It is about 400 miles long, with an average width of 25 miles, and is 1570 ft. above sea-level. Its area is about equal to that of Tanganyika. The phytoplankton has been fairly well investigated by Schmidle from material collected at intervals from April 1898 to Dec. 1900 by Dr. Fülleborn. Schmidle reported upon the species he found in the plankton, the periodicity of the genera so far as he was able to work it out, and the vertical depth to which the various genera extended in the lake. Nyasa is shallow at the north end and very deep towards the south end, no bottom having been found in several places at 1200 feet. Schmidle states that the phytoplankton extends in no trifling quantity to fully 300 ft. from the surface, and at this depth consists principally of Diatoms, with a few Chlorophyceae and Myxophyceae.

In Dr. Cunnington's material, collected in June 1904, Chlorophyceae were not very abundant, and those which did occur were mostly representatives of the Protococcoidae. Only three Desmids were observed, one of which—Staurastrum leptocladum forma africanum—was in moderate abundance. Forms of Pediastrum simplex and species of Calastrum were very abundant, and in some of the collections Closteriopsis longissima was fairly common. The Diatoms comprised relatively few genera, of which Melosira, Cyclotella,
OF THE THIRD TANGANYIKA EXPEDITION.

Stephanodiscus, and Surirella were conspicuous. A few species of Navicula were not uncommon and Nitzschia nyassensis was frequent. Surirella Nyassa and S. bifrons were very characteristic, the former being a large and handsome species which is apparently peculiar to this lake.

Some of the collections, more especially nos. 15 and 16, were remarkable for the prodigious abundance of a form of Anakvna Flos-aquae. The other Myxophycæae of importance were Lyngbya bipunctata and Gloeotrichia longiarticulata, sp. n.

A species of Peridinium, which Lemmermann has described as P. africanum, occurred abundantly in some of the material.

Phytoplankton of Victoria Nyanza.—This large sheet of water extends from 0° 25' N. to 3° S. and from 31° 45' to 34° 45' E., occupying an area of 32,167 square miles. Its greatest length is 180 miles and its greatest width 208 miles, its height above the sea being about 3800 ft. The depth is very variable, from about 6 ft. (at 2 miles from the shore) in Speke Gulf in the south to 300 ft. towards the middle, and 620 ft. near the eastern shore.

The material was collected in April 1905, and was decidedly rich in Chlorophyceæ, especially Protococcæ and Desmidææ. Of the latter, Staurostrum limneticum and S. tofopèkaligense occurred in great abundance, and S. leptocladum forma africanum, S. brevispinum var. inerme, forms of S. gracile, and Cosmarium moniliforme were fairly common. The Protococcææ were both abundant and of diverse character. Conspicuous were numerous forms of Pediastrum simplex and large coenobia of Calastraurn reticulatum and C. cambricum var. nasutum. Calastraurn compositum is a previously undescribed species in which the grouping of the cells is very peculiar. Fine colonies of Dimorphococcus lunatus were not uncommon, and the colonies of Selenastrum gracile were the largest and best-developed I have ever seen. Closteriopsis longissima, which was present in the material from Lake Nyasa, and which is known from the plankton of several parts of Europe, was frequent, and Sphinctosiphon polymorphus is a new genus of the Palmellæææ in which the mature colonies assume a vermiform character.

The Diatoms were relatively few in number, but included a few fine species of Surirella, such as S. Füllebornii and S. Malomber, a large new species of Cymatopleura (C. Nyars, sp. n.), and several species of Cyclotella and Melosira.

The Myxophycææ were poorly represented except for a few of the Chroococcæææ. Two species I have considered to be new, Lyngbya circumcreta and Daetlylococcopsis africana. Only a few fragments of a species of Anabena were observed, but this may be due to the season of the year, as this genus was abundant in Tanganyika and Lake Nyasa later in the year.

Of the Peridiniæææ, a curious reduced form of Ceratium Hirundinella was
rather scarce. The apical horn was very short and only two ant-apical horns were present.

From the examination of Dr. Cunnington's material collected in April, I agree with Schmidle’s remarks upon Dr. Stuhlmann’s collections which were made in October. The phytoplankton is essentially a Chlorophyceous plankton, and from the abundance of certain species of Staurastrum, it has all the features of a Desmid-plankton.

**Phytoplankton of Tanganyika.**—This lake is an elongated sheet of water lying between 3° and 9° S. lat. It has a length of 400 miles and a width varying between 10 and 45 miles. Its area is estimated at 14,000 square miles, and it is situated at 2700 ft. above sea-level. It is a deep lake, the southern end reaching a depth of 980 ft., and the northern end exceeding 1300 ft. in several places. The mean temperature of the water is stated to be 24.7° C. (76° F.).

Dr. Cunnington's collections of plankton extended from July 1904 to February 1905, and can be considered as fairly representative of eight consecutive months from July to February inclusive.

The phytoplankton is considerably richer as regards species than that of Lake Nyasa or Victoria Nyanza. The Chlorophyceae are not particularly abundant, and, as in Lake Nyasa, Desmids are practically absent. In direct contrast to the phytoplankton both of Nyasa and Victoria Nyanza, *Pediastrum simplex* was very scarce and the genus *Celastrum* was quite absent. *Oocystis lacustris* was the most abundant of the Protococcomoidae, although *Scedesmus quadricauda* was fairly general, and *Scedesmus bijugatus forma arcuatus* was a feature of the October and November plankton. Other interesting species of the Protococcomoidae were *Crucigenia tetracantha*, sp. n., *Ankistrodesmus nitzschioides*, sp. n., *Cerasterias rhaphidioides*, Reinsch, and *Chodatella subsalsa*, Lemm. The latter is a brackish-water species which occurred in abundance in one of the November collections.

The Diatoms formed a large part of the phytoplankton throughout the whole eight months, and 25 of the species were not observed either in Nyasa or Victoria Nyanza. Eight species of *Navicula* were noted, two of which, *N. Tanganyika* and *N. distincta*, are new. The genus *Surirella* was represented by five species, of which three (*S. plana*, *S. obtusiuscula*, and *S. Tanganyika*) are new, and one of the others, *S. striatula*, is usually brackish or marine. A Diatom which I have considered to be identical with *Nitzschia nyassensis*, O. Müll., occurred in prodigious abundance from July to September, and in considerable quantity in the other months. The remaining Diatoms of importance were *Synedra actinostroides*, *S. Acus var. revaliensis*, *Gyrosigma nodosum*, and *Cymbella grossestriata var. Tanganyikar.*

The almost entire absence of Centric Diatoms is a noteworthy feature of
the Tanganyika collections, offering a marked contrast to the plankton of Nyasa and Victoria Nyanza, in which Stephanodiscus, Cyclotella, and Melosira abound. Only one species of Cyclotella was observed in the Tanganyika plankton and that very sparingly in the November collections.

Of the Myxophyceae, two pelagic species of Nostoc (N. piscinale and N. carneum) were present in the August collections, and Anabena Flos-aqua var. circularis occurred in large quantity from October to February. So abundant was this Anabena from October to December that the material taken from the tow-nets was of a dull blue-green colour although no spores had been developed. A. Tanganyikae, a new, spirally-twisted species, only occurred in January and February. Four species of Oscillatoria were observed, one of which, O. Tanganyikae, is a remarkable new species nearest to the marine O. subuliformis. Another new species of interest is Spirulina laxissima. The cells in the genus Spirulina are normally twisted into a rather close and narrow spiral, and the laxness of the twists in S. laxissima may be due to its adaptation to a pelagic existence.

The occurrence of Plectonema Wollei, Farlow, in the plankton is also worthy of note. This alga is not uncommon in the more aerated of the fresh waters of the tropics, but usually occurs attached to stones or large aquatic plants, especially in running water. Except for the very rare presence of false branches (“pseudo-rami”), this species appears to me to differ in no essential point from Lyngbya majuscula, Harvey, which is the largest of the marine species of Lyngbya. May not the presence or absence of false ramification be due to a difference of environment?

Eight species of the Chroococcaceae were observed in the plankton of Tanganyika which were not observed from the other lakes.

Four species of the Peridiniales occurred, all of which were most abundant from September to November, about the time of the maximum period of Anabena Flos-aqua var. circularis. Peridinium africanum and Peridiniopsis Cunninghamii have been described by Lemmermann as new species. Glenodinium Pulvisculus was particularly abundant in one of the November collections.

From a careful comparison of the collections there are slight indications that the plankton of this lake may not be uniform throughout. The constituents are probably not in the same proportions in different parts of the lake at the same time, and further observations will probably show that this is especially the case with regard to the relative dominance of Anabena Flos-aqua and Synedra Acus (together with Nitzschia myassensis).

The following table contrasts the relative frequency of the various species observed in the collections from July 1904 to February 1905. “cccc” = very abundant, “ccc” = common, “cc” = fairly common, “c” = infrequent, “rr” = rare, and “rrr” = very rare.
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<thead>
<tr>
<th>Species</th>
<th>Chlorophyceae</th>
<th>Bacillariae</th>
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<tbody>
<tr>
<td>Closterium Leibleini, Kütz.</td>
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<tr>
<td>Staurotrum alternans, Bréb.</td>
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<tr>
<td>Hydroclea mucosa, (Dillw.) Ehrenb.</td>
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<tr>
<td>Pedionema simplex, Meyen</td>
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<tr>
<td>&quot; duplex, Meyen</td>
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<tr>
<td>&quot; Boryanum, (Torp.) Monog.</td>
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<td>&quot; Tetras, (Ehrenb.) Ralsis</td>
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<td>&quot; integrum, Näg.</td>
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<td>Scenedesmus bijugatus, (Torp.) Kütz.</td>
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<td>&quot; forma arca tus, (Lemm.) W. &amp; G. S. West.</td>
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<tr>
<td>&quot; acutiformis, Schröder, var. brasilensis,</td>
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<td>(Bohlin) W. &amp; G. S. West.</td>
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<tr>
<td>&quot; quadricauda, (Torp.) Bréb. var. maximus,</td>
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<tr>
<td>W. &amp; G. S. West.</td>
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<tr>
<td>Ankistrodesmus falcatus, (Corda) Ralsis,</td>
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<td>var. spirillumformis, G. S. West.</td>
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<td>nitzchioides, sp. n.</td>
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<td>&quot; Tetraedron minimum, (A. Br.) Hang.</td>
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<td>&quot; Cerasterias raphidioides, Reinsch.</td>
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<td>&quot; Richteriella botryoides, (Schmidle) Lemm.,</td>
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<tr>
<td>&quot; forma quadrineta, (Lemm.) Chodat.</td>
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<td>Chodatella subsalsa, Lemm.</td>
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<tr>
<td>&quot; Dictysphrium pulchellum, Wood</td>
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<tr>
<td>&quot; Tetracoccus botryoides, West</td>
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<tr>
<td>&quot; Botryococcus Braunii, Kütz.</td>
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<td>&quot; Gloeocystis gigas, (Kütz.) Lagerh.</td>
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<td>Coconeis Pedi culus, Ehrenb.</td>
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<td>&quot; Navicula Tanganyika, sp. n.</td>
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<td>&quot; elliptica, Kütz.</td>
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<td>&quot; Papula, Kütz.</td>
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<td>&quot; bahiensis, Grun.</td>
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<td>&quot; rhynchocephala, Kütz.</td>
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<td>&quot; diastica, sp. n.</td>
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<td>&quot; Gastrum, Ehrenb.</td>
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<tr>
<td>Coconeis grossstraum, (Q. Mull.) nob.</td>
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<td>Amphora ovalis, Kütz.</td>
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<td>1905</td>
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<td><strong>Amphora coffeiformis</strong>, (Ag.) Kütz.</td>
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<td><strong>Epithemia turrida</strong>, (Ehrenb.) Kütz.</td>
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<tr>
<td><strong>Rhodotria gibba</strong>, (Kütz.) O. Müll., var. ventricosa, (Grun.) O. Müll.</td>
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<tr>
<td>&quot; hirudiniformis, O. Müll.</td>
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<tr>
<td>&quot; gracilis, O. Müll.</td>
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<tr>
<td><strong>Nitzchia Tryblionella</strong>, Hantzsch, var. littoralis, (Grun.) Van Heurck.</td>
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<tr>
<td>&quot; dissipata, (Kütz.) Grun., var. media, Hantzsch.</td>
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<tr>
<td>&quot; tubicola, Grun.</td>
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<tr>
<td>&quot; Palea, (Kütz.) W. Sm.</td>
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<tr>
<td>&quot; nysseensis, O. Müll.</td>
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<tr>
<td><strong>Surirella plana</strong>, sp. n.</td>
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<tr>
<td>&quot; constricta, Ehrenb., var. africana, O. Müll.</td>
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<tr>
<td>&quot; Tanganyika* sp. n.</td>
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<tr>
<td>&quot; striatula, Turp.</td>
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<tr>
<td><strong>Cymatopleura Solea</strong>, (Kütz.) W. Sm.</td>
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**Myxophyceae.**

<table>
<thead>
<tr>
<th>Species</th>
<th>1904</th>
<th>1905</th>
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<tbody>
<tr>
<td><strong>Nostoc piscinale</strong>, Kütz.</td>
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<tr>
<td>&quot; carneum, Ag.</td>
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<tr>
<td><strong>Anabaena Flao-aquae</strong>, (Lyngb.) Bréb., forma sp. lila rigidissima</td>
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<tr>
<td><strong>Tanganyika</strong>, sp. n.</td>
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<tr>
<td><strong>Plectonema Wolleí, Farlow</strong></td>
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<td>r</td>
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<tr>
<td><strong>Lyngbya perelegans</strong>, Lemm.</td>
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<tr>
<td>&quot; limnetica, Lemm.</td>
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<td>r</td>
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<tr>
<td><strong>Phormidium tenue</strong>, (Ag.) Gomont angustissimum, W. &amp; G. S. West</td>
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<tr>
<td><strong>Oscillatoria Princeps</strong>, Vauch.</td>
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<tr>
<td><strong>Tanganyika</strong>, sp. n.</td>
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<tr>
<td><strong>tennis, Ag.</strong></td>
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<tr>
<td><strong>Spirulina laxissima</strong>, sp. n.</td>
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<tr>
<td><strong>Glaciolithria natans</strong>, (Hedwig) Rabenh.</td>
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<tr>
<td><strong>Merismopedia elegans</strong>, A. Br.</td>
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<tr>
<td>&quot; var. remola, var. n.</td>
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<tr>
<td>&quot; aruginosa, Bréb.</td>
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<tr>
<td>&quot; glauca, (Ehrenb.) Nag.</td>
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<tr>
<td><strong>Gomphosphaeria eponina</strong>, Kütz.</td>
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<tr>
<td><strong>Microcystis elabens</strong>, (Bréb.) Kütz.</td>
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<tr>
<td><strong>Chroococcus turridus</strong>, (Kütz.) Nag.</td>
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</table>

**Peridinieae.**

<table>
<thead>
<tr>
<th>Species</th>
<th>1904</th>
<th>1905</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glenodinium Pulviscula</strong>, (Ehrenb.) Stein</td>
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<tr>
<td><strong>Peridinium africennum</strong>, Lemm., sp. n.</td>
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<tr>
<td>&quot; berolinense, Lemm., var. speiculum, Lemm., var. n.</td>
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<tr>
<td><strong>Peridiniopsis Cunningtonii</strong>, Lemm., sp. n.</td>
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It will be seen from the above table that the phytoplankton is richest in species in October and November, especially the latter month. In these months occur the maxima of Scenedesmus biugatus f. arcuatus, Synedra Acus (and var. delicatissima), Nannochloris Gastrum, Anabena Flos-aquae (and var. circularis), Phormidium angustissimum, Spirulina laxissima, and Glenodinium Pulvisculus. In December there is a marked general decrease in the number of species. In January (the following month) the decrease in the Chlorophyceae and Myxophyceae is very noticeable, and concurrently a great quantity of Nauplius-larvae appear in the plankton.

*Plankton from the Lofu River.*—This river runs into Tanganyika, and two tubes of plankton-material were collected from it by Dr. Cunnington in October 1904. The phytoplankton differs very much from that of Tanganyika, and the species bear much resemblance to those of the surrounding pools and swamps, from which they are doubtless recruited. Of the thirty species observed in this river-plankton only one occurred in the plankton of the lake itself.

The occurrence of *Sphaerocystis Schroeteri*, Chodat, is very remarkable. This Alga is one of the most conspicuous features of the European freshwater phytoplankton, and is rarely found except in the plankton of lakes. No specimens were observed in the collections from Tanganyika itself, nor any from Lake Nyasa or Victoria Nyanza, but it was present in great abundance in the Lofu River and the specimens were exceedingly well developed.

The following species were observed:—

**Chlorophyceae.**

*Edogonium*, sp.

*Myecophyton subuligerum*, (Kütz.) Hazen.

*Ulothrix tenerrima*, Kütz.

*Mougeotia*, sp.

*Zygnemia*, sp.

*Spirogyra*, sp.

*Gonatozygon monotanum*, De Bary.

*Closterium Venus*, Kütz.

*Pleurotaenium subcoronulatum*, (W. B. Turn.) W. & G. S. West.

... *elatum*, (W. B. Turn.) Borge, var. *conjunctum*, (W. B. Turn.) W. & G. S. West.

*Euastrom denticalatum*, (Kirchn.) Gay.

*Micrasterias americana*, (Ehrenb.) Ralfs.

*Cosmarium Pseudobroomei*, Wolle.

... *Blyttii*, Wille.

... *bivittatum*, Nordst.

... *margaritatum*, (Lund.) Roy. & Biss.

... *nitidulum*, De Not.
OF THE THIRD TANGANYIKA EXPEDITION.

Hyalothece mucosa, (Dillw.) Ehrenb.
Scenedesmus denticulatus, Lagerh., var. linearis, Hansg.

obliquus, (Turp.) Kütz.
Ankistrodesmus falcatus, (Corda) Ralfs.
Sphaerocystis Schroeteri, Chodat.

Bacillariaceae.

Synedra Ulna, (Nitzsch) Ehrenb.

var. splendidus, (Kütz.) Van Houck.
Achnanthes linearis, (W. Sm.) Grun.

Vanheurckia vulgaris, (Thw.) Van Heurck.
Gomphonema parvulum, (Kütz.) Grun.

Cocconema gracile, (Rabenh.) G. S. West.

lace, (Nig.) nob.
Surirella robusta, Ehrenb., var. splendida, (Ehrenb.) Van Heurck.

Myxophyceae.

Lyngbya bipunctata, Lemm.

III SYSTEMATIC ACCOUNT OF THE ALGAE OF THE COLLECTIONS.

This portion of the paper is devoted to a complete systematic account of all the Algae observed in Dr. Cunnington's collections, those from pools and swamps, from scrapings of wet rocks, &c., being included along with the plankton. The collections from Tanganyika and the vicinity were the most numerous, and this fact accounts largely for the greater number of species recorded from that area. The few collections from the vicinity of Victoria Nyanza contained a relatively greater variety of Algae, and had more collections been made in the area, a very rich Alga-flora would undoubtedly have been revealed.

The absence of plants belonging to the Stigonemaceae is somewhat remarkable, the genus Nostochopsis being the only representative of the family observed. Species of Hapalosiphon are of general occurrence in the swamps and marshes of the tropics, not to mention certain of the bog-loving and rupestral Stigonema, and four species of the first-mentioned genus have already been recorded from Tropical Africa.

Several of the Algae observed have been excluded from this account owing to the impossibility of identifying them with any degree of certainty. Such species were mostly in a fragmentary condition, and amongst them were two species of Nostoc from the Tanganyika area, a species of Calothrix from Deep Bay, Nyasa, and a Batrachospermum from the Lofu River, Tanganyika.

One genus, thirty-six species, and eighteen varieties and forms are here described for the first time.

LINN. JOURN.—BOTANY, VOL. XXXVIII.
The Peridiniaceae have been examined, and the new forms described, by Mr. E. Lemmermann of Bremen, to whom I offer my best thanks for his kindly assistance on this as on other occasions, with this group of flagellate organisms.

Class CHLOROPHYCEÆ.

Order ÆDOGONIALES.

Family ÆDOGONIACEÆ.

Genus ÆDOGONIUM, Link.


Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).


Crass. cell. veget. 11-13 μ; altit. 4-5-plo major;
" oogon........... 34-37 μ; " 37-40 μ;
" oospor. ......... 30-31 μ; " 30-31 μ;
" cell. antherid... 11 μ; " 7-8.5 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

This species has previously been observed only in Galicia and Ireland.

Var. AFRICANUM, var. n.

Var. cellulis vegetativis leviter crassioribus et brevioribus, levissime capitellatis; oogoniis paullo majoribus; antheridiis 3-cellularibus.

Crass. cell. veget. 13-15 μ; altit. 2 1/2-3-plo major;
" oogon........... 39-40 μ; " 38 μ;
" oospor. ......... 33-34 μ; " 33-34 μ;
" cell. antherid... 13-13.5 μ; " 5-6 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

3. ÆDOGONIUM DICTYOSPORUM, Wittr. Prodr. Monogr. Ædog. (1874) p. 13; Hirn, l. c. p. 103, t. 7. fig. 43.

Forma oogoniis et oosporis ovato-ellipsoideis, paullo majoribus.

Crass. cell. veget. 14-16 μ; altit. 3-5-plo major;
" oogon........... 42 μ; " 52 μ;
" oospor. ......... 40 μ; " 50 μ;
" cell. antherid... 13 μ; " 8-9 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

Crass. cell. veget. ...... 47–51 μ; altit. 2–5-plo major;
"  oogon. ......... 78–90 μ; "  111–121 μ;
"  oospor. ......... 75–86 μ; "  80–90 μ;
"  cell. antherid. .... 44–50 μ; "  6–16 μ.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32).

This interesting species was in fine fruiting condition. It has only previously been found in the Pegu province of E. India. Hirn states that the number of cells composing the antheridia may be as many as six. In the African specimens four or five was the usual number, but some of the antheridia were composed of as many as 15 cells. The hypogynous position of the antheridia was very characteristic.

5. *Edogonium Kitute*, sp. n.

*E*. dioicum, nannandrium; oogoniis singulis vel binis, subglobosis vel obovato-globosis, poro superiore apertis; oosporis globosis, oogonia non complentibus, membrana glabra; cellulis suffultioris tumidis; androsporangii ...... ? cellula terminali obtusa; nannandribus elongatis, leviter curvatis, oblongis, interne angustioribus, in cellulis suffultioris et oogoniis sedentibus, antheridio interiori (?)

Crass. cell. veget. ...... 26 μ; altit. 5–7-plo major;
"  oogon. ......... 76–78 μ; "  75–80 μ;
"  oospor. ......... 72 μ; "  72 μ;
"  cell. suffult. ..... 44 μ; "  3-plo major;
"  nannandr. ..... 12–13 μ; "  58–66 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

No examples of this species were observed in which the antheridia were fully formed, but from the structure of the dwarf-males (nannandria) there can be little doubt that they are internal in development. The only dioecious nannandrous species in which the antheridia are developed internally within the dwarf-males, and which can be compared with *E*. *Kitute* in respect of size of vegetative cells and form of oogonia and oospores, are *E*. *alternans*, Wittr. & Lund., *E*. cataractum, Wolle, and *E*. *cyathigerum*, Wittr.

*E*. *Kitute* differs from *E*. *alternans* in the smaller size of its vegetative cells, which are more elongated, and in the oospores not filling the oogonia. The oogonia are also much less numerous than in *E*. *alternans*, and they are only found singly or in pairs near the ends of the filaments.

From *E*. *cyathigerum* it is distinguished by its relatively larger and differently-shaped oogonia and oospores, the latter being destitute of the longitudinal costae.

It should also be compared with *E*. *Borisiannum*, (Le Clerc) Wittr., from
which it differs in its slightly thicker vegetative cells, its larger oogonia and oospores, and in its internal antheridia. The oogonia are developed in a very similar manner and in the same part of the filament as those of *O. Borisianum*.

**Note.**—Sterile species of *Edogonium* were observed from the following localities:—**Nyasa.** In swamp, Kota Kota (20 June, 1904; no. 18); in swamp, Karonga (2 July, 1904; no 34); small sp. with capitellate cells in the plankton of Monkey Bay (17 June, 1904; no. 15), and off Vahambwera Point (24 June, 1904; no. 24).—**Tanganyika.** In swamp, Kituta (23 Aug. 1904; no. 72); on surface of swampy pond, Mrumbi (27 Dec. 1904; no. 195); in the plankton of Lofu River (5 Oct. 1904; no. 124).

**Genus BULBOCHATE, Ag.**


Crass. cell. veget. .... 14-17 μ; altit. 2-3-plo major;

" oogon. .......... 41-43 μ; " 36-38 μ;

" cell. androsp. ... 12 μ; " 9 μ;

" stip. nannandr. 8 μ; " 23 μ;

" cell. antherid... 7 μ; " 11 μ.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

**Note.**—Sterile species of *Bulbochate* were observed from the two following localities:—**Nyasa.** In swamp, Kota Kota (20 June, 1904; no. 18).—

**Tanganyika.** Surface of swamp, Toa (10 Jan. 1905; no. 208).

**Order CHAETOPHORALES.**

**Family ULOTRICHACEÆ.**

**Genus ULOTHRIX, Kütz.**


Crass. fil. 7-5-8-5 μ; cellulis diametro 1-1/4-plo longioribus.

**Tanganyika.**—In plankton, surface of Lofu River (5 Oct. 1904; no. 124).

**Genus UREONEMA, Lagerh.**


Crass. fil. 4-5-6-5 μ.
OF THE THIRD TANGANYIKA EXPEDITION.

Victoria Nyanza.—Among *Utricularia* in swampy pool near Bukoba (20 Aug. 1905; no. 618).

Tanganyika.—Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905; no. 611).

Family **CHÆTOPHORACEÆ**.

Genus CHÆTOPHORA, Schrank.


Crass. cell. 3.5–5.5 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123); in small gelatinous masses among *Myxonema subuligerum*. The specimens were insufficient for accurate identification.

Genus MYXONEMA, Fries, 1825.


Crass. fil. prim. 14.5–16 μ; crass. ram. circ. 6–10 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124)

Order **CLADOPHORALES**.

Family **CLADOPHORACEÆ**.

Genus CHÆTOMORPHA, Kütz.


Crass. fil. 108–161 μ; crass. membr. cell. 6–8 μ.

Tanganyika.—Dredged from a few fathoms, Niamkolo Bay (3 Aug. 1904; no. 40). Floating on the surface, Kituta Bay (26 Aug. 1904; no. 79).

Genus CLADOPHORA, Kütz.

Crass. fil. prim. 80-102 µ; crass. ram. 65-70 µ; crass. ramul. 25-32 µ.

Tanganyika.—Scraped from the bottom of Dr. Cunnington’s “dau” (24 Jan. 1905; no. 216).

The branches of the first order were somewhat patent and subdichotomously branched; those of the second order (ramuli) were short, often papilliform and unicellular, or even merely curved (subuncinate) outgrowths from the upper extremities of the cells of branches of the first order.


Tanganyika.—Growing on grass-stems close to the shore, Kituta Bay (23 Aug. 1904; no. 73). Forma parva, parce ramosa, articulis diametro 5-12-plo longioribus; cytoidermate crasso, distincte plicato-striato.
Crass. fil. prim. 48-58 µ; crass. ram. 23-27 µ.

Nyasa.—Dredged in three fathoms, growing on bivalve shells, Anchorage Bay (no. 11).
Forma parva, rigida, parce ramosa, filis usque ad 2-5 cm. longis.
Cross. fil. prim. 95-104 µ; crass. ram. 30-64 µ.

Victoria Nyanza.—Growing on rocks just below the water-level, Bukoba (17 Apr. 1905; no. 247).


Rabenh. l. c. p. 342.

Forma capitellata.
Forma parva, usque ad 2 cm. alta, ramosissima, ramis basi connatis; articulis diametro 4-8-plo longioribus, distincte capitellatis, ad genicula plus minusve constrictis.
Crass. fil. prim. 26-34 µ; crass. ram. 18-24 µ.

Nyasa.—On rocks at water-level, Deep Bay (25 June, 1904; no. 26).

Tanganyika.—Scraped from the bottom of Dr. Cunnington’s “dau” (24 Jan. 1905; no. 217).

Fila usque ad 4 mm. alta, densissime radiata circa culmos vetustos pelagios, ramosissima; ramis divaricatis et intricatis; articulis diametro 5-11-plo longioribus.
Crass. fil. prim. 50-64 µ; crass. ram. et ramul. 27-35 µ.

Tanganyika.—Thickly covering floating fragments of stems collected in the tow-nets off Niamkolo Island (29 July, 1904; no. 36).
16. **Cladophora inconspicua**, sp. n.

_C. pallide viridis, minuta, calce partim incrustata, in lapidibus litoris erosis; caespitibus 1–3 mm. alta, valde et dichotome ramosa, ramis sursum subdichotome ramulosis, ramis et ramulis plerumque crassitudine æqualibus, insertione ramorum laterali vel apicali; cellulis (fil. prim., ramorum, et ramulorum) diametro 3½–8½-plo longioribus; cellula apicali ramorum mueronata; membrana firma et subcrassa._

Crass. fil. prim. 50–56 μ; crass. ram. et ramul. 18–40 μ; crass. ramul. ult. 12–15 μ.

**Tanganyika.**—On stones, dredged in a few fathoms, Niamkolo.

The pebbles on which this _Cladophora_ was growing were coated with a deposit of lime about 4–5 mm. in thickness, the surface of which was much eroded, and the minute tufts of the Alga occupied the numerous irregular depressions and holes covering the exposed surface of the incrustation. The pebbles were of a flinty nature, consisting of dark-coloured impure silica, and the outer incrustation of lime containing the hollows was of a brownish-yellow colour and much pitted. The actual thallus of the _Cladophora_ is not incrusted with lime except at the extreme basal portions. The pebbles presented much the same appearance as those described by Chodat from the lakes of the Jura.

_Cladophora inconspicua_ is probably the smallest described species of the genus. The thallus is much branched, the branching being mostly dichotomous. The tufts are very dense, and the basal part of the thallus is firmly attached to the stone by colourless rhizoids, which frequently branch and become somewhat irregular in outline. Some of the branches of the first order terminate in cylindrical apical cells with a mucronate apex, whereas the apical cells of the smaller branches are generally narrower and considerably attenuated to a blunt extremity.

Among the basal portions of the _Cladophora_, in the eroded cavities of the stones, were numerous thalli of _Palmophyllum foliaceum_, sp. n., and attached to the branches of the _Cladophora_, especially the younger ones, were quantities of _Calothrix brevissima_ forma.

17. **Cladophora** sp.

_C. filis di(vel 3–4)-chotoma, ramosissima, ad 6 mm. altis, ramulis brevibus et fasciculatis, articulis diametro 3–7-plo longioribus._

Crass. fil. prim. usque ad 130 μ; crass. ram. 24–34 μ.

**Tanganyika.**—Growing on stones, shells, submerged roots and grasses, Niamkolo (1 Aug. 1904; no. 44). Probably the same plant but less branched, with quantities of sand among the branches, attached to shells dredged in about 10 fathoms, Mtondwe Bay (2 Sept. 1904; no. 83).
Order CONJUGATAE.

Family ZYGNEMACEAE.

Subfam. MESOCARPEAE.

Genus MOUGEOTIA, Ag.

A number of sterile species of this genus were observed, principally from the Tanganyika region. No trace of spore-formation was observed in any of them.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72). In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

Subfam. ZYGNEMACEAE.

Genus DEBARYA, Wittr.

18. **DEBARYA AFRICANA**, sp. n. (Pl. 5. figs. 3–4.)

_D. caespitibus laxo intricatis, cellulis vegetativis diametro 4–8-plo longioribus, pyrenoidibus 5–8 in chromatophora unoque; zygosporis ubi conjugatione scalariformi productis, globoso-ellipsoideis, magnis, tubo conjugatione complentibus et in gametangiis immersis, axe longiore transverse disposito; membrana zygospore glabra; membrana gametangiorum subcrassa; gameta-

Crass. cell. veget. 23–26 μ; lat. zygosp. 56 μ; long. zygosp. 50 μ.

**Nyasa.**—In swamp, Kota Kota (20 June, 1904; no. 18).

As in other species of Debarya the gametangia undergo a change subsequent to conjugation. In this case the cell-walls increase considerably in thickness, and during this process a narrow pit arises in the middle of each transverse wall (vide Pl. 5. fig. 4). The zygospore is large and occupies the whole of a greatly swollen conjugating-tube, extending on each side to the outer walls of the gametangia.

_D. africana_ is nearest to _D. immersa_, W. West (Mougeotia immersa, W. West, in Journ. Bot. xl. (1902) p. 144), a species only known from India, but is distinguished by its much longer vegetative cells, its larger, smooth, and more completely immersed zygospores, and by the thickened walls of the gametangia.

Genus ZYGNEMA, Ag.

Sterile species were observed from:

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 80). In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).
Genus SPIROGYRA, Link.

The zygospores were not mature and the specimens were scarcely in a condition for accurate description.
Crass, cell. veget. 34–38 μ; long, zygosp. immat. 72 μ, lat. 53 μ.
Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

Var. africana, var. n.
Var. cellulis fructiferis leviter tumidis; cellulis vegetativis et chromatophoris singulis ut in forma typica; zygosporis paullo majoribus, oblongo-ellipticis, mesosporio plicato-ruguloso.
Crass, cell. veget. 40–41 μ; long, zygosp. 93 μ, lat. 58 μ.
Nyasa.—Among weeds and various Alge, in swamp, Karonga (2 July, 1904; no. 34).

21. Spirogyra æquinoctialis, sp. n. (Pl. 5, figs. 1–2.)
S. cellulis vegetativis diametro circiter 4–6-plo longioribus, extrematibus non replicatis; chromatophoris 3 (interdum 2), subcrassis, marginibus irregulat. undulat. anfractibus 1–1½, cum pyrenoidibus magnis; conjugatione scalariformi, cellulis fructiferis inflatis et suboblongo-rectangularibus; zygosporis oblongo-ellipticis, ovoideis, vel oblongo-ovoideis, diametro circiter 1½–1¾-plo longioribus; membrana zygospore crassa, lamina mediana dense scrobiculata.
Crass, cell. veget. 23–25 μ; crass. cell. fructif. (? 41½–43 μ; long, zygosp. 52–71 μ, lat. 41–43 μ; crass. membr. zygosp. 4 μ.
Nyasa.—Growing on stones, &c., on the shore, Domira Bay (19 June, 1904; no. 17).

The zygospores are mostly oblong-elliptic in form, with brown walls of considerable thickness, the middle coat of which is densely and markedly scrobiculated. They fill up the fructiferous cells transversely, being closely applied to the swollen walls of the female gametangia. The chloroplasts are most commonly three (sometimes only two) in each cell, with nodulose or undulate margins and large pyrenoids.

It stands nearest to another tropical species, S. Schmidtii, W. & G. S. West (Freshw. Alg. Koh Chang, in Bot. Tidsskr. xxiv. (1901) p. 161, t. 4, figs. 43–45), but is distinguished by its thinner vegetative filaments with shorter cells, by the shorter and more oblong zygospores, and by the oblong form of the inflated fructiferous cells.

Crass. cell. veget. 32-36 μ; long. zygosp. 65-68 μ; lat. zygosp. 37-39 μ.

**Nyassa.**—In swamp, Karonga (2 July, 1904; nos. 32 and 33).

Forma cellulis crassioribus et zygosporis sepe diametro duplo longioribus.
Crass. cell. veget. 42-54 μ; long. zygosp. 68-124 μ; lat. zygosp. 47-50 μ.

**Nyassa.**—In swamp, Karonga (29 June, 1904; no. 32).


Forma major, cellulis vegetativis diametro 2½-5(usque 6)-plo longioribus; cellulis fructiferis non inflatis; chromatophoris 3, cum marginibus asperis, anfractibus 2½-4½.

Crass. cell. veget. 46-52 μ; long. zygosp. 72-92 μ; lat. zygosp. 46-50 μ.

**Nyassa.**—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 80).

Precisely the same form has been observed from Koh Chang in the Gulf of Siam.

Very near to these tropical forms of S. decimina, and most probably identical with them, is a species described by Schmidle as S. Füllebornii (vide Engl. Bot. Jahrb. xxxii. (1903) p. 76, t. 3, fig. 2). The thickness of the vegetative cells is the same, there are three spirals in each case, and the size and form of the zygospores are the same. Schmidle’s plant was described from the vicinity of Nyassa.


Crass. cell. veget. 52-59 μ; long. zygosp. 74-78 μ; lat. zygosp. 52-53 μ.

**Tanganyika.**—In swamp, Mrumbi (27 Dec. 1904; no. 196).

24. Spirogyra nitida, (Dillw.) Link, Handb. iii. (1833) p. 262; Kütz. l. c. p. 442; Petit, l. c. p. 28, t. 10, figs. 6-10.

Crass. cell. veget. 80-85 μ; long. zygosp. 105-148 μ; lat. zygosp. 55-84 μ.

**Nyassa.**—In swamp, Karonga (2 July, 1904; no. 33).


**Var. minor, var. n.**

Var. cellulis angustioribus et zygosporis minoribus. Crass. cell. veget. 56-58 μ; diam. zygosp. 44-56 μ.

**Tanganyika.**—In swamp, Mrumbi (27 Dec. 1904; no. 196).
Note.—Sterile species of *Spirogyra* were observed from the following localities:—**Nyasa.** In swamp, Kota Kota (20 June, 1904; no. 18). In pools, on shore, Nkata Bay (23 June, 1904; no. 22). Among weeds, in swamp, Karonga (2 July, 1904; no. 34).—**Tanganyika.** In swamp, Mbete (28 Sept. 1904; no. 108). In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124); this was a large species, similar to *S. crassa*, Kütz.; crass. veg. cell. 114–132 μ; diam. zygosp. immatur. 100–104 μ.

A fact of some interest is the complete absence from the collections of any species of *Spirogyra* with replicate extremities to the vegetative cells.

**Family DESMIDIACEÆ.**

Subfam. *Sacco dermae*.

Genus *GONATOZYGON*, De Bary.


**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).


**Nyasa.**—In swamp, Kota Kota (20 June, 1904; no. 18).

**Victoria Nyanza.**—In swampy pool, near Bukoba (20 Apr. 1905; no. 618).

Genus *CYLINDROCYSTIS*, Menegh.


Long. 26–29 μ; lat. 16–18 μ; lat. constrict. 15–16 μ.

**Victoria Nyanza.**—In swampy pool, Bukoba (20 Apr. 1905; no. 618).

**Tanganyika.**—Among weeds, mouth of Malagarasi River (16 Jan. 1905 no. 611).

Genus *NETRIUM*, Lütkem.

29. *Netrium Digitus*, (Ehrenb.) Itzigs. & Rothe, in Rabenh. Alg. no. 508 (1856); W. & G. S. West, Brit. Desm. i. (1904) p. 64, t. 6. figs. 14–16.—Penium Digitus, Bréb. in Ralfs, Brit. Desm. (1848) p. 150, t. 25. fig. 3.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

Forma parva et angustior: long. 112–140 μ; lat. 27–32 μ.

**Victoria Nyanza.** —In pools near the shore, Bukoba (20 Apr. 1906; no. 251).

**Tanganyika.** —In swamps, Kituta (26 Aug. 1904; no. 80).
Subfam. Placodermæ.
Genus Penium, Brêb.


Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618).


a. Forma brevior: long. 55–57 µ; lat. 36–38 µ; lat. isthm. 35–36 µ. (Pl. 6. fig. 3.)

Victoria Nyanza.—Near the shore, Bukoba (20 Apr. 1905; no. 251).

b. Forma crassior: long. 72 µ; lat. 51 µ; lat. isthm. 48 µ. (Pl. 6. fig. 4.)

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618)

Genus Closterium, Nitzschi.


Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).


Var. tumidum, var. n. (Pl. 6. fig. 2.)

Var. cellulis paullo tumidis ad medium marginis ventralis, polis obtusioribus, striis validioribus.
Long. 190 µ; lat. 27 µ; lat. apic. 10 µ.

Victoria Nyanza.—Near the shore of the lake, Bukoba (20 Apr. 1905; no. 251).

The apices of this variety are more obtuse than in the typical form, and the ventral margin of the cell is distinctly tumid, giving it a stouter appearance.


Small forms: lat. 11 µ; apicibus 105 µ inter se distantibus.

Nyasa.—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

Victoria Nyanza.—In swamp pool near Bukoba (20 Apr. 1905; no. 618).

Lat. 11–13 µ; apicibus 82–91 µ inter se distantibus.

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).
   Lat. 8°5' ; apicibus 72 μ inter se distantibus.
   Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).
   Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123).

   Nyasa.—Among Algae growing on stones, Domira Bay (19 June, 1904; no. 17). Among Utricularia, Domira Bay (19 June, 1904; no. 579).
   Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).
   Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108). In plankton, Baraka (24 Feb. 1905; no. 240).

38. Closterium moniliferum, (Bory) Ehrenb. Infus. p. 91 (1838); Ralfs, Brit. Desm. (1848) p. 166, t. 2. fig. 3; W. & G. S. West, l. c. p. 142, t. 16. figs. 15, 16.
   Long. 248–294 μ; lat. 44–47 μ; lat. apic. 11–12 μ.
   Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).
   The African plants possessed a smooth and colourless cell-wall, and agreed perfectly in size and general proportions with Gutwinski's Galician examples. The distinctive features from typical C. moniliferum are the thickened apices of the cells and the reduced ventral inflation.

   Nyasa.—Among other Algae on the shore, Domira Bay (19 June, 1904; no. 17). Among Utricularia, Domira Bay (19 June, 1904; no. 579.)
   Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208.)

   Rather stout forms: long. 116–142 μ; lat. 19–20 μ; lat. apic. circ. 5 μ.
   Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).

41. Closterium gracile, Breb. List Desmid. p. 155 (1856); W. & G. S. West, l. c. p. 166, t. 21. figs. 8–12.
   Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

42. Closterium acutum, (Lyngb.) Bréb. in Ralfs, Brit. Desm. (1848) p. 177, t. 30. fig. 5, t. 34. fig. 5 a, b, d-f; W. & G. S. West, Brit. Desm. i. (1904) p. 177, t. 23. figs. 9-14.

Lat. cell. 4-4.5 μ; long. zygosp. 32 μ; lat. max. zygosp. 18 μ.

Nyasa.—Among Utricularia, swampy margin of lake, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—In swamp, Kituta, with zygospores (26 Aug. 1904; no. 80).

43. Closterium rafaelii, Bréb. in Ralfs, Brit. Desm. (1848) p. 17; Ralfs, l. c. p. 174, t. 30. fig. 2; W. & G. S. West, l. c. p. 182, t. 24. figs. 6, 7.


Forma paullo crassior: long. 302-332 μ; lat. 42-45 μ; lat. apic. 9-10 μ.

Victoria Nyanza.—In swamp, near the shore, Bukoba (20 Apr. 1905; no. 251).

The specimens were rather broader than is usual for this frequent tropical Closterium, and in this respect they resembled a plant described by Gutwinski as C. Wagé (vide Rospraw. matem.-przyr. Akad. Umiej. Krakow. 1896, p. 40, t. 2. fig. 20). The apices were also somewhat angular. It seems probable that C. Wagé is only an extreme shortened form of C. Rafalii var. hybridum.

Genus Pleurotænum, Näg.

44. Pleurotænum coronatum, (Bréb.) Rabenh. Fl. Europ. Alg. iii. (1868) p. 143; W. & G. S. West, l. c. p. 199, t. 27. figs. 16-18, t. 28. fig. 4.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; nos. 72 and 80).


Long. 460 μ; lat. ad bas. semicoll. 40 μ, ad apic. 35 μ.

Victoria Nyanza.—Among Utricularia in swampy pool near Bukoba (20 Apr. 1905; no. 618).

Borge has observed specimens from Brazil in which only one semicell possessed the infra-apical constriction (vide Arkiv för Botanik, K. Sv. Vet.-Akad., Bd. i. (1903), p. 82). The curious ligature-like constriction of this variety was well marked in the examples from Victoria Nyanza, but it is possible that it is only a variation due to inequality of growth.


Long. 530-561 μ; lat. ad bas. semicell. 45-48 μ; lat. apic. 40-42 μ.

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

The individuals observed were slightly larger than Turner’s measurements of *P. elatum* var. *conjunctum*, but not so large as the forma *duplo-major* described from Ceylon. The lateral margins of the semicells were slightly undulate from base to apex, and each apex possessed 26-27 tuberculi. The individuals remained attached by their apices, and filaments of 15 cells were observed.


**Forma africana.** (Pl. 6 fig. 1.)

Forma cellulis longioribus, leviter attenuatis apices versus, tuberculis apicalibus 18 (9-10 visis).

Long. 670 μ; lat. ad bas. semicell. 34 μ; lat. apic. 25 μ.

**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 34).

The African form differs principally from the Brazilian one in the distinct attenuation of the apical part of the semicells.


**Nyasa.**—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

**Victoria Nyanza.**—In swampy pools near Bukoba (20 Apr. 1905; nos. 251 and 618).

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72. Also 26 Aug. 1904; no. 80).


**Victoria Nyanza.**—In swampy pool near Bukoba (20 Apr. 1905; no. 251).


Long. 720 μ; lat. ad bas. semicell. 40 μ, ad apic. 28 μ.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).
Genus EUASTRUM, Ehrenb.


Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618).

52. EUASTRUM ANSATUM, Ralfs, l. c. t. 14, fig. 2.

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 251).


Long. 46 μ; lat. 27 μ.

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).


Forma incisuris apicalibus leviter apertioribus, angulis basalibus semicellularum delicatissime bidenticulatis.

Long. 48 μ; lat. 32 μ; lat. isthm. 9 μ; crass. 17 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).


Forma angulis basalibus semicellularum sursum divergentibus.

Long. 31 μ; lat. 20 μ; lat. isthm. 6.5 μ.

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

56. EUASTRUM BINALE, (Turn.) Ehrenb. in Berlin Monatsber. (1840) p. 208; W. & G. S. West, l. c. p. 51, t. 38. figs. 28, 29.


Nyasa.—Among Algae growing on stones, Domira Bay (19 June, 1904; no. 17).

Var. subelobatum, West, l. c. p. 140, t. 20. fig. 15.

Long. 21 μ; lat. 16.5 μ; lat. isthm. 5 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).


Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).


Victoria Nyanza.—Among Utricularia in sheltered bay near Entebbe (1 May, 1905; no. 620).


Small form: long. 56 μ; lat. 48 μ; lat. isthm. 12 μ.

**TanganYika**.—Among Algae in swamp, Mrumbi (27 Dec. 1904; no. 196).


Long. 44 μ; lat. 39 μ.

**Nyasa**.—In swamp, Karonga (2 July, 1904; nos. 33 and 34).


Forma mucronibus lobi polari reductis. (Pl. 7. figs. 4-5.)

Long. 44–46 μ; lat. 34–35.5 μ; lat. lob. pol. 20–21.5 μ; lat. isthm. 8 μ.

**TanganYika**.—In swamp, Kituta (23 Aug. 1904; no. 72).

61. **Euasturm truncatiforme**, sp. n. (Pl. 7. fig. 3.)

*E. submediocre, circiter 1½-plo longius quam latius, profundissime constrictum, sinu angusto-linearis extremo subampliato; semicellulæ trilobæ, incisuris lateralibus subprofundis et angustis; lobis lateralibus sinuato-bilobulatis, lobulis subquadraatis rotundulo-omarginatis; lobo polari transverse rectangulare-fusiformi, lateribus sursum convergentibus et retusis, apice convexo; tumore magni glabro in lobo laterali unoquoque, tumore magni in centro lobi polari, tumore parvo intra lobulo laterali unumqueque; a vertice viso oblongo-elliptico, polis rotundatis, tumoriis magnis binis subdistantibus utroique et tumore parvo polum unumqueque versus utroique, lobo polari subrhomboidei; a latere viso subovate, tumore magni prope basin et tumore minore apicem rotundatum versus utroique.

Long. 47 μ; lat. 33 μ; lat. lob. pol. 21 μ; lat. isthm. 8 μ; crass. 19 μ.

**Victoria Nyanza**.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

This species bears considerable resemblance to *E. symphgeum*, W. & G. S. West (in Trans. Linn. Soc. ser. 2, Bot. v. (1895) p. 50, t. 6. fig. 11), a species known only from Madagascar, but is distinguished by the relatively smaller polar lobe, by the strongly retuse lateral lobes with broader angles (lobules), and by the different disposition of the surface tumours, the latter feature causing considerable differences in the vertical and lateral views.

It should also be compared with *E. truncatum*, Joshua (vide W. & G. S. West, l. c. vi. (1902) p. 152, t. 20. figs. 9, 10), from which it differs in the deeply retuse lateral lobes, the convex apex of the polar lobe, and the form of the polar lobe in vertical view. The three large tumours of *E. truncatiforme* also occur in the same relative positions on *E. truncatum*, but the latter possesses two others within the angles of the polar lobe, and
lacks the small tumours which occur within the lateral lobules of *Euastrum truncatiforme*. The large scrobiculation in the centre of the semicells of *E. truncatum* is likewise absent from *E. truncatiforme*.


Genus *MICRASTERIAS*, Ag.


*Forma lobis lateralibus oblique truncatis; spinis totis minoribus.*

**Nyasa.**—In swamp, Kota Kota (20 June, 1904; no. 18).

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 80).

63. *MICRASTERIAS CUNNINGTONII*, sp. n. (Pl. 7. figs. 1–2.)

*M. mediocris, circiter ½-plo longior quam latior, elliptica, profundissime constricta, sinu angusto sed leviter aperto; semicellulae quinquilocoe, incisis inter lobos non profundis et apertos; lobo polari late et breviter cuneato (late campanulato e basi subangusto), apice convexo sed late emarginato ad medium, cum dentibus irregularibus circ. 10 ad marginem superiorem et angulis lateralibus unidentatis; lobis lateralibus subequallibus (superioribus majoribus), cum incisura primaria mediana et incisuris parvis secundis duobus, lobulis emarginato-bispinatis (raro trispinatis) quattuor; membrana irregulariter et subsparse denticulato-spinata. Semicellula a latere viso ovato-lanceolata, ad basin subrotundate, lateribus subretusis, apice rotundato et tridentato, marginibus lateralibus dense denticulato-spinatis.

**Victoria Nyanza.**—In swampy pools near the shore, Bukoba (20 Apr. 1905; no. 251).

This species can best be compared with *M. apiculata*, (Ehrenb.) Menegh., from which it is at once distinguished by the shallow incisions and the much wider and shorter polar lobe. The spines are also shorter, and they are much more irregular in size and disposition than those of *M. apiculata*, especially towards the centre of the semicells. It is, however, the polar lobe which is the distinctive feature of *M. Cunningtonii*. It is very widely campanulate from a rather narrow base, and the disposition of the spines on its convex-emarginate apex is also peculiar.
64. **Micaasterias americana** (EHRENBERG) Ralfs, *Brit. Desm.* (1848) p. 19

**Victoria Nyanza.**—Among *Utricularia* in swampy pool, Bukoba (20 Apr 1905; no. 618).

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 124).

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**Nyasa.**—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

**Victoria Nyanza.**—In swamps pools near the shore, Bukoba (20 Apr. 1905; no. 251).

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72. Also 26 Aug. 1904; no. 80).


Long. 74 μ; lat. 67 μ; lat. isthm. 29 μ.

**Nyasa.**—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).


**Forma sinu non aperto.**

Long. 48-56 μ; lat. sine spin. 46-54 μ; lat. cum spin. 49-58 μ; lat. isthm. 27-30 μ.

**Nyasa.**—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

This species has been recorded by Schmidle from the vicinity of Lake Nyasa (vide Engl. *Bot. Jahrb.* xxxii. (1903) p. 68, t. 1. fig. 24). It is now known to occur in Madagascar, Central Africa, Siam, and Central China.

The Desmid described by Gutwinski from Java as *C. suberosum* (Gutw. in Bull. de l’Acad. Sci. Cracov., Nov. 1902, p. 592, t. 38. fig. 36) is identical with *C. subauriculatum* var. *truncatum*, W. & G. S. West, in *Bot. Tidsskr.* xxiv. (1901) p. 172, t. 2. fig. 20, described from the island of Koh Chang in the Gulf of Siam.


Long. 24-5 μ; lat. 24-5 μ; lat. isthm. 7 μ.

**Nyasa.**—Among *Utricularia*, Domira Bay (19 June, 1904; no. 579).

A form approaching var. *elevatum*, Nordst.

**Nyasa.**—Among Algae on the shore, Domira Bay (19 June, 1904; no. 17).

70. *Cosmarium bioculatum*, Bréb. in Ralfs, Brit. Desm. (1848) p. 95, t. 15. fig. 5; W. & G. S. West, Brit. Desm. ii. (1905) p. 165, t. 61. figs. 3-7. Forms with a punctate cell-wall, some individuals approaching var. *hians*, W. & G. S. West: long. 19-21 μ; lat. 16-18 μ; lat. isthm. 4-5-6 μ.

**Victoria Nyanza.**—Among *Utricularia*, near Bukoba (20 Apr. 1905; no. 618).


Long. 11 μ; lat. 9 μ; lat. isthm. 3 μ; crass. 5-5 μ.

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

It is with much doubt that we refer this minute *Cosmarium* to *C. minutissimum*, Arch., a species concerning which very little is definitely known. Another African form, from Huilla, Angola, W. Africa, has also been with uncertainty regarded as *C. minutissimum* (vide W. & G. S. West, in Journ. Bot. xxy. (1897) p. 38). The sinus of the Nyanza specimens was not a narrow incision" as described by Archer, and the outline of the cell was exactly similar to that exhibited by some forms of *C. contractum*, var. *ellipsodeum*.


**Victoria Nyanza.**—In plankton, Bukoba (18 Apr. 1905; no. 249). In sheltered bay near Entebbe (1 May, 1905; no. 620).


**Victoria Nyanza.**—In plankton, Bukoba (18 Apr. 1905; no. 249).

**Tanganyika.**—In swamp, Mbete (28 Sept. 1904; no. 108).


Long. 22-31 μ; lat. 17-23 μ; lat. apic. 9-3'-13:5 μ; lat. isthm. 5-6'5 μ.

**Victoria Nyanza.**—Near Bukoba (20 Apr. 1905; no. 618). In sheltered bay near Entebbe (1 May, 1905; no. 620).
This form was not uncommon from the above localities, and to a certain extent it combines the characters of *C. retusum* (Perty) Rabenh., and *C. retusiforme* (Wille) Gutw. It has the deep linear constriction of the former, but the proportions of the latter. The subrectangular basal angles are distinctive. It appears to be a tropical form with a wide geographical distribution, and was first described from Sumatra.


**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905; no. 251).


**Nyasa.**—In pools, Nkata Bay (23 June, 1904; no. 22). In swamp, Karonga (2 July, 1904; no. 34).


Var. *retusum*, var. n. (Pl. 7. fig. 6.) 
Semicellula lateribus paullo retusis apicem versus et apice leviter retuso. 
Long. 38 μ; lat. 34 μ; lat. isthm. 10 μ.

**Nyasa.**—In the swampy lake margin, Domira Bay (19 June, 1904; no. 579).

**Victoria Nyanza.**—In sheltered bay near Entebbe (1 May, 1905; no. 620). The Desmid described and figured by Schmidle from Nyasa (cf. Engl. Bot. Jahrb. xxxii. (1903) p. 69, t. 1. fig. 26) as "*C. homalodermum var. minor*" is most probably identical with this variety.

Small form: long. 25 μ; lat. 21 μ; lat. isthm. 5 μ.

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 124).


**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905; no. 251).

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72. Also 26 Aug. 1904; no. 80).


**Victoria Nyanza.**—In plankton, Bukoba (18 Apr. 1905; no. 249).
p. 252, t. 15. fig. 17.—*C. globosum, Wolle, Desm. U.S.* (1884) p. 60, t. 49. 
forme 15-17.

*Forma major*: long. 44-49 μ; lat. 37-39 μ.; lat. isthm. 35-37 μ. (Pl. 7. 
fig. 10.)

**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905; nos. 251 
and 618).

**Tanganyika.**—In swamp close to shore, Kituta (23 Aug. 1904; nos. 72 
and 73). Also 26 Aug. 1904; no. 80).

This *Cosmarium* occurred in some abundance, and is characterized by the 
slightness of its constriction. In outline the African specimens agreed 
exactly with the figures given by Wolle, but they were of decidedly larger 
dimensions.

There is one pyrenoid in each semicell, from which radiate a number of 
vertically-disposed divisions of the chloroplast.

The specimens very closely resemble a Desmid described by Schmidle from 
Zanzibar as *Dysphinctium subellipticum* (*vide* *Engl. Bot. Jahrb.* xxvi. (1898) 
p. 21, t. 1. fig. 15), but there was no large series of punctuations on each side 
of the isthmus.

p. 66, t. 2. fig. 4.

Long. 27-30 μ; lat. 26-28 μ.; lat. isthm. 17-20 μ.; crass. 17-19 μ.

**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905; nos. 251 
and 618).

This species was fairly abundant, and seems well characterized by its 
shallow constriction and by the two pyrenoids in each semicell.

p. 112, t. 7. fig. 8; *G. S. West, in Journ. Linn. Soc.*, *Bot.* xxvii. (1899) p. 387, 
t. 10. figs. 10-21.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

v. (1895) p. 59, t. 8. fig. 9.

Long. 29 μ; lat. 18 μ; lat. isthm. 6 μ.

**Nyasa.**—In shore pools, Nkata Bay (23 June, 1904; no. 22).

85. Cosmarium minimum, W. & G. S. West, *l.c.* p. 58, t. 8. fig. 10.

Several slightly different forms.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).
OF THE THIRD TANGANYIKA EXPEDITION.


Long. 13·5 μ; lat. 11·5 μ; lat. isthm. 3 μ; lat. apic. 6 μ.

**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 34). Among *Utricularia*, Domira Bay (19 June, 1904; no. 579).

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 80).


**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).


**Forma octangulare**, *Wille*, in *Öfvers. K. Vet.-Akad. Förh.* (1879) no. 5, p. 43, t. 12, fig. 35.

**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 33).

**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905; no. 251),


**Nyasa.**—Among Algae on shore, Domira Bay (19 June, 1904; no. 17). In swamp, Kota Kota (20 June, 1904; no. 18).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).


**Victoria Nyanza.**—In swampy pool near Bukoba (20 Apr. 1905; no. 618). Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).


**Nyasa.**—Among Algae on shore, Domira Bay (19 June, 1904; no. 17).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620)


**Nyasa.**—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

91. Cosmarium Cunningtonii, sp. n. (Pl. 7, fig. 7.)

* C. parvum, circiter 11⁄2-plo longius quam latius, profundissime constrictum, sinu angustissimo-lineari extremo paullo ampliato; semicellulae pyramidatae (vel pyramidato-subtrapeziformes), angulis basalibus truncato-rectangularibus
(interdum levissime retusis), lateribus subrectis vel levissime convexis, angulis superioribus subrotundatis, apice subtruncato-convexo, infra et juxta apicem granulis magnis binis ornatae, granulo singulo ad angulis basalibus juxta sinum, et scrobiculis conspicuis quinuncialiter ordinatis in centro semicellulæ; a vertice visse elliptice, polis levissime truncatis, intra marginem unumquemque granulis magnis binis instructæ; a latere oblongo-elliptice (vel elliptico-circularis), ad apicem utrinque granulo magni ornatæ; pyrenoidibus binis.

Long. 42–44 μ; lat. 31·5–32·5 μ; lat. isthm. 9 μ; crass. 19 μ.

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

This species stands nearest to C. bigemma, Racib. (in Pamietnik matem.-przy. Akad.] Umiej. Krakow. xvii. (1889) p. 85, t. 5. fig. 10), from which it is distinguished by the truncate basal angles of the semicells, the smooth sides and slightly convex apex, as well as by the two pyrenoids in each chloroplast.


Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905; no. 251).

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).


Victoria Nyanza.—In sheltered bay, near Entebbe (1 May, 1905; no. 620).


Var. ornatum, var. n. (Pl. 7. fig. 8.)

Var. semicellulæ depressis, granulis infra sed juxta apicem majoribus et conspicuis, cum granulum supra isthmum et granulis duobus apicem versus.

Long. 26 μ; lat. 26–29 μ; lat. isthm. 9 μ; crass. 17 μ.

Victoria Nyanza.—In sheltered bay, near Entebbe (1 May, 1905; no. 620).

This variety differs from the type in the somewhat flattened apices, the more conspicuous apical granules, the single granule above the isthmus, and the two granules below the apex of the semicells. Schmide has described a var. striatum of this species from Zanzibar and Mozambique.

It is closely allied to varieties of C. taxichondrum, Lund., especially to var. subandulatum, Boldt, and its form subdenticulatum, W. & G. S. West.

**Nyasa.**—On the shore, Domira Bay (19 June, 1904; no. 17).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 123).


**Nyasa.**—On the shore, Domira Bay (19 June, 1904; no. 17).

**Tanganyika.**—In plankton, Toa (10 Jan. 1905; no. 208).


**Nyasa.**—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).


**Nyasa.**—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

**Victoria Nyanza.**—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 80).

Schmidle has described a species from Nyasa as C. *occultum* which stands very near to *C. subprotumidum*.


**Nyasa.**—In shore pools, Nkata Bay (23 June, 1904; no. 22).

**Victoria Nyanza.**—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 72. Also 26 Aug. 1904; no. 80).


**Nyasa.**—In shore pools, Nkata Bay (23 June, 1904; no. 22).

**Victoria Nyanza.**—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 123).


**Tanganyika.**—In swamp, Mbete (28 Sept. 1904; no. 108).


**Nyasa.**—In shore pools, Nkata Bay (23 June, 1904; no. 22).

**Victoria Nyanza.**—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

The original examples of this species were described from Pungo Andongo.
in Angola, W. Africa. The Nyanza specimens were relatively a little longer, but otherwise precisely similar.

One of the chief features of this species is the presence between the granules of small rounded scrobiculations similar to those of *C. margaritatum* (Lund.), Roy & Biss.; and I should like once more to emphasize the fact that it is the only species of its section in which the hexagons of scrobiculations are disposed so that two opposite sides are horizontal.

Schmidle (in Engl. Bot. Jahrb. xxvi. (1898) p. 27, t. 1. fig. 20) has described and figured a *Cosmarium* from Zanzibar, which he names "*C. multi-ordinatum*, forma," but which is most probably a form of *C. decoratum*, W. & G. S. West.

Forma granulis paullo minoribus.
Long. 66 μ; lat. 65 μ; lat. isthm. 22 μ.

**Nyasa.**—Among Algae on rocks, Nkata Bay (23 June, 1904; no. 23).
This form was very slightly smaller than the original Swedish plants, and the granules were rather more numerous and of somewhat smaller size.

Long. 66 μ; lat. 60 μ; lat. isthm. 19 μ.

**Nyasa.**—Among Algae on stones, Domira Bay (19 June, 1904; no. 17).

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 124).

104. *Cosmarium lacunatum*, sp. n.
*C. medioeere, circiter tam longum quam latum, profundissime constrictum, sinu angusto introrsum valdissime ampliato (lacunato), isthmo breviter cylindrico; semicelleae trapeziformes, angulis superioribus et inferioribus rotundatis, apice lato recto vel levissime concavo, lateribus leviter convexis et sursum divergentibus; membrana granulata, granulis in seriebus oblongo-elliptice, polis rotundatis.
Long. 77 μ; lat. bas. semicell. 60–62 μ; lat. apic. semicell. 80–86 μ; lat. isthm. 22 μ; crass. 37 μ.

**Nyasa.**—In swamp, Karonga (29 June, 1904; no. 32).
This remarkable *Cosmarium* is at once distinguished by the form of the semicells and the extraordinarily dilated sinus. The granulation is very similar to that of *C. margaritatum*, and, as in that species, small punctulations are present between the granules. Excluding the sinus, the outline of the semicells very much resembles that of *C. biretum*, Bréb.
One other curious feature of *C. lacunatum* is the narrowness of the vertical view, which is $2\frac{1}{3}$ times longer than broad.

Compare also with *C. sublatum*, Nordst.


**Nyasa.**—In swamp, Kota Kota (20 June, 1904; no. 18). In swamp, Karonga (2 July, 1904; no. 34).

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 123).

Var. compressum, var. n. (Pl. 7. fig. 11.)

Var. cellulis paullo latioribus quam longioribus, angulis superioribus magis rotundatis.

Long. 30 $\mu$; lat. 35 $\mu$; lat. isthm. 8 $\mu$; crass. 18 $\mu$.

**Tanganyika.**—Abundant in swamp, Kituta (23 Aug. 1904; no. 72).

Since Wolle’s somewhat crude account of *C. Pseudobroomei* in 1884, the species has been found in many parts of the world and is now very well known.

A number of varieties have also been discovered, some of which appear to be well-marked and of constant character. The African variety most nearly approaches var. *convexus*, W. & G. S. West (in Trans. Bot. Soc. Edinb., Nov. 1904, p. 21, t. 1. fig. 22), in the roundness of the upper angles of its semicells, but the general proportions and the basal angles are quite different.


**Victoria Nyanza.**—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

This plant differs from typical *C. Pseudobroomei* in its open sinus and in its fewer and relatively smaller granules. In view, however, of the recently discovered varieties of *C. Pseudobroomei*, it would perhaps be better regarded as a variety of that species.


a. Forma paullo major: long. 59 $\mu$; lat. 28 $\mu$; lat. isthm. 23 $\mu$.

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

b. Forma major et paullo longioribus: long. 71 $\mu$; lat. 29 $\mu$; lat. isthm. 24 $\mu$.

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904; no. 80).

Many of the specimens of the latter form were considerably larger than any I have previously examined, and in some the granules were more evidently arranged in transverse than in longitudinal series.
Genus XANTHIDIUM, Ehrenb.

108. XANTHIDIUM CRISTATUM, Bréb. in Ralfs, Brit. Desm. (1848) p. 115, t. 19. fig. 3.
Forma semicellulis subsemicirculari-trapeziformibus, sinu aperto, spinis basalisibus paullo reductis (interdum duplicatis ut in X. fasciculato).
Long. sine spin. 60 μ, cum spin. 74 μ; lat. sine spin. 46 μ, cum spin. 58 μ; lat. isthm. 15 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

Genus ARTHRODESMUS, Ehrenb.

a. Forma semicellulis triangularibus, apice recto, spinis validis variabiliter curvatis subhorizontaliter dispositis.
Long. 20 μ; lat. sine spin. 16 μ, cum spin. 52 μ. (Pl. 6. fig. 13.)
Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).
b. Forma spinis multe brevioribus.
Long. 14–5 μ; lat. sine spin. 13 μ; long. spin. 3–5 μ.
Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905; no. 618).
This form is almost identical with one observed in the Scottish plankton (vide W. & G. S. West, in Trans. Roy. Soc. Edinb. xli. pt. iii. (1905) p. 501 t. 7. fig. 10).

Genus STAURASTRUM, Meyen.

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).

112. STAURASTRUM BREVISPINUM, Bréb. in Ralfs, Brit. Desm. (1848) p. 124, t. 34. fig. 7.
Forma tetragona: long. 40–43 μ; lat. 32–38 μ; lat. isthm. 14–17 μ.
Victoria Nyanza.—In plankton with preceding species (no. 252).
OF THE THIRD TANGANYIKA EXPEDITION.


**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).


Forma minor: long. 28 μ; lat. 25 μ; lat. isthm. 10 μ.

**Nyasa.**—In shore pools, Nkata Bay (23 June, 1904; no. 22).

115. **Staurastrum punctulatum**, Bréb. in Ralfs, Brit. Desm. (1848) p. 113, t. 22. fig. 1.

**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905; no. 251).

116. **Staurastrum alternans**, Bréb. in Ralfs, l. c. p. 132, t. 21. fig. 7.

**Tanganyika.**—In plankton, Kalambo (5 Nov. 1904; no. 154).


Long. 18–18.5 μ; lat. 18–23 μ; lat. isthm. 7 μ.

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).


Var. minimum, var. n. (Pl. 6. fig. 5.)

Var. perparva, spinis ut in forma typica sed minoribus.

Long. sine spin. 22 μ, cum spin. 25 μ; lat. sine spin. 20–22 μ, cum spin. 25 μ; lat. isthm. 6 μ.

**Victoria Nyanza.**—Swampy pool, Bukoba (20 Apr. 1905; no. 618).

119. **Staurastrum echinatum**, Bréb. in Ralfs, Brit. Desm. (1848) p. 215, t. 35. fig. 24 (figure poor); W. & G. S. West, in Bot. Tidsskr. xxiv. (1901) p. 177, t. 3. fig. 31.

Small form: long. sine spin. 26 μ, cum spin. 31 μ; lat. sine spin. 23 μ, cum spin. 32 μ; lat. isthm. 8 μ.

**Victoria Nyanza.**—With the preceding species (no. 618).

Except for being slightly smaller, the specimens agreed very well with those observed from Siam. The cells were of the same form, and the spines were of the same size and length.


Long. sine acul. 60 μ, cum acul. 77 μ; lat. sine acul. 48–52 μ, cum acul. 84–90 μ; lat. isthm. 11 μ.

**Victoria Nyanza.**—In the plankton, Bukoba (21 Apr. 1905; no. 252).

This Desmid was not uncommon in the plankton of Victoria Nyanza, but the specimens observed were decidedly larger than those collected by Stuhlmann in 1872 and subsequently described by Schmidle (1898). The var. **Nyansa** appears to differ from the type in the deeper constriction and in the fewer number of the more delicate aculei. Even in European specimens, however, the number of these delicate aculei is very variable.

121. **Staurastrum quadrangulare**, Bréb. in Ralfs, Brit. Desm. (1848) p. 128, t. 34. fig. 11, t. 22. fig. 7.


Forma angulis semicellulararum compressis, cum spinis duobus supra et spinis singulis vel binis infra; a vertice visis pentagonis, lateribus retusis, angulis bi-vel trispinatis. (Pl. 6. fig. 6.)

Long. 25 μ; lat. sine spin. 21–24 μ, cum spin. 24–27 μ; lat. isthm. 9 μ.

**Tanganyika.**—In swamp, Mbetu (28 Sept. 1904; no. 108).

Lagerheim has recorded a pentagonal form of this variety from Abyssinia (vide Nuova Notarisia, 1893, p. 164). The form observed from Tanganyika might equally well be regarded as a small pentagonal form of **S. angulare**, W. B. Turn. (in K. Sv. Vet.-Akad. Handl. xxv. (1893) no. 5, p. 130, t. 14. fig. 17), a species which appears scarcely to be distinct from **S. quadrangulare**.


**Var. bidens**, var. n. (Pl. 6. fig. 9.)

Semicellulæ a fronte visae subrectangulares, verrucis bidenticulatis (vel bispinatis) binis supra angulum unumquemque; a vertice visae quadrato, lateribus levissime retusi, angulis bidenticulatis.

Long. sine dentic. 27 μ, cum dentic. 32 μ; lat. sine dentic. 22–26 μ, cum dentic. 26–32 μ; lat. isthm. 10 μ.

**Victoria Nyanza.**—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

This variety differs from **S. monticulosum** var. **bijrium**, Nordst., in the absence of the six inferior accessory spinate warts. It closely approaches a Desmid described by Raciborski as **S. Libeltii** (in Pamiętnik matem.-przy. Akad. Umiej. Krakow. xvii. (1889) p. 100, t. 7. fig. 12).
OF THE THIRD TANGANYIKA EXPEDITION.


Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618).

124. Staurastrum cunningtonii, sp. n. (Pl. 6, fig. 7.)

_S. parvum, circiter tam longum quam latum (cum processibus), modice constrictum; semicellula campanulata, parte inferiore glabra, angulis superiores in processus breves denticulatos horizontaliter dispositos productis, apicibus processuum tridenticulatus, apice convexo et verrucoso; a vertice visae triangulares, lateribus rectis (vel levissime convexis), angulis in processus breves denticulatos productis, cum dente conico ad basin processuum utroque et verrucis bidenticulatis intra marginem lateralem unumque in centro punctatae.

Long. 30 μ; lat. cum proc. 24–30 μ; lat. isthm. 8 μ.

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

This species should be compared with _S. margaritaceum_, (Ehrenb.) Menegh., from which it is distinguished by the more delicate processes, the verrucose apex of the semicell, and the form of the vertical view. The triangular vertical view possesses a conical tooth at each side of the base of each process and a pair of bidenticulate warts within each lateral margin.


Victoria Nyanza.—Among _Utricularia_, near Entebbe (1 May, 1905; no. 620).


Long. 35 μ; lat. 35 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

127. Staurastrum polymorphum, Bréb., in Raf's, Brit. Desm. (1848) p. 135, t. 22. fig. 9, t. 34. fig. 6.

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905; no. 618).


Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905; no. 251.)


Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72). In swamp, Mbete (28 Sept. 1904; no. 108).
Forma processibus minus divergentibus.
Long. sine proc. 8 μ, cum proc. 16 μ; lat. sine proc. 6 μ, cum proc. 29 μ; lat. isthm. 2.5 μ.

**Victoria Nyanza.**—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Forma 3-radiata.

**Victoria Nyanza.**—Among Utricularia, in sheltered bay near Entebbe (1 May, 1905; no. 620).


**Victoria Nyanza.**—In plankton, Bukoba (18 Apr. 1905; no. 249).

Var. protractum, var. n. (Pl. 6, fig. 11.)
Var. apice semicellulæ protracto leviter retuso et glabro.
Long. 29 μ; lat. sine proc. circ. 16 μ, cum proc. 58–62 μ; lat. isthm. 7 μ.

**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; no. 9).

Var. Nyansæ, var. n. (Pl. 6, fig. 10.)
Var. corpore semicellulærum angustiore, ad basin inflato-bulboso, processibus incurvatis delicate noduloso-denticulatis.
Long. 26 μ; lat. sine proc. circ. 12 μ, cum proc. 48 μ; lat. isthm. 4.5 μ.

**Victoria Nyanza.**—In plankton, Bukoba (18 Apr. 1905; no. 249).

This variety is very near to *S. gracile* var. *elegantidum*, W. & G. S. West (in *Trans. Linn. Soc.* ser. 2, Bot. vi. (1902) p. 191, t. 22, fig. 20), but differs in the narrow and bulbous base of the semicells, and in the more incurved and more coarsely denticate processes.


**Victoria Nyanza.**—Among Utricularia, near Entebbe (1 May, 1905; no. 620).


**Victoria Nyanza.**—With the preceding species (no. 620).
Forma semicellulæ a vertice vise lateribus undulatis et denticulatis (verrucis emarginatis perreductis ornatis).
Long. 38 μ; lat. cum proc. 52–60 μ; lat. bas. semicell. 13.5 μ; lat. isthm. 8.5 μ.

**Nyasa.**—In swamp, Karonga (2 Aug. 1904; no. 34).

Var. subglabrum, var. n. (Pl. 6. fig. 8.)

Var. corpore semicellularum verrucis emarginatis paene destituto; processibus ut in forma typica.

Long. sine proc. 42 μ; lat. sine proc. 24–27 μ; cum proc. 84–96 μ; lat. isthm. 11·5 μ.

**Victoria Nyanza.**—In plankton, Bukoba (21 Apr. 1905; no. 252).

Only a few of the emarginate warts are present on the semicells of this variety, but the processes are quite characteristic of the species.


Forma africanum, nob. (Pl. 6. fig. 12.)

Forma paullo major, processibus subrectis et horizontaliter dispositis (parallelis), ad basin semicellulae cum denticulis singulis vel binis; apicibus semicellularum convexis et glabris; semicellulis a vertice visis corpore lato elliptico-rotundato.

Long. 42–43 μ; lat. sine proc. circ. 11–21 μ, cum proc. 146–152 μ; lat. isthm. 6–7 μ; crass. 14 μ.

**Nyasa.**—In the plankton, near Mtangula (22 June, 1904; no. 20). Plankton, off Vahambwera Point (24 June, 1904; no. 24). Plankton, Deep Bay (24 June, 1904; no. 25). Plankton, off Karonga (1 July, 1904; no. 30).

**Victoria Nyanza.**—In plankton, Bukoba (21 Apr. 1905; no. 252).

This large form with horizontally-directed processes was frequent in the plankton of Nyasa and Victoria Nyanza. Schmidle mentions a form which is possibly identical with it as occurring in Stuhlmann’s collections from Victoria Nyanza.

A few smaller specimens of *S. leptocladum* were observed from Victoria Nyanza in which the processes were shorter, and the two spines at the extremity of each process disposed in a horizontal plane, the bifurcation only being apparent in the vertical view.


Long. sine proc. 46–51 μ; lat. sine proc. circ. 28–36 μ, cum proc. 100–130 μ; lat. isthm. 14 μ. (Pl. 3. figs. 8–10, 20.)

**Victoria Nyanza.**—Abundant in the plankton, Bukoba (18 Apr. 1905; no. 249, and 21 Apr. 1905; no. 252).

**Linn. Journ.—Botany, Vol. XXXVIII.**
This species was in great abundance in the plankton of Victoria Nyanza, the locality from which Schmidle originally described it. The semicells possessed either five or six processes, which exhibited considerable variation in the denticulation. The denticulation of the under surfaces of the processes was commonly much more pronounced than that of the upper surfaces, but in some few cases the denticulation was almost equal all round the processes. Each process was terminated by three or four short spines.


Long. sine proc. 36-38 μ; lat. sine proc. circ. 23-25 μ, cum proc. 103-128 μ; lat. isthm. 9 μ.

Victoria Nyanza.—Abundant with the type (nos. 249 and 252).

This variety was quite as abundant as the more typical form, and the semicells similarly possessed either five or six processes. It appears to differ from S. limneticum in two principal features:—the body of the semicell is relatively much smaller, and the processes are aculeate.

Lemmermann’s specimens were from the plankton of Lake Wakatipu, New Zealand, and the African examples differed from his in the fewer and more irregularly disposed aculei, which were strongly reminiscent of those on the processes of S. aspinosum, Wolle, and S. acanthastrium, W. & G. S. West. Some individuals were noticed which possessed a few sharp aculei on the apex of the semicells near the bases of the processes.


a. Forma triangularis: long. sine proc. 51 μ, cum proc. 86-91 μ; lat. sine proc. 35-36 μ, cum proc. 90-96 μ; lat. isthm. 16-5 μ.

b. Forma quadrangularis: long. sine proc. 49 μ, cum proc. 84 μ; lat. sine proc. 33-34 μ, cum proc. 76-78 μ; lat. isthm. 16 μ.

Victoria Nyanza.—Plankton, Bukoba (18 Apr. 1905; no. 249, and 21 Apr. 1905; no. 252).

Triangular and quadrangular forms of this species were equally abundant in the plankton of Victoria Nyanza. They were typical as regards proportions and length of processes, and the latter possessed two or three divergent spines at their apices. These are the first specimens of the type form which have been recorded with more than two spines on the processes, although three spines are generally found on the described varieties of this species.

Schmidle has recorded the var. quadrangularis, W. & G. S. West, from Victoria Nyanza, but no specimen I examined possessed the proportions of that variety.
Genus SPHEROZOSMA, Corda.

Nyasa.—Plankton, Anchorage Bay (11 June, 1904; no. 5).

Genus HYALOTHECA, Ehrenb.

139. HYALOTHECA MUCOSA, (Dillw.) Ehrenb. in Bericht Berlin (1840), p. 212; Ralfs, Brit. Desm. (1848) p. 53, t. 1. fig. 2.—Conferva mucosa, Dillw. (1819).

Order PROTOCOCCOIDEÆ.

Family VOLVOCAEÆ.

Genus PANDORINA, Bory.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).
Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

Family CHARACIEÆ.

Genus CHARACIUM, A. Br.

Long. cell. 28.5–31 µ; lat. cell. 6–7 µ; long. stip. 12.5–18 µ.
Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

142. CHARACIUM PRINGSHEIMII, A. Br. Alg. Unicell. p. 106 (1855); Rabenh. l. c. p. 86.
Long. cell. cum stip. brev. 34 µ; lat. cell. 11 µ.
Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Family PLEUROCOCCEÆ.

Genus TROCHISCOLA, Kütz.

143. TROCHISCOLA ACICULIFERA, (Lagerh.) Hansg. in Hedwigia, xxvii. (1888), p. 129.—Acanthococcus aciculiferus, Lagerh.
Diam. cell. sine spin. 14 µ; long. spin. 2.5 µ.
Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).
Family HYDRODICTYACEÆ.

Subfam. PEDIASTREÆ.

Genus PEDIASTRUM, Meyen.


Disposicio cellularum 4, 1 + 7, et 5 + 11.

Nyasa.—On shore, Domira Bay (19 June, 1904; no. 17). In swamp, Kota Kota (20 June, 1904; no. 18). Swampy lake margin, Domira Bay (no. 579).

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).


From Nyasa (no. 17) a coenobium was observed consisting of only three cells (Pl. 5, fig. 6). This is a very interesting condition directly intermediate in character between the two-celled coenobia of Euastropsis and the simple four-celled coenobia of Pediastrum.

Var. LONGICORNE, Racib.

Diam. coenob. 4 cell. (cum cornibus) 18–20 μ. (Pl. 5, fig. 5.)

Nyasa.—Plankton, Anchorage Bay (13 June, 1904; no. 9).


Nyasa.—Plankton, Deep Bay (24 June, 1904; no. 25). In swamp, Kota Kota (20 June, 1894; no. 18).

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).


Var. RUGULOSUM, var. n. (Pl. 5, fig. 22.)

Var. cellulis irregulariter cristatis, cristis valde irregularibus sinuatis et anastomosis.

Diam. coenob. 150–192 μ; diam. cell. 22–29 μ.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).


Diam. coenob. 28–67 μ.

Tanganyika.—Plankton, near Mbete (28 Sept. 1904; no. 109). Plankton, near Kala (19 Nov. 1904; no. 170).

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—Plankton, near Baraka (24 Feb. 1905; no. 240).
Forma cellulis centralibus ut in forma rectangulari, cellulis periphericis cum processibus divaricatis valde attenuatis; membra na cellularum granulata.

Diam. coenob. 160-235 μ; diam. cell. 29-33 μ.

Victoria Nyanza.—Plankton, near Bukoba (20 Apr. 1905; no. 252).
This form resembles forma coherens, Bohlin, and forma rectangularis, Bohlin (in Bih. K. Sv. Vet.-Akad. Handl. xxiii. no. 7 (1897), p. 31, t. 2. figs. 1-3), in the form of the central cells, but differs in its peripheral cells.


Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).
Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In swamp, Mbete (28 Oct. 1904; no. 108).


Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In swamp, Mbete (no. 108).


Peripheral cells produced outwardly into a long attenuated process, outer margins of cells concave; central cells polygonal, either without intercellular spaces, or with minute spaces between some or all of the cells. Processes radiating, generally rather delicate but sometimes stout, apices minutely truncate or nearly emarginate; cell-walls commonly punctate and sometimes granulate.

Diam. coenob. 44-92 μ; diam. cell. 9-16 μ.

Nyasa.—Plankton, Anchorage Bay (13 and 14 June, 1904; nos. 9 and 10).

Tanganyika.—In plankton, near Chamkaluki (15 Nov. 1904; no. 160) and near Baraka (24 Feb. 1905; no. 240).


Outer margins of peripheral cells convex; central cells generally without intercellular spaces, but sometimes with small ones.

Diam. coenob. 20-82 μ; diam. cell. 8-17 μ.
Nyasa.—Plankton, Anchorage Bay (13 Apr. 1904; no. 9).

Victoria Nyanza.—Near Bukoba (17 Apr. 1905; no. 248). In sheltered bay, near Entebbe (1 May, 1905; no. 620).


With large intercellular spaces between the central cells; outer margins of peripheral cells typically concave. Processes long and moderately robust.

Diam. coenob. 100-180 μ; diam. (max.) cell. 18-26 μ. (Pl. 2. figs. 17, 18; Pl. 3. fig. 16.)

Nyasa.—Plankton, off Vahambwera Point (24 June, 1904; no. 24) and off Karonga (1 July, 1904; no. 30).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).


Coenobium consisting of a ring of peripheral cells, the outer margins of which are concave; no central cells.

Diam. coenob. 46-75 μ. An abnormal coenobium is figured on Pl. 5. fig. 21.

Nyasa.—Plankton, Anchorage Bay (11 and 13 June, 1904; nos. 5 and 9). Plankton, off Vahambwera Point (24 June, 1904; no. 24) and off Karonga (1 July, 1904; no. 30).

Victoria Nyanza.—In sheltered bay, near Entebbe (1 May, 1905; no 620).


Peripheral cells of coenobium as in typical var. clathratum, but central cells stouter with smaller intercellular spaces.

Diam. coenob. usque ad 182 μ.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).

—— forma ovatum, (Ehrenb.).—P. Schröteri, Lemm. l. c. p. 20, t. 2. fig. 33, et var. microporum, Lemm. l. c. t. 2. figs. 34, 35. P. clathratum, forma ovatum, (Ehrenb.) Schmidle, in Engl. Bot. Jahrb. xxxii. (1903) p. 84, t. 3. fig. 18.

Central and peripheral cells ovoid and stout, margins generally convex (rarely slightly concave).

Diam. coenob. usque ad 240 μ.

Nyasa.—Plankton, Anchorage Bay (13 and 14 June, 1904; nos. 9 and 10). Plankton, off Vahambwera Point (24 June, 1904; no. 24) and off Karonga (1 July, 1904; no. 30).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).

P. simplex occurred in great abundance in some of the plankton-material
and many diverse forms were observed. Extreme forms scarcely appear to belong to the same species, but a careful comparison of all the forms gives almost a complete gradation from one extreme to the other. Most of these forms have at different times been described under various specific names; but after examining the African plankton-forms it is impossible to recognize more than one species, and for the specific name I have retained Meyen’s old name Pediastrum simplex. This name is a very appropriate one, as there is no other species of the genus with a simple radiating process from each peripheral cell.

In any of the forms the cell-wall may be smooth, punctate, or granulate, and the processes may be obtuse, truncate, or minutely emarginate.

In one most interesting form the coenobium was not plane, the cells being disposed in the manner of a somewhat simplified Cellastrum. Some of these cells possessed only one process and others two, and one of them appeared to be a resting akinete (Pl. 5. fig. 20). This form was from Victoria Nyanza (no. 620): diam. coenob. 40–46 μ; diam. cell. 10–17 μ. It should be compared with Cellastrum cornutum, Lemaire (in Journ. de Bot. févr. (1894) pp. 82, 83 cum fig.), and also with Pediastrum Kawraiskyi, Schmidle (Algen Hochseen Kaukasus, 1897, p. 5; Lemm. in Ber. Deutsch. Bot. Ges. xix. (1901) t. 4. fig. 5).

Family PROTOCOCCACEÆ (or AUTOSPORACEÆ).

Subfam. CŒLASTRÆÆ.

Genus CŒLASTRUM, Näg.

Diam. coenob. 38–90 μ; diam. cell. 11·5–27 μ.

Nyasa.—Plankton, Anchorage Bay (13 June, 1904; no. 9).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).

150. CŒLASTRUM SPHERIcoM, Näg.Gatt. einz. Alg. (1849) p. 97, t. 5 c. fig. 1 a–d.
Nyasa.—Plankton, Anchorage Bay (13 June, 1904; no. 9). Swampy lake margin, Domira Bay (19 June, 1904; no. 579). In swamp, Kota Kota (20 June, 1904; no. 18).

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Nyasa.—Plankton, Anchorage Bay (14 June, 1904; no. 10).
Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80). In swamp, Mbete (28 Sept. 1904; no. 108).
Victoria Nyanza.—Near Entebbe (1 May, 1905; no. 620).
This species was abundant in some of the collections, and the cells showed great variation in the form of the external margin. It is a very characteristic plant and should not be confused with any other species of the genus. Lemaire's "var. quinqueradiatum" is one of its commonest forms.

Diam. coenob. usque ad 108 µ; diam. cell. 13-16 µ.

Nyasa.—Plankton, Anchorage Bay (14 June, 1904; no. 10).
The cells of this variety, as in the case of the type, possess from four to six short radiating processes. The variety only differs in the bluntness of the outstanding projections, which are rounded and not truncate.

Diam. coenob. 40-114 µ; diam. cell. 8-27 µ; long. process. margin. 4.5-6.5 µ.

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905; no. 249).
This well-marked variety occurred abundantly, and a large number of auto-colonies were observed in process of formation in the mother-cells. The principal feature of the variety could be recognized when the auto-colonies were only 18 µ in diameter. The marginal processes were sometimes truncate and sometimes broadly rounded. It was originally described from the plankton of Victoria Nyanza by Schmidle in 1898.

152. Coelastrum compositum, sp. n. (Pl. 5, figs. 8-9.)
C. coenobiis cubicis e subfamiliiis 8 formatis vel sphericis e subfamiliiis pluribus formatis; subfamilia unaquaque tetraëdrica cum angulis abrupte truncatis vel depresso-pyramidatis, e cellulis parvis 4 tetraëdrica dispositis compositis, et cum lacuna minuta inter cellulas; lacunis magnis inter subfamilias, iis coenobiorum cubicorum irregulariter rotundato-rectangularibus, iis coenobiorum sphericorum subtriangularibus. Membrana cellularum firma glabra et non incrassata.
Diam. coenob. 36-82 µ; diam. cell. 6-10 µ.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).
Among Utricularia, near Entebbe (1 May, 1905; no. 620).
This interesting C. coelastrum differs from all other species of the genus in having a tetrahedral group of four cells in place of what would normally be a single cell. The interstices between the groups are very large, and there is
also a small intercellular space between the four cells of each group. The abruptly truncate external angles of the cells are also peculiar.

I have not seen any stage in the formation of auto-colonies in this species; such a condition should be of great interest.


**Diam. coenob. usque ad 132 μ.**

**Nyasa.**—In shore pools, Nkata Bay (23 June, 1904; no. 22). Plankton, off Vahambwera Point (24 June, 1904; no. 24) and in Deep Bay (24 June, 1904; no. 25). In swamp, Karonga (2 July, 1904; no. 33).


Some of the specimens reached a large size, and the reticulate colonies were a conspicuous feature of the plankton.

**Genus SORA STRUM, Kütz.**


**Nyasa.**—In swamp, Kota Kota (20 June, 1904; no. 18).

**Victoria Nyanza.**—Plankton, near Bukoba (18 Apr. 1905; no. 249).

**Subfam. CRUCIGENIEÆ.**

**Genus CRUCIGENIA, Morren.**

155. *Crucigenia tetracantha,* sp. n. (Pl. 5, fig. 7.)

Coenobium quadratum, e cellulis 4 formatum conosciatum; cellulæ sub-quadratæ, lateribus subrectis, ad angulum exteriorum spina longa valida attenuata leviter curvata ornate, apicibus spinorum acutissimis; pyrenoide singulo in cellula unaquaque.

**Diam. coenob. sine acul. 17–19 μ; diam. cell. 9 μ; long. acul. 17–18 μ.**

**Tanganyika.**—Plankton, near Baraka (24 Feb. 1905; no. 240).

This species is, perhaps, nearest to *C. heteracanthea,* Nordst., but is at once distinguished by the large solitary spine at the external angle of each of the four cells. It bears considerable resemblance to a four-celled colony of some forms of *Pediastrum simplex.* There is a minute space in the centre of the coenobium between the four cells, and there appeared to be a complete absence of a mucous envelope. The spines are hollow, greatly attenuated, and their apices drawn out into very sharp points. The single pyrenoids in each cell were conspicuous.
Subfam. *Sebacidae*.

Genus *Scenedesmus*, Meyen.


**Nyasa.**—In swamp, Kota Kota (20 June, 1904; no. 18). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).


**Tanganyika.**—Plankton, Komba Bay (11 Oct. 1904; no. 135) and near Chamkaluki (15 Nov. 1904; no. 160).

This form appears to be frequent in the plankton. Several colonies were observed (from no. 160) attached together to form a curved plate of oblong cells, which greatly resembled a colony of *Crucigenia rectangularis*, (Nag.) F. Gay, var. *irregularis*, (Wille) nob.


**Nyasa.**—On stones on shore, Domira Bay (19 June, 1904; no. 17). In swamp, Kota Kota (20 June, 1904; no. 18). In swamp, Karonga (2 July, 1904; no. 34).

**Tanganyika.**—Plankton, Lofu River (5 Oct. 1904; no. 123).


**Nyasa.**—In pools, Nkata Bay (23 June, 1904; no. 22). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).


**Nyasa.**—On rocks and in shore-pools, Nkata Bay (23 June, 1904; nos. 22
OF THE THIRD TANGANYIKA EXPEDITION.

and 23). Among other Algae in scrapings off the bottom of s.s. 'Guendolen,' at anchor at S. end of the lake (15 June, 1904; no. 577).

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72). Plankton, near Sumbu (13 Oct. 1904; no. 138) and near Kaia (19 Nov. 1904; no. 170).


**Nyasa.**—On stones on shore, Domira Bay (19 June, 1904; no. 17). Shore-pools, Nkata Bay (23 June, 1904; no. 22).

**Tanganyika.**—Plankton, Lofu River (5 Oct. 1904; no. 123).


**Nyasa.**—Plankton, Anchorage Bay (13 June, 1904; nos. 5 and 9). On shore, Domira Bay (19 June, 1904; no. 17). Shore-pools, Nkata Bay (23 June, 1904; no. 22). In swamp, Kota Kota (20 June, 1904; no. 18). In swamp, Karonga (2 July, 1904; no. 33). S. end of lake (no. 577). Swampy lake margin, Domira Bay (no. 579).

**Tanganyika.**—In swamp, Mbete (28 Sept. 1904; no. 108). Plankton, Kituta Bay (26 Aug. 1904; no. 81), near Kala (19 Sept. 1904; no. 170), near Kirando (1 Dec. 1904; no. 175), near Maswa (14 Jan. 1905; no. 211), and near Baraka (24 Feb. 1905; no. 240).

**Victoria Nyanza.**—Swampy pool near Bukoba (20 Apr. 1905; no. 618). Sheltered bay near Entebbe (1 May, 1905; no. 620).


**Nyasa.**—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

**Tanganyika.**—In plankton, near Sumbu (13 Oct. 1904; no. 138), near Chamkaluki (15 Nov. 1904; no. 160), near Kala (19 Nov. 1904; no. 170), off Kirando (1 Dec. 1904; no. 175), and near Baraka (24 Feb. 1905; no. 240).

**Victoria Nyanza.**—In plankton, near Bukoba (18 Apr. 1905; no. 249). Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Some of the coenobia were very large, up to 54 μ in length (coenob. of 4 cells); length of cells 42 μ. The variety was originally described from Madagascar.


**Tanganyika.**—Abundant in swamp, Mbete (28 Sept. 1904; no. 108).
Genus DIMORPHOCoccus, A. Br.


Diam. colon. usque ad 104 μ; long. cell. 14–16 μ.

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905; no. 249).

Genus ANKISTRODESMUS, Corda.


Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—Plankton, Lofu River (5 Oct. 1904; no. 123).

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905; no. 618). Among Utricularia, near Entebbe (1 May, 1905; no. 620).

a. Forma cellulis robustis lunatis, chromatophora cum pyrenoide singulo. Lat. cell. 5 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

b. Forma cellulis robustis rectis solitariis, leviter tumidis, sine pyrenoidibus. Lat. cell. 7 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 24).


Nyasa.—On stones on shore, Domira Bay (19 June, 1904; no. 17). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).


Tanganyika.—Plankton, near Kala (19 Nov. 1904; no. 170).

163. Ankistrodesmus NITRSCIHOIDES, sp. n. (Pl. 5. fig. 18.)

A. cellulis solitariis, elongatis, fusiformibus, ad polum unum queque in spinam longissimam tenuissimam valde attenuatis, extremitatis spinarum curvatis (extremitati spinae alterius poli cum ea alterius curvato in directione opposita); chromatophora pallide viridi, pyrenoidibus nullis.

Long. cell. cum spin. 116–126 μ; lat. cell. in med. 3·6–4 μ.

Tanganyika.—Plankton, near Chamaluki (15 Nov. 1904; no. 160).

fig. 4), but is distinguished by its narrower cells, its stouter and curved spines, and by the absence of pyrenoids from the chloroplast.

It bears considerable resemblance to certain small and attenuated species of the genus *Nitzschia*.

Genus *CLOSTEROIOPSIS*, Lemm.


*Nyasa.*—Plankton, Deep Bay (24 June, 1904; no. 25) and off Karonga (1 July, 1904; no. 30).

*Victoria Nyanza.*—Plankton, near Bukoba (18 Apr. 1905; no. 249).

Genus *SELENASTRUM*, Reinsch.


Diam. colon. usque ad 154 μ; crass. cell. 4–5 μ.

*Tanganyika.*—In swamp, Kituta (23 Aug. 1904; no. 72).

*Victoria Nyanza.*—Plankton, near Bukoba (21 Apr. 1905; no. 252).

Some of the colonies were of very large size.

Genus *KIRCHNERIELLA*, Schmidle.


*Tanganyika.*—In swamp, Kituta (26 Aug. 1904; no. 80).

*Victoria Nyanza.*—Plankton, near Bukoba (18 Apr. 1905; no. 252).

Subfam. *OOCYSTIDEÆ*.

Genus *OOCYSTIS*, Nag.


*Nyasa.*—In swamp, Karonga (2 July, 1904; no. 34).


*Nyasa.*—Plankton, Monkey Bay (17 June, 1904; no. 15).


Long. colon. 39–54 μ; long. cell. 12–20 μ; lat. cell. 7–13 μ.

*Nyasa.*—Plankton, Anchorage Bay (13 June, 1904; no. 9).
Tanganyika.—Plankton, off Niamkolo (July and Aug. 1904; nos. 36 and 39), near Mbete (28 Sept. 1904; no. 109), Vua Harbour (29 Oct. 1904; no. 150), near Kalambo (5 Nov. 1904; no. 154), near Chamkaluki (15 Nov. 1904; no. 160), near Kala (19 Nov. 1904; no. 170), near Kirando (1 Dec. 1904; no. 175), in middle of lake crossing from Rumonge to Uvira (30 Jan. 1905; no. 218), near Ndauvie (7 Feb. 1905; no. 227), and near Baraka (24 Feb. 1905; no. 240).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905; no. 249).

This Alga was very frequent in the plankton, especially of Tanganyika. The envelope surrounding the colonies is always very hyaline, and no colonies were observed of more than eight cells. The faint apiculus at each pole is very characteristic, although exceedingly slight. Two chloroplasts were generally present in each cell. The plants observed were identical in every respect with those which occurred in the plankton of certain Irish lakes (vide Trans. Roy. Irish Acad. xxxiii. sect. B, 1906, p. 107).

Genus Nephrocytium, Näg.


Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

Tanganyika.—In swamp, Kituta (23 & 26 Aug. 1904; nos. 72 and 80).


Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

Subfam. TETRAEDRÆ.

Genus Tetraëdron, Kütz.

172. Tetraëdron Trigonum, (Näg.) Hansg. in Hedvigion, xxvii. (1888) p. 130.—Polyedrium trignonum, Näg. Gatt. einz. Alg. (1849) p. 84, t. 4 n. fig. 1. Diam. cell. sine spin. 14–16 μ; long. spin. 5–6.5 μ.

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).


Trigonal forms: Nyasa.—In scrappings from bottom of s.s. ‘Guendolen’ at anchor S. end of lake (15 June, 1904; no. 577). In swamp, Karonga (2 July, 1904; no. 34).

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904; no. 36). In swamp, Toa (10 Jan. 1905; no. 168).
Diam. cell. sine spin. 18–26 μ.
Nyassa.—In swamp, Karonga (29 June, 1904; no. 32, and 2 July, 1904; no. 34).

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905; no. 618).
Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Genus CERASTERIAS, Reinsch.

Diam. cell. (cum radiis) 48–60 μ.
Tanganyika.—Plankton, near Chamkaluki (15 Nov. 1904; no. 160) and near Kala (19 Nov. 1904; no. 170).

Subfam. PHYTHELIEAE.

Genus RICHTERIELLA, Lemm.

Forma quadriseta, (Lemm.) Chodat, 1902.—R. quadriseta, Lemm. l. c. p. 307, t. 10. fig. 7.
Tanganyika.—Plankton, near Kala (19 Nov. 1904; no. 170).

Genus CHODATELLA, Lemm.

Long. cell. (sine acul.) 5–13 μ; lat. cell. 2·5–8·5 μ; long. acul. 7·5–26 μ.
Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170).
This Alga was fairly frequent in one of the plankton collections from Tanganyika (no. 170), but was not observed from any of the others. The
cells attained slightly larger dimensions than those described by Lemmermann from Germany. The three spine-like bristles at each pole were frequently bent and usually widely spreading.

Subfam. Dic**ty**osphaeri**æ**.

Genus Dictyosphe**r**ium, Nag.


**Nyasa.**—In plankton, Anchorage Bay (11 June, 1904; no. 5).

**Tanganyika.**—In plankton, near Chumkaluki (15 Nov. 1904; no. 160) and near Kala (19 Nov. 1904; no. 170).

**Victoria Nyanza.**—In plankton, near Bukoba (18 Apr. 1905; no. 249). In swampy pool near Bukoba (20 Apr. 1905; no. 618).

Genus Tetra**c**occus, West.


Diam. colon. 56–84 µ; diam. cell. 4–8 µ.

**Tanganyika.**—In plankton, off Niamkolo Island (29 July, 1904; no. 36), Komba Bay (11 Oct. 1904; no. 135), and near Kala (19 Nov. 1904; no. 170).

Genus Botryo**c**occus, Kötz.


**Nyasa.**—In plankton, Monkey Bay (17 and 18 June, 1904; nos. 15 and 16); also off Vahambwera Point (24 June, 1904; no. 24) and off Karonga (1 July, 1904; no. 30).

**Tanganyika.**—In plankton, Utinta (5 Dec. 1904; no. 181).

**Victoria Nyanza.**—In plankton, near Bukoba (20 and 21 Apr. 1905; nos. 250 and 252).

The large colonies of this Alga formed in some instances a yellow scum on the surface of the water. This was due to the appearance of the brick-red pigment which at certain seasons gives the colonies a decided yellow or yellowish-red colour and causes a corresponding coloration of the water.

Genus Ineffigiata, W. & G. S. West.


**Victoria Nyanza.**—In plankton, near Bukoba (21 Apr. 1905; no. 252).
This Alga requires further investigation. The tough membrane which
encloses the families of cells, and irregular lobes and strands of which hold
the colonies together, seems to distinguish it from Botryococcus Braunii.
It may, however, be only a state of that Alga. All the specimens from
Victoria Nyanza had the prickly appearance which is often one of the
peculiarities of Ineffigita (vide W. & G. S. West, in Journ. Bot. xli. (1903)
t. 447. fig. 3), the tough outer membrane being densely covered with irregular
spines and spinous processes.

Family PALMELLACEÆ.

Genus PALMOPHYLLUM, Kütz.

184. Palmophyllum foliaceum, sp. n. (Pl. 5. fig. 10.)
Thallus minutus, cartilagineus, subcrassus, foliaceo-lobatus, basin an-
gustiorem fixus, sine lineis concentricis, lobis sinuatis; cellulis minutissimis,
confertissimis, in lineis longitudinaliter dispositis, oblongis vel oblongo-
ellipticis, viridibus. Cellularum divisio in unam directionem.
Long. thall. 250–330 μ; lat. max. thall. 140–320 μ; long. cell. 2.2–3.4 μ;
lat. cell. 1.3–1.6 μ.

Tanganyika.—On stones, dredged in a few fathoms, Niamkolo; among
Cladophora inconspicua in the hollows of a calcareous incrustation.
This species is distinguished from P. crassum, (Nacc.) Rabenh. (= P.
flabellatum, Kütz.) by the smaller size of the thallus, which is destitute of the
zones of concentric lines, and by the minute cells. The thallus is expanded
from a narrow base and is of uneven thickness. It is of a dark green colour,
lobed and sinuate at the margin, and sometimes deeply cleft. The nature of
the chloroplast could not be determined from the preserved (dried)
material.

SPHINCTOSIPHON, gen. n.

Cellulae in tegumentis tubulosis conferte et irregulariter aggregatae;
tegmentis gelatinosis, achrois, tubulosus, firmis et lamellosis, lamellis externis
sepe diffuentibus; cellulae globose, cum chromatophora singula parietali
lacte viridi et valde granulosa: membrana cellularum tenuissima; tegumentis
junioribus subrotundatis vel irregulariter lobatis, iis vetustis elongatis, siphoni-
formibus, curvatis, hinc inde ligatis. Propagatio divisione tegumentorum
lobatorum juniorum in omnes directiones.

185. Sphinctosiphon polymorphus, sp. unica. (Pl. 3. fig. 12; Pl. 5.
figs. 11–13.)
Character idem ac generis. Tegmentis adultis irregulariter cylindricis,
vermiformibus, nunquam ramosis, sepe in articulis elongatis constrictis vel
subconstrictis.
LINN. JOURN.—BOTANY, VOL. XXXVIII.
Diam. teg. jun. 80–180 μ; diam. teg. adult. (vermiform.) 39–60 μ; diam. cell. 5.5–7.5 μ; crass. teg. 5–8 μ.

Victoria Nyanza.—In plankton, near Bukoba (18 and 21 Apr. 1905; nos. 249 and 252).

This peculiar genus stands nearest to Palmodactylon, Nág., but is at once distinguished by the hollow integuments with a firm outer gelatinous wall. If the Alga be subjected to slight pressure, the cells can be squeezed from one part of the hollow vermiform integument to another. The wall of the integument often shows a lamellose structure, and in the younger individuals the outer coats often become mucilaginous. In the young stages the thallus is rounded or irregularly lobed, and while in this condition it frequently divides, forming several more or less rounded segments, each of which then grows to form an adult plant. The adult thallus is very long, reaching a length of 2 mm., and it is more or less cylindrical and vermiform in appearance. It possesses slight irregular swellings and constrictions of variable depths at intervals, and is not infrequently segmented into several elongated joints. Sphinctosiphon does not appear to branch.

The exact nature of the chromatophore could not be determined from the preserved material. It is undoubtedly massive and occupies most of the cell, being for the greater part parietal in disposition.

Genus SPHÆROCYSTIS, Chodat.


Tanganyika.—In the plankton, Lofu River (5 Oct. 1904; nos. 123 and 124). This Alga occurred in great abundance in the two collections of river-plankton and, curiously enough, it was not observed in the plankton of the lakes themselves. The colonies were the largest I have yet seen and reached a diameter of 240 μ. It is generally distributed in all the freshwater plankton of Europe.

Genus GLÆOCYSTIS, Nág.


Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18). In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Tanganyka.—In swamp, Kituta (26 Aug. 1904; no. 80). A form with rather large cells and very tough, brownish or yellowish integuments occurred in the plantation from near Sumbu (13 Oct. 1904; no. 138).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).
Class **HETEROKONTÆ.**
Order **CONFERVALES.**
Family **TRIBONEMACEÆ.**
Genus **OPHIocytiUM, NaG.**

Crass. cell. 4–5 μ.
**Nyasa.**—Among weeds and various Algae, in swamp, Karonga (2 July, 1904; no. 34).

Class **BACILLARIEÆ.**
Order **CENTRICE.**
Family **MELOSIRACEÆ.**
Genus **MELOSIRA, Ag.**

Crass. fil. 22–33 μ. (Pl. 2. figs. 6, 7; Pl. 3. figs. 5, 26.)
**Nyasa.**—In plankton, Anchorage Bay (9–14 June, 1904; nos. 2, 5, 7, 9, and 10), and also off Karonga (1 July, 1904; no. 30).
**Victoria Nyanza.**—In plankton, off Bukoba (20 and 21 Apr. 1905; nos. 250 and 252).
This Diatom was the dominant feature of some of the plankton collections. It was described by O. Müller in 1895 from the plankton of Lake Nyasa and the waters of some of the surrounding areas. It may be regarded as one of the numerous forms of *Melosira granulata.*

**Nyasa.**—In plankton, Anchorage Bay (13 and 14 June, 1904; nos. 9 and 10).
**Victoria Nyanza.**—In plankton, near Bukoba (20 Apr. 1905; no. 250).
Var. **angustissima, O. Müll. l. c. p. 285, t. 4, fig. 12.**
Crass. fil. 3–4·5 μ.
**Nyasa.**—In plankton, Anchorage Bay (9–14 June, 1904; nos. 2, 7, 9, and 10), and also off Karonga (1 July, 1904; no. 30).
**Victoria Nyanza.**—In plankton, near Bukoba (21 Apr. 1905; no. 252).
This delicate variety was very abundant in some of the plankton collections, and unless cleaned and prepared specially for examination, was difficult to recognize as a *Melosira.* As compared with their diameter, the cells are relatively longer than in other forms of *M. granulata.*
Family COSCINODISCACEÆ.

Genus CYCLOTELLA, Kütz.


Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905 ; no. 249).


Nyasa.—In scrapings from bottom of s.s. ‘Guendolen’ at anchor S. end of lake (15 June, 1904 ; no. 577).

193. Cycolotella operculata, Kütz. l. c.

Nyasa.—In plankton, Anchorage Bay (11–14 June, 1905 ; nos. 5, 9, and 10) and Monkey Bay (18 June, 1904 ; no. 16).

Tanganyika.—In plankton, near Kala (19 Nov. 1904 ; no. 170).


Nyasa.—In plankton, Anchorage Bay (14 June, 1905 ; nos. 9 and 10).

Tanganyika.—On surface of swamp, Toa (10 Jan. 1905 ; no. 208).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905 ; no. 252).

Genus STEPHANODISCUS, Ehrenb.


Nyasa.—In plankton, Anchorage Bay (11–14 June, 1904 ; nos. 5, 9, and 10). On shore, Domira Bay (19 June, 1904 ; no. 17). On rocks, Nkata Bay (23 June, 1904 ; no. 23). In plankton, off Vahambwera Point (24 June, 1904 ; no. 24).

Some finely developed specimens of this Diatom were observed, the valves attaining a diameter of 81 μ.

Var. spinulosus, *Grun.* ; *Van Heurck, l. c.* t. 95. fig. 6.

Nyasa.—In plankton, Anchorage Bay (14 June, 1904 ; no. 10); also Deep Bay (24 June, 1904 ; no. 25).

Var. minutulus, *(Kütz.)* Grun. ; *Van Heurck, l. c.* t. 95. figs. 7, 8.—Cycolotella minutula, Kütz.

Nyasa.—In plankton, Anchorage Bay (11–14 June, 1904 ; nos. 5, 9, and 10).
Order PENNATÆ.

Family FRAGILARiaeæ.

Genus FRAGILARIA, Lyngb.


Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

197. FRAGILARIA ETHIOPICA, sp. n. (Pl. 8. fig. 1.)

Cellula ut visa aspectu valvulari subanguste elliptica, polis rotundatis, pseudorhaphide distincta sublata in centro stauriformi, costis lateralibus crassis glabris 11 utrobiique, costa mediana brevi et rotundata; ut visa aspectu cingulato quadrato-rectangularis, apicibus truncatis, lateribus levissime retusiis in medio et cum costis crassiis 11. Cellulae ut visae solitariae.

Long. valv. 17–19:5 μ; lat. valv. 7:5–8 μ.

Tanganyika.—On stones, submerged roots, grasses, etc., Niamkolo (1 Aug. 1904; no. 44).

This species is readily distinguished by its few, broad costæ. The valve-view is somewhat narrowly elliptic, and there are eleven broad smooth costæ on each side, extending towards the central line, but leaving a fairly broad pseudoraphe. In the centre the pseudoraphe widens out forming a stauros, the median costa on each side being correspondingly short. The costæ are not transverse, but exhibit a decided radiation near the median part of the valve. In the girdle-view the cell is quadrato-rectangular and the costæ show very plainly along each lateral margin.

F. ethiopica belongs to the section 'Staurosira, Ehrenb.’

Genus SYNEDRA, Ehrenb.

198. SYNEDRA NYANJSE, sp. n. (Pl. 8. fig. 3.)

Cellula ut visa aspectu valvulari robusta, linearis, diametro 6½–13½–plio longior, marginibus lateraliibus paralleliis, subiter attenuata apices versus, apicibus productis et subcapitato-rostratis, pseudorhaphide recta magna et conspicua (usque 4 μ lata), striis 14–15 in 10 μ; ut visa aspectu cingulato linearis, apicibus rectangularibus.

Long. valv. 91–150 μ; lat. valv. 10–13 μ; lat. apic. 3:2–3:8 μ.

Victoria Nyanza.—Among Alge on rocks below the water-level, Bukoba (17 Apr. 1905; no. 248).

This species resembles in outline S. Ulna, (Nitzsch) Ehrenb., and S. oxyrhynchus, Kütz., but differs in its much finer striations, its broader and more conspicuous pseudoraphe, as well as in the absence of the clear space in the median part of the valves.

In its general proportions it was somewhat variable, and some very short, robust individuals were observed.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123). In swamp, Toa (10 Jan. 1905; no. 208).

Victoria Nyanza.—In swampy pool, near Bukoba (20 Apr. 1905; no. 618).


Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

200. Synedra Pulchella, Kütz. Bacill. (1844) p. 68, t. 29. fig. 37; W. Sm. Brit. Diat. i. p. 70, t. 11. fig. 84.

Tanganyika.—Floating on surface of water, Kituta Bay (26 Aug. 1904; no. 79). In swamp, Mbete (28 Sept. 1904; no. 108).

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).


Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—In plankton, near Kirando (1 Dec. 1904; no. 175).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252). Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Var. delicatissima, (W. Sm.) Grun.—S. delicatissima, W. Sm.

Nyasa.—In plankton, Anchorage Bay (9 June, 1904; no. 2, and 13 June, 1904; no. 9), and Monkey Bay (18 June, 1904; no. 16). S. end of lake (15 June, 1904; no. 577).

Tanganyika.—In plankton, off Niamkolo (29 July, 1904; no. 36, and 9 Aug. 1904; no. 53). In swamp, Kituta (26 Aug. 1904; no. 80). In plankton, Mbete (28 Sept. 1904; no. 109), Komba Bay (11 Oct. 1904; no. 135), Vua Harbour (29 Oct. 1904; no. 150), near Kassanga (14 Nov. 1904; no. 159), and near Chamkaluki (15 Nov. 1904; no. 160). This variety was particularly abundant from no. 109.

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).


Long. 85-94 μ; lat. 2-2-5 μ.

Tanganyika.—In plankton, near Kasawa, near Kirando (1 Dec. 1904; no. 175), near Utinta (5 Dec. 1904; no. 181), near Maswa (14 Jan. 1905; no. 211), in middle of lake between Rumonge and Uvira (30 Jan. 1905; no. 218), and near Ndaavie (7 Feb. 1905; no. 227).

I am not quite certain of this determination, as I have not seen a published description or figure of Lemmermann’s species. [Since this was written Lemmermann’s description of S. revaliensis has appeared in Ber. Deutsch. Bot. Ges. xxiv. (1906) p. 536.] It agrees, however, with
specimens of a Synedra from the Irish Lakes which were referred by Lemmermann to S. revaliensis. It seems to be identical with the Synedra mentioned by Ostenfeld and Wesenberg-Lund as occurring in two Icelandic lakes (vide Proc. Roy. Soc. Edinb. xxv. part xii. (1906) p. 1114, t. 2. figs. 16, 17); and I am inclined to agree with those authors that it is merely a form of S. Acus var. delicatissima, the stellate colonies resulting from an adaptation to a limnetic life. Some of the radiating colonies contained upwards of 50 individuals. It may also be identical with the Diatom recorded by Schmidle from Lake Nyasa as "Synedra? asterionelloides, O. Müller, n. sp." (cf. Engl. Bot. Jahrb. xxxiii. (1902) p. 8).

In both this Diatom and the succeeding species (S. actinastroïdes) the individuals are arranged in radiating colonies after the manner of the genus Actinastrum, and Lemmermann places them along with the two species S. limnetica, Lemm., and S. berolinensis, Lemm., in a subgenus "Belonastrum" of Synedra.


Long. 44–49 μ; lat. 2·5 μ.

Tanganyika.—In plankton, off Niamkolo (2 and 9 Aug. 1904; nos. 36 and 52), in Kituta Bay (25 Aug. 1904; no. 77), near Mbete (28 Sept. 1904; no. 109), near Kasawa (no. 132), near Kassanga (14 Nov. 1904; no. 159), near Maswa (14 Jan. 1905; no. 211), and in middle of lake between Rumouge and Uvira (30 Jan. 1905; no. 218).

203. Synedra Cunninghamii, sp. n. (Pl. 8. fig. 4.)

Cellula ut visa aspectu valvulari angustissima linearis, in parte mediana tertia cum inflationibus insignis latis binis, partibus apicalibus angustissimis cum marginibus parallelis, apicibus minute capitatis, striis 12–13 in 10 μ, in partibus apicalibus elongatis vix conspicuis, pseudorhaphide lata in parte mediana inflata cellulae; ut visa aspectu cingulato anguste linearis, partibus angustissimis inflatae, polis truncatis.

Long. 200–210 μ; lat. in med. 4·5 μ; lat. max. 6·5 μ; lat. part. apical. 1·4 μ; lat. apic. 1·8 μ.

Victoria Nyanza.—Among Utricularia, in sheltered bay near Entebbe (1 May, 1905; no. 620).

This Synedra is remarkable for the double inflation of the median part of the valves, the extremities being very long and narrow, with parallel margins. The inflation is not merely visible in the valve-view, but is likewise very large in the girdle-view. In the girdle-view, however, the median inflation has subparallel margins in the central part and does not show any signs of the constriction which is such a peculiar feature of the valve-view. Each of the narrow extremities of the valve is very faintly (almost imperceptibly) swollen.

I know of no species to which it is very closely related except forms of S. Acus, and from these it is at once distinguished by its peculiar form.
Family **EUNOTIACEAE**.

Genus **EUNOTIA**, Ehrenb.

**Tanganyika.**—In swamp, Kituta (26 Aug. 1904 : no. 80).  
**Victoria Nyanza.**—In swampy pool near Bukoba (20 Apr. 1905 : no. 618)

**Victoria Nyanza.**—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251), and among Utricularia, near Bukoba (20 Apr. 1905 ; no. 618).

**Victoria Nyanza.**—Among Utricularia, near Bukoba (20 Apr. 1905 ; no. 618), and in sheltered bay near Entebbe (1 May, 1905 ; no. 620).

Family **ACHNANTHACEAE**.

Genus **ACHNANTHES**, Bory.

**Nyasa.**—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

**Tanganyika.**—In the plankton, Lofu River (5 Oct. 1904 ; no. 123).

Family **COCONEIDACEAE**.

Genus **COCCONEIS**, Ehrenb.

**Victoria Nyanza.**—Swampy pool near Bukoba (20 Apr. 1905 ; no. 618). In sheltered bay near Entebbe (1 May, 1905 ; no. 620).  
**Tanganyika.**—On stones, shells, submerged grasses, etc., Niamkolo Bay (Aug. 1904 ; nos. 40 and 44). Among various Algæ, Kituta Bay (26 Aug. 1904 ; no. 79). In plankton, near Mbeto (28 Sept. 1904 ; no. 105), Komba Bay (11 Oct. 1904 ; no. 135), off Chamkalkuki (15 Nov. 1904 ; no. 160), and near Kala (19 Nov. 1904 ; no. 170). Also among Utricularia, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

**Tanganyika.**—In plankton, off Niamkolo Island (29 July, 1904; no. 36), and Kituta Bay (26 Aug. 1904; no. 81). In shallow water, Mbete (29 Sept. 1904; no. 114).

**Family NAVICULACEAE.**

**Genus NAVICULA, Bory.**


**Nyasa.**—In swamp, Karonga (29 June, 1904; no. 32).

212. Navicula (§ Neidium) Tanganyikae, sp. n. (Pl. 8. fig. 11.)

Cellula ut in visa aspectu valvulari oblonga cum lateribus levissime concavis, utroque polis cunctatis et apicibus obtusis; platea axiali angusta, lineis approximatis binis utroque inter marginem lateralem valvae unumqueque et axem centrali, platea centrali transverse dilatata (elliptica); punctis valvae densissimis et irregulariter ordinatis; striis margines versus visis 10–11 in 10 μ.

Long. valv. 76–98 μ; lat. 34–40 μ.

**Tanganyika.**—In plankton, Kituta Bay (25 Aug. 1904; no. 77), near Mbete (28 Sept. 1904; no. 105), near Kalambo (5 Nov. 1904; no. 154), and near Baraka (24 Feb. 1905; no. 240).

Pfitzer founded the genus *Neidium* in 1871 on the general arrangement of the cell-contents, and Cleve (1894) has pointed out that the structure of the valve is also sufficient to separate the species included in *Neidium* from the rest of the naviculoid Diatoms. *N. Tanganyikae* is on the whole nearest to *N. Amphigomphus*, Ehrenb., but in none of the specimens I examined were the punctae of the valves arranged in lines. There were a pair of accessory longitudinal lines, closely approximate, and running from pole to pole between the central line and each margin of the valve. These lines were situated rather nearer the outer margin than the median line, and they were regularly bent inwards in the cuneate poles. The central area was transversely elliptical and the punctae were rather more distinct in its immediate vicinity. The striations could only be observed between the margins of the valve and the accessory longitudinal lines. The area between the latter and the sagittal axis (or raphe) was entirely occupied by irregularly scattered punctae.


**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; no. 9).
Tanganyika.—In plankton, near Sumbu (13 Oct. 1904; no. 138) and near Kalambo (5 Nov. 1904; no. 154). Among various Algae scraped from the inside of canoe (6 Jan. 1905; no. 205).


Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904; no. 81), near Kalambo (5 Nov. 1904; no. 154), near Kala (19 Nov. 1904; no. 170), off Kirando (1 Dec. 1904; no. 175), and near Baraka (24 Feb. 1905; no. 240).

215. **Navicula mutica**, Kütz. l.c. t.3. fig. 32; Cleve, Synops. Navic. Diat. i. (1894) p. 129.

*Forma valvis leviter tumidis ad medium utrobique.*

Long. valv. 30–34 μ; lat. ad med. 13–14 μ.

**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; nos. 9 and 10).


**Nyasa.**—In plankton, Anchorage Bay (11 June, 1904; no. 5).


**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; no. 9).

Tanganyika.—In plankton, off Kirando (1 Dec. 1904; no. 175).

This Diatom has previously been recorded only as a marine species, but is regarded by Van Heurck as a variety of *N. minuscula*, Grun., which is of freshwater habit.

218. **Navicula (§ Anomoneis) sphærophora**, Kütz. Bacill. 1844, p. 95, t. 4. fig. 17.

**Nyasa.**—On shores of lake, Domira Bay (19 June, 1904; no. 17).


**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 34).


Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208).

221. **Navicula radiosa**, Kütz. t. c. p. 91, t. 4. fig. 23.

**Victoria Nyanza.**—In plankton, near Bukoba (18 Apr. 1905; no. 249).
Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904: no. 81), and off Kirando (1 Dec. 1904: no. 175).

222. NAVICULA RHYNCHOCEPHALA, Kütz. Bacill. (1844) t. 30. fig. 35; Donkin, Brit. Diat. p. 38, t. 6. fig. 4.

Nyasa.—In plankton, Anacostia Bay (June 1904; nos. 9 and 10).

Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904; no. 81), near Mbete (28 Sept. 1904; no. 105), and near Chamkaluki (15 Nov. 1904; no. 160). In swamp, Toa (10 Jan. 1905; no. 208).

223. NAVICULA DISTINCTA, sp. n.

Minuta; cellula ut in visa aspectu valvulari late elliptica, polis rotundatis vel subacuta rotundatis; striis validis, distinctis et glabris, 8 in 10 μ, radiatis, in parte mediana striis brevibus 2 vel 3 cum striis multe longioribus alternantibus.

Long. 20–24 μ; lat. 16–17 μ.

Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170.)

This small species is distinct by reason of its broadly elliptical valves and the conspicuous striations. There are in all 17 or 18 striations along each side of the valve, markedly radiating in disposition, and reaching close up to the sagittal line or raphe. Two or three of the median striations are relatively short, extending only about halfway from the margin of the valve to the sagittal line. These short striations do not occur next each other, but alternate with those of maximum length. The striations appear to be perfectly smooth.


Nyasa.—In plankton, Anchorage Bay (June 1904; nos. 9 and 10). On rocks, Deep Bay (25 June, 1904; no. 26).

Tanganyika.—In plankton, Kitutu Bay (26 Aug. 1904; no. 81), near Niamkolo (7 Sept. 1904; no. 88), near Mbete (28 Sept. 1904; no. 105), Lofu (6 Oct. 1904; no. 130), near Kala (19 Nov. 1904; no. 170), and near Kirando (1 Dec. 1904; no. 175).

From no. 175 some very large forms were observed: length 64 μ; lat. 28 μ.


Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

Tanganyika.—In rain-water pool on large rock near the shore, Utinta (6 Dec. 1904; no. 186).

The specimens observed had a rhomboidal central area (forma biceps): long. 60 μ; lat. ad med. 13 μ; lat. apic. 8.5 μ.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).


Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208).


Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22). In swamp, Kambwelagoona near Karonga (27 June, 1904; no. 20).

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904; nos. 195 and 196). In swamp, Toa (10 Jan. 1905; no. 208).


Nyasa.—In swamp, Karonga (29 June, 1904; no. 32, and 2 July, 1904; no. 33).


Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

231. Navicula (§ Pinnaularia) viridis, Kütz. l. c. t. 30. fig. 12; Van Heurck, l. c. t. 5. fig. 5.

Victoria Nyanza.—In swampy pools, near Bukoba (20 Apr. 1905; no. 251).

232. Navicula (§ Pinnaularia) cardinalis, Ehrenb. in Abh. p. 19 (1840); W. Sm. Brit. Diat. i. t. 19. fig. 166.

Victoria Nyanza.—With the preceding species, but not so abundant (no. 251).

Genus Stauroneis, Ehrenb.


Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Victoria Nyanza.—In swampy pools, near Bukoba (20 Apr. 1905; no. 251).

Genus Schizostauron, Grun.

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Large forms: long. 42–65 µ; lat. 9·5–15·5 µ; lat. apic. 3·2–3·8 µ. Valves oblong or oblong-lanceolate, with rostrate apices. (Pl. 8, fig. 12.)

**Tanganyika.**—Plankton, Kituta Bay (26 Aug. 1904; no. 81), Komba Bay (11 Oct. 1904; no. 135), and near Kirando (1 Dec. 1904; no. 175).

The bifid stauros and the longitudinal septa (or diaphragms) in the apical parts of the valves are the distinguishing features between this genus and *Stauroneis*. The specimens observed were all obtained from the fine surface plankton, and they reached almost twice the size of any previously recorded examples. The striae were very fine, about 23 or 25 in 10 µ.

**Genus VANHEURCKIA, Bréb.**


**Victoria Nyanza.**—In swampy pools, near Bukoba (20 Apr. 1905; no. 251).


**Tanganyika.**—In swamp, Mbete (28 Sept. 1904; no. 108).

**Victoria Nyanza.**—In swampy pool, near Bukoba (20 Apr. 1905; no. 618).


**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 123).

**Genus GYROSIGMA, Hass.**


**Tanganyika.**—In plankton, near Kassanga (14 Nov. 1904; no. 159), near Kala (19 Nov. 1904; no. 170), near Maswa (14 Jan. 1905; no. 211), and near Baraka (24 Feb. 1905; no. 240).

The specimens observed were all considerably shorter than is usual in this species. The apices of the valves were not quite so attenuated as in European examples.


Long. 152 µ; lat. 17 µ.

**Tanganyika.**—In plankton, near Kala (19 Nov. 1904; no. 170).

The general form of this species and the curious elongated, oblique central nodule appear to me to be quite distinctive.
Family GOMPHONEMACEÆ.

Genus GOMPHONEMA, Ag.


Nyasa.—On bivalve shells, Anchorage Bay (no. 11). On rocks, Deep Bay (25 June, 1904; no. 26).

Tanganyika.—On rocks in shallow water, Mbete (29 Sept. 1904; no. 114). In plankton, Lofu River (5 Oct. 1904; no. 123). Among Algae scraped from the bottom of Dr. Cunnington’s daw (24 Jan. 1905; nos. 216 and 217).


Victoria Nyanza.—On rocks, near Bukoba (17 Apr. 1905; no. 247).


Nyasa.—On stones, shores of Domira Bay (19 June, 1904; no. 17).

241. Gomphonema intricatum, Kütz. l. c. p. 87, t. 9, fig. 4.

Nyasa.—On Cladophora, Anchorage Bay (no. 11). On rocks and inshore pools, Nkata Bay (23 June, 1904; nos. 22 and 23).


Nyasa.—On stones, shores of Domira Bay (19 June, 1904; no. 17). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).


Nyasa.—In swamp, Karonga (29 June, 1904; no. 32).

Victoria Nyanza.—On rocks, near Bukoba (17 Apr. 1905; no. 247).

Var. dichotomum, (W. Sm.) Van Heurck.—G. dichotomum, W. Sm. Brit. Diat. i. p. 79, t. 28, fig. 240.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

243. Gomphonema exiguum, Kütz. l. c. p. 84, t. 30, fig. 58; Cleve, Synops. Navic. Diat. i. (1894) p. 188.

Victoria Nyanza.—On Algae attached to rocks, near Bukoba (17 Apr. 1905; no. 247).

Tanganyika.—In large numbers attached to decaying fragments of Cladophora sp., in plankton off Niamkolo Island (29 June, 1904; no. 36). On Algae floating in Kituta Bay (26 Aug. 1904; no. 79). Attached to Algae scraped from bottom of Dr. Cunnington’s daw (24 Jan. 1905; no. 217).

This species appears to have been previously recorded only as marine in habit.
244. Gomphonema africanum, sp. n. (Pl. 8. fig. 13.)

G. magna; cellula ut in visa aspectu valvulari ovato-lanceolata, lateribus inferioribus leviter concavis, lateribus superioribus convexis, apice subacuto, ad basin angulare-rotundata, cum stigmati singulo unilaterali prope nodulum centralem, platea axiali angusta in medio non dilatata, striis 10–11 in 10 μ, transversis sed radiatis prope apicem; in visa aspectu cingulato cuneata, basi et apice rotundato-truncato, lateribus levissime biundulato.

Long. 102–128 μ; lat. max. 28–28 μ; lat. apic. aspect. cingul. usque ad 34 μ.

Tanganyika.—Among Chatomorpha Linum, Kütz., floating on surface of Kituta Bay (26 Aug. 1904; no. 79). On rocks, in shallow water, near Mbete (29 Sept. 1904; no. 114).

This species should be compared with G. oxycephalum, Cleve, Synops. Navic. Diat. i. (1894) p. 187, t. 5. fig. 10.

Family COCCONEMACEÆ.

Genus COCCONEMA, Ehrenb.


Tanganyika.—In plankton, Lofu River (5 Nov. 1904; no. 124).


Victoria Nyanza.—Near Bukoba (17 Apr. 1905; no. 248).


Var. Tanganyikæ, var. n. (Pl. 8. fig. 9.)

Var. marginé ventrali convexiore, polis obtusioribus sed levissime productis; striis validis et latis, 3·5 in 10 μ (ad pol. 4 in 10 μ).

Long. 74 μ; lat. 29 μ.

Tanganyika.—In plankton, near Kassanga (14 Nov. 1904; no. 159) and near Kirando (1 Dec. 1904; no. 175).

This is a handsome Diatom with exceedingly coarse striæ composed of large granules. The specimens observed from Tanganyika were stouter and more swollen on the ventral margin than Müller’s Nyasa specimens, the striæ being even coarser.


Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904; no. 196).
249. **Cocconeuma ventricosum**, (Kütz.) nob.—Frustulia ventricosa, Kütz. (1834). Encyonema ventricosum, Van Heurck. E. caespitosum, Kütz. (1849). **Tanganyika.**—On the shore, near Niamkolo (1 Aug. 1904; no. 44) and in Niamkolo Harbour (7 Sept. 1904; no. 87).


**Genus Amphora, Ehrenb.**


Genus **EPITHEMIA**, Brèb.


**Nyasa.**—In plankton, Anchorage Bay (June 1904; nos. 9 and 10). In swamp, Karonga (29 June, 1904; no. 32). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

**Victoria Nyanza.**—In plankton, near Bukoba (21 Apr. 1905; no. 252).

**Tanganyika.**—In plankton, near Mbete (28 Sept. 1904; no. 105) and near Kala (19 Nov. 1904; no. 170). Among **Utricularia**, mouth of Malagarasi River (16 Jan. 1905; no. 611).

Genus **RHOPALODIA**, O. Müll.


**Tanganyika.**—In swampy pond, Mrumbi (27 Dec. 1904; no. 181).

Var. **ventricosa**, (Kütz.) O. Müll.—Epithemia ventricosa, Kütz.

**Nyasa.**—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

**Victoria Nyanza.**—In plankton, near Bukoba (21 June, 1905; no. 252). In sheltered bay, near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In plankton, Kituta Bay (27 Aug. 1904; no. 82) and near Sumbu (13 Oct. 1904; no. 138).


**Nyasa.**—Among Alge in shallow water, Anchorage Bay (15 June, 1904; no. 12). On rocks, Nkata Bay (23 June, 1904; no. 23). In swamp, Karonga (2 July, 1904; no. 33).

**Tanganyika.**—Among floating Alge, Kituta Bay (26 Aug. 1904; no. 79).


**Nyasa.**—In the plankton, Anchorage Bay (14 June, 1904; no. 10). In swamp, Kuta Kuta (20 June, 1904; no. 18). On rocks, Deep Bay (25 June, 1904; no. 26). In swamp, Karonga (29 June, 1904; no. 32). In scrapings from off bottom of s.s. ‘Guendolen’ at anchor S. end of lake (15 June, 1904; no. 577).

**Victoria Nyanza.**—In plankton, near Bukoba (21 Apr. 1905; no. 252). In swampy pool, near Bukoba (20 Apr. 1905; no. 618). Among **Utricularia**, near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In plankton off Niamkolo Island (29 July, 1904; no. 36). Floating in Kituta Bay (26 Aug. 1904; no. 79). On rocks, Mbete (29 Sept. 1904; no. 114). In plankton, near Kala (19 Nov. 1904; no. 170).

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**Tanganyika.**—In plankton, off Niamkolo Island (29 July, 1904; no. 36) and off Kalambo (5 Nov. 1904; no. 154).


**Nyasa.**—In plankton, Anchorage Bay (no. 1) and off Vahambwera Point (24 June, 1904; no. 24).


**Nyasa.**—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).


**Nyasa.**—In plankton, Monkey Bay (17 June, 1904; no. 14). On rocks, Deep Bay (25 June, 1904; no. 26).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

This species is commonly attached by thick gelatinous stalks and occurs in dense clusters. It was observed forming thick, yellow-brown, matted masses on the back of a beetle (*Limnogeton*) on the lake shore, Karonga, Nyasa.

**Family NITZSCHIACEÆ.**

**Genus NITZSCHIA, Hass.; em. Grunow.**


**Var. littoralis**, (Grun.) Van Heurck.—N. littoralis, Grun.

**Tanganyika.**—In plankton, near Niamkolo (7 Sept. 1904; no. 88).


Long. 46–48 μ; lat. 10–11 μ; punct. carin. 6 in 10 μ; striis 13 in 10 μ.

**Nyasa.**—In plankton, Anchorage Bay (June 1904; nos. 9 and 10).


**Var. media**, Hantzsch.

**Tanganyika.**—In plankton, near Sumba (13 Oct. 1904; no. 138).


Long. 69 μ; lat. 7 μ; punct. carin. 7 in 10 μ.

**Tanganyika.**—In plankton, off Niamkolo Island (29 July, 1904; no. 36) and near Kala (19 Nov. 1904; no. 170).
Cellule lanceolata cum punct. carin. 7 in 10 μ ; long. 35 μ ; lat. 10 μ.  
Nyasa.—Abundant in scrapings off bottom of s.s. ‘Guendolen’ at anchor S. end of lake (15 June, 1904 ; no. 577).

Var. *tenuis*, Grun.—N. *tenuis*, W. Sm.  
Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18).  
Tanganyika.—In swamp, Mrumbi (27 Dec. 1904 ; no. 196).

267. *Nitzschia Palea*, (Kütz.) W. Sm. *l. c.* ii. p. 89.—*Synedra Palea*, Kütz. *Bacill.* (1841) t. 3, fig. 27, t. 4, fig. 2.  
Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18). On rocks, Nkata Bay (24 June, 1904 ; no. 23). In swamp, Karonga (2 July, 1904 ; no. 34).  
Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905 ; no. 252).  
Tanganyika.—On rocks, Niamkolo Harbour (7 Sept. 1904 ; no. 87). In plankton, near Mbete (28 Sept. 1904 ; no. 108). In swamp, Toa (10 Jan. 1905 ; no. 208).  
Victoria Nyanza.—On rocks, Bukoba (17 Apr. 1905 ; no. 248).  
Tanganyika.—In swamp, Toa (10 Jan. 1905 ; no. 208).

Long. 380–430 μ ; lat. ad med. (aspect, valv.) 3·2 μ. (Pl. 4, figs. 7–9.)  
Nyasa.—In plankton, off Vahambwera Point (24 June, 1904 ; no. 24) and off Karonga (1 July, 1904 ; no. 30). Also in swamp, Kambwelagoon near Karonga (27 June, 1904 ; no. 29).  
Tanganyika.—In plankton, Niamkolo (July and Aug. 1904 ; nos. 36, 39, and 52), Kituta Bay (Aug. 1904 ; nos. 77 and 81), near Mbete (28 Sept. 1904 ; nos. 105 and 109), Komba Bay (11 Oct. 1904 ; no. 135), Vua Harbour (29 Oct. 1904 ; no. 150), near Kalambo (5 Nov. 1904 ; no. 154), near Kirando (1 Dec. 1904 ; no. 175), Utinta (5 Dec. 1904 ; no. 181), and near Maswa (14 Jan. 1905 ; no. 211). Also in Mtondwe Bay, among Algae scraped from shells (2 Sept. 1904 ; no. 83).  
This Diatom occurred in prodigious quantity in the plankton of Tanganyika, more especially from July to September. I am somewhat doubtful regarding its exact identification, as it seems to me to resemble so closely the slender and elongated species of *Synedra*. It undoubtedly agrees with Müllers
species, which he described from the plankton of Nyasa and the pools in the vicinity of that lake, but I am not convinced of its correct inclusion in the genus *Nitzschia*. On first examining it I took it to be a form of *Synedra Lemmermannii*, W. & G. S. West ("Plankton of Some Irish Lakes," *Trans. Roy. Irish Acad.* xxxiii. (1906) p. 109, t. 11. figs. 1, 2), but the frustules are not so straight as in that species, the markings not so distinct, and the poles much less capitate. The African forms were commonly a little curved, which is not surprising in such a long narrow Diatom, and in some of the collections they were often curiously bent (especially in nos. 52 and 150). In this species, and very probably in several other shorter ones, the genera *Nitzschia* and *Synedra* merge into each other.

**Family SURIRELLACEAE.**

**Genus SURIRELLA, Turp.**


Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 124).


Victoria Nyanza.—In plankton, near Bukoba (18 Apr. 1905; no. 249).


Long. 216–250 μ; lat. 80–97 μ. (Pl. 3. figs. 3, 4.)

Victoria Nyanza.—With the typical form, but much more abundant (nos. 249 and 252).


Var. *tumida*, *O. Müll. l. c.* p. 27, t. 1. fig. 2.

Long. 98–160 μ; lat. 46–53 μ.

Nyasa.—In plankton, Anchorage Bay (June, 1904; nos. 9 and 10).

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249).

Var. *intermedia*, *O. Müll. l. c.* p. 27, t. 1. fig. 1.

Nyasa.—In plankton, Anchorage Bay (June, 1904; nos. 9 and 10).

272. *Surirella Malombea*, *O. Müll. l. c.* p. 34, t. 2. fig. 5 [inclus. forma acuta, *O. Müll. l. c.* t. 2. fig. 7].

Long. 125–161 μ; lat. 70–74 μ. (Pl. 3. figs. 2, 13, 14, 22, 23.)

Victoria Nyanza.—Very abundant in the plankton, near Bukoba (Apr. 1905; nos. 249 and 252).
This species was in great abundance and every intermediate stage was noticed between it and *S. bifrons* var. *tumida*. Many of the forms of *S. bifrons* var. *tumida* from Lake Nyasa might have been equally well named *S. Malombe*. Much variation was also shown in the apiculation of the extremities.


*Long.* 359–382 μ; *lat.* max. 69–75 μ; *lat.* ad med. 54–57 μ.

**Nyasa.**—In plankton, off Vahambwera Point (24 June, 1904; no. 24), Deep Bay (24 June, 1904; no. 25), and off Karonga (1 July, 1904; no. 30).

This handsome species was very abundant and many intermediate states occurred between the typical form as described by Müller and his var. *Sagitta*. It is a large species, which, so far as present observations go, appears to be confined to the plankton of Lake Nyasa.

Many of the frustules were thickly coated with attached *Vorticella* (vide Pl. 2. figs. 11, 12).

274. **Surirella plana**, sp. n. (Pl. 8. fig. 5.)

*S. subparva*; *cellula* ut in visa aspectu valvulari ovato-elliptica; pseudorhaphide recta et distincta; *costis* validis subconferitis, ciriciter 3 in 10 μ (29–30 in margine laterali unoquoque), transversis sed polos versus leviter radiatis, pseudorhaphidem extensis; *alis* curtis juxta margines laterales.

*Long.* 103 μ; *lat.* max. 39 μ.

**Tanganyika.**—In plankton, near Nduvie (7 Feb. 1905; no. 227).

This Diatom was only noticed from one of the plankton collections. It should be compared with *S. diaphana*, Bleisch, and *S. tenera*, Greg.


**Victoria Nyanza.**—Among *Utricularia*, near Bukoba (20 Apr. 1905; no. 618).


*Long.* 250–295 μ; *lat.* max. 42–45 μ; *lat.* min. 33–34 μ.

**Tanganyika.**—In plankton, Niamkolo (7 Sept. 1904; no. 88), near Sumbu (13 Oct. 1904; no. 138), and near Kassanga (14 Nov. 1904; no. 159).

277. **Surirella obtusiuscula**, sp. n. (Pl. 8. fig. 7.)

*S. parva*; *cellula* ut in visa aspectu valvulari oblongo-elliptica, marginibus lateralibus leviter concavis (cellula levissime et gradatim constricta), *polis obtusis*; pseudorhaphide recta vix distincta; *costis* brevibus, transversis sed polos versus radiatis, 4 in 10 μ (20–21 in margine laterali unoquoque); *alis* ad margines laterales; *cellula* ut in visa aspectu cingulato oblonga, marginibus lateralibus in medio retusis, *polis* truncatis sed angulis rotundatis.
Long. 60–62 µ; lat. max. 18 µ; lat. min. 16 µ.

**Tanganyika.**—In plankton, Komba Bay (11 Oct. 1904; no. 135) and near Kala (19 Nov. 1904; no. 170).

Compare with *S. linearis*, W. Sm., and *S. constricta*, Ehrenb.

278. **Surirella Tanganyikae**, sp. n. (Pl. 8. fig. 6.)

*S. parva*; cellula ut in visa aspectu valvulari elliptico-oblonga, marginibus lateralibus in parte mediana subparallelis, polis subconicis ad extremo leviter rotundatis; pseudoraphide recta et distincta; costis validis paucis 2–2½ in 10 µ (12–13 in margine laterali unoquoque), subbrevis, iis in medio transversis, iis ad polos radiatis; alis intra et juxta margines laterales; valvis inter costos dense et valore punctata; cellula ut in visa aspectu cingulato oblongo-rectangularis, angulis rotundatis.

Long. 84–88 µ; lat. 30–32 µ.

**Tanganyika.**—In plankton, Kituta Bay (25 Aug. 1904; no. 77), near Mbete (28 Sept. 1904; no. 105), and near Kala (19 Nov. 1904; no. 170).

This species was not uncommon in the above plankton collections. The costa are relatively few, although occasionally slightly irregular in their arrangement; and they are also short, only extending about half the distance from the margin of the valve to the sagittal axis (pseudoraphae). The alae as seen in the valve-view are marginal or just within the margin. The entire valve between the costa and right up to the pseudoraphae is strongly punctate. There is no hyaline area on each side of the pseudoraphae.

The outward form of the valve, the few and remote costa, and the strong punctuations are features which separate *S. Tanganyikae* from any other species.


**Tanganyika.**—In plankton, near Maswa (14 Jan. 1905; no. 211) and near Baraka (24 Feb. 1905; no. 240).

This interesting species is mostly marine and submarine in habit.

Genus **Cymatopleura**, W. Sm.


**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; no. 9) and off Karongo (1 July, 1904; no. 30).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In plankton, Kituta Bay (26 Aug. 1904; no. 81), Komba Bay (11 Oct. 1904; no. 135), near Kirando (1 Dec. 1904; no. 175), and near Ndauvie (7 Feb. 1905; no. 227).
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Forma cellulis curitis, polis mucronatis, ad formam apiculatam (= C. apiculata, W. Sm.) accedens.

**Tanganyika.**—In plankton, near Kala (19 Nov. 1904; no. 170).


**Nyasa.**—In plankton, Anchorage Bay (14 June, 1904; no. 10).

281. *Cymatopleura Nyasa,* sp. n. (Pl. 8. fig. 8.)

*C. magna et insignis;* cellula ut in visa aspectu valvulari in parte mediana angusta et subcylindrica, in partibus apicalibus valde inflatis subcircularibus, polis submamillatis; costis ad margines laterales 7 in 10 µ; cellula ut in visa aspectu cingulato ut in *C. Solea.*

Long. 189–195 µ; lat. in med. 20 µ; lat. max. (part. polar.) 56–58 µ.

**Victoria Nyanza.**—Not uncommon in the plankton, near Bukoba (April 1905; nos. 249 and 252).

This species is distinct from *C. Solea* by reason of its curious dumbbell-shaped valves. The median part of the valve is relatively narrow, and the polar portions are almost circular in outline.

Class **MYXOPHYCEÆ.**

Order HORMOGONEÆ.

Family **STIGONEMACEÆ.**

Genus **NOSTOCHOPSIS,** Wood.


Crass. fil. prim. (cell. torulos.) 4–5 µ; crass. ram. (cell. cylindr.) 2–3 µ; crass. heterocyst. 5.5–6.5 µ.

**Nyasa.**—Taken in a shrimp-net in about 4 feet of water (15 June, 1904; no. 12).

The plants occurred in free-floating gelatinous masses of irregular outline, reaching a diameter of several cms. The main portions of the primary filaments were more or less torulose, and the cells were of very variable shape. The lateral branches consisted of cylindrical cells, 2 1/2–4 times longer than the diameter, with slight constrictions between them. The apical cells were bluntly rounded. The heterocysts were invariably lateral, either sessile or stalked, the stalk consisting of one to three rounded cells. Each branch is attached to the side of one of the primary cells, from which it originally arose as a small lateral outgrowth.

The specimens collected by Dr. Cunnington agreed very well with Schmidle’s description and figures, the plants he examined being collected in the vicinity of Nyasa in 1899.
I think Schmidle's genus *Myxoderma* must be regarded as synonymous with *Nostochopsis*, Wood. The only difference is in the form of the thallus, which is expanded in the one case (*N. Goetzei*) and more or less rounded in the other (*N. lobatus*), and to my mind this is not sufficient as a generic distinction. One of the most distinctive features of *Nostochopsis* is the lateral and often stalked condition of the heterocysts, and this is the same in each case. *N. lobatus*, Wood, is known to occur in Central Africa (vide W. & G. S. West, in Journ. Bot. xxxiv. (1896) p. 381, t. 361. figs. 1, 2; op. cit. xxxv. (1897) p. 264); and *N. Goetzei* differs from it in the more expanded thallus and consequent laxer disposition of the filaments, which in their inferior part are not arranged in parallel bundles.

**Family SCYTONEMACEAE.**

**Genus SCYTONEMA, Ag.**


*Tanganyika.*—In swamp, Kituta (23 Aug. 1904; no. 72).


*Nyasa.*—On rocks at water-level, Deep Bay (25 June, 1904; no. 26).

*Tanganyika.*—Among other Algae scraped from bottom of Dr. Cunnington's dau (24 Jan. 1905; no. 217).

**Genus TOLYPOTHRIX, Kütz.**


Crass. fil. 11-14 μ; crass. trich. 9-10 μ.

*Tanganyika.*—In swamp, Kituta (23 Aug. 1904; no. 72).

I thoroughly agree with Schmidt (l. c. 1899) regarding the identity of *Tolypothrix tenuis*, Kütz., and *T. lanata*, Wartm.

**Family NOSTOCACEAE.**

**Genus NOSTOC, Vauchер.**


*Nyasa.*—In swamp, Karonga (2 July, 1904; no. 34).

Crass. trich. 4 μ; crass. heterocyst. 5-6 μ; diam. spor. 5.5-7.5 μ.

Tanganyika.—In plankton, Kituta Bay (24 Aug. 1904; no. 74). On surface of swamp, Toa (10 Jan. 1905; no. 209).


Crass. trich. 2.8-3.5 μ; long. heterocyst. 10 μ; lat. heterocyst. 5.5 μ; long. spor. 9-11.5 μ; lat. spor. 5.7-6.5 μ.

Tanganyika.—In plankton, Kituta Bay (27 Aug. 1904; no. 82).

Genus ANAB. ENA, Bory.


Forma trichomatibus curtis, spiraliter dispositis, anfractibus arctis integrosisque 2-4; cellulis globosis cum granulis conspicuis paucis; heterocystis intercalaris (non terminalibus); sporis non vidis.

Crass. trich. 6-7 μ; crass. heterocyst. 7.5-8 μ. (Pl. 4. figs. 10, 11, 14, 15; Pl. 10. fig. 1.)

Nyasa.—In the plankton, Anchorage Bay (13 June, 1904; no. 9) and Monkey Bay (17 and 18 June, 1904; nos. 15 and 16); very abundant.

Tanganyika.—In the plankton, near Kalambo (5 Nov. 1904; no. 154), near Kirando (1 Dec. 1904; no. 175), and near Utinta (5 Dec. 1904; no. 181).

The trichomes are spirally twisted after the manner of a corkscrew, mostly making from 2 to 4 turns, rarely as many as 8. The cells are almost exactly globose, and the heterocysts were never observed to be terminal. It was the dominant feature of two of the Nyasa plankton collections.

This form may be the same as the Anabaena mentioned by Schmidle as occurring in Lake Nyasa, and for which he suggested the name "A. Flus-aquæ, forma discoidea" (cf. Schmidle, in Engl. Bot. Jahrb. xxxii. (1903) p. 61). It is, however, rather larger than the measurements he gives for the specimens collected by Dr. Fülleborn. It may also be identical with A. spiroides, Klebahn.

Dr. Cunnington states that on one occasion in Lake Nyasa, and on a few occasions in Lake Tanganyika, a yellow scum was present on the surface, which he attributed to immense quantities of an Anabaena. He thinks that this appearance was the same as that noted by Livingstone and more recently by Mr. J. E. S. Moore ("The Tanganyika Problem," p. 323), who describes the surface as "appearing as if tinged with a fine golden dust." Mr. Moore,
however, says that the “yellow clouds” consisted of a large infusorian resembling a *Peridinium* or a *Colpodium*. The organism in question may have been a *Peridinium* or possibly *Botryococcus Braunii*, a Protococcaceous alga, which is the cause of similar coloration and “yellow clouds” in many European lakes.

Var. *circularis*, var. n. (Pl. 4. figs. 10, 11, 14, 15; Pl. 10. fig. 2.)
Var. *filis brevissimis*, spiraliter dispositus anfractibus 1½, utroque fine heterocysta terminatis; cellulis sphæricis, oblongo-ellipticis vel oblongis, cum granulo magno (*gas-vac.*). in cellula unaquaque.
Crass. trich. 4½–6 μ; crass. heterocyst. 5–8 μ.

**Tanganyika.**—In plankton, Komba Bay (11 Oct. 1904; no. 135), near Sumbu (13 Oct. 1904; no. 138), Vua Harbour (29 Oct. 1904; no. 150), near Kalambo (5 Nov. 1904; no. 154), near Kassanga (14 Nov. 1904; no. 159), near Chamaluki (15 Nov. 1904; no. 160), near Kala (19 Nov. 1904; no. 170), near Kirando (1 Dec. 1904; no. 175), near Maswa (14 Jan. 1905; no. 211), and near Baraka (24 Feb. 1905; no. 240).

This variety was the dominant feature of some of the plankton collections from Tanganyika, giving the collected sediment a decided blue-green colour. The trichomes are remarkable for their shortness, being mostly coiled in the form of a circle, sometimes overlapping at the extremities to form a spiral with about one and a half turns. Each end of this short trichome is terminated by a globular or ellipsoidal heterocyst, and both cells and heterocysts contain a single large granule, most probably the nature of a gas-vacuole. The total length of the trichomes from heterocyst to heterocyst varies from 80 to 140 μ. Very rarely a straight (or almost straight) trichome is observed among the coiled ones. The cells are somewhat variable in form, showing all gradations from globose to oblong.

290. *Anabena* sp. (Pl. 9. fig. 8.)

*A. trichomatibus rectis rigidissimis, evaginatis, solitariis; cellulis sphæricocompressis, cytoplasmate atro-viridi et minute granulato; heterocystis sphæricis, diametro trichomatis subsequalibus; sporis non visis.* Forsan sit propria species: *A. rigidissima*.
Crass. trich. 11–12 μ.

**Victoria Nyanza.**—Among *Utricularia*, near Bukoba (20 Apr. 1905; no. 618).

**Tanganyika.**—In plankton, near Kala (19 Nov. 1904; no. 170).

The trichomes of this *Anabena* were remarkable for their exactly linear character.

Crass. trich. 3½–4 μ; crass. heterocyst. 6 μ; sporis non vidis.

**Nyasa.**—In swamp, Kambwelagoon near Karonga (27 June, 1904; no. 29).
292. **Anabæna Tanganyika**, sp. n. (Pl. 10. fig. 3.)

A. pelagica, trichomatibus brevissimis, spiraliter contortis anfractibus 1-2 (plerumque circ. 1\textdegree), evaginatis, inter cellulas non constrictis, utroque fine heterocysta terminalis; cellulis cylindricis, diametro 2-3-plo longioribus (3'5-8'5 \(\mu\) longis), utroque polo truncatis; cytoplasmate minute granulato, pallide seruginoso; heterocystis oblongo-ellipticis terminalibus; sporis ellipticis, solitariis?, ab heterocystis plerumque remotis, episporio laevi et hyalino.

Crass. trich. 2'4-2'6 \(\mu\); long. heterocyst. 5'5 \(\mu\); lat. heterocyst. 3 \(\mu\); long. spor. 13 \(\mu\), lat. 7 \(\mu\).

**Tanganyika.**—In plankton, near Baraka (24 Feb. 1905; no. 240).

This species presents a similar modification of the trichomes to that shown by A. Flos-aqua var. circularis. Each trichome is short and twisted into a spiral of rather more than one complete revolution, and each extremity is terminated by a heterocyst. Beyond this point, however, the resemblance ceases. A. Tanganyika is a very much narrower species, with exactly cylindrical cells and scarcely any trace of constrictions between them.

In the thickness of its trichomes it most nearly approaches A. hyalina, Schmidle, but is very different in other characters and in its habit.


Forma tenuis: crass. trich. 4-5 \(\mu\); crass. heterocyst. 5'5 \(\mu\); long. spor. 11-14 \(\mu\); lat. spor. 10 \(\mu\).

**Nyasa.**—Among Utricularia, Domira Bay (19 June, 1904; no. 579).

The filaments are rigid and straight, and except for being a trifle thinner agree in every particular with the description of A. sphærica. It is similar in size to A. baltica, J. Schmidt, but the trichomes of the latter are strongly flexuose and circinate, and the spores are relatively larger.

294. **Anabæna** sp. ad A. baltica, J. Schmidt, accedens; trichomatibus valde flexuoso-circinatis; cellulis globosis, diam. 3-3'5 \(\mu\); sporis non vidis.

**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; no. 9).

**Genus NODULARIA, Mertens.**


Crass. trich. 6 \(\mu\).

**Tanganyika.**—On surface of swamp, Toa (10 Jan. 1905; no. 208).

296. **Nodularia tenuis**, sp. n.

N. filis tenuibus, brevibus et rigidis, utroque fine paullo attenuatis et cellula acute conica terminatis; vagina tenerrima, hyalina et difluente, vix conspicua; cellulis ante divisionem diametro equilobis, rotundo-quadratis; heterocystis late ellipsoides; sporis . . . ?

Crass. trich. 3-3'8 \(\mu\); crass. heterocyst. 5'5-6 \(\mu\); long. heterocyst. 7 \(\mu\).
Tanganyika.—Among various Algae, floating, Komba Bay (10 Nov. 1904 ; no. 134).

The spores of this species were not observed, but it differs so much from previously described plants of this genus that I feel justified in naming it *Nodularia tenuis*.

The trichomes are thinner than those of *N. Harveyana*, (Thw.) Thur., the cells are rounded quadrate, and the apical cells are acutely conical. The heterocysts are very numerous, broadly elliptical in form, and situated about 110-120 μ apart.

297. Nodularia sp.
Crass. cell. veget. (trich.) 6-7 μ; crass. heterocyst. 10-11 μ; sporis non vidis.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904 ; no. 22).

298. Nodularia sp.
Crass. trich. 4-4·5 μ; cellulis depresso-quadratis; heterocystis late ellipticis, long. 7·5-9 μ, lat. 6-7 μ; cellula apicali hemisphaerica; sporis non vidis.

Tanganyika.—Among *Cladophora* sp., on stones, shells, roots of grasses, etc., Niamkolo (1 Aug. 1904 ; no. 44).

Genus CYLINDROSPERMUM, Kütz.

Crass. trich. 2·2-3 μ; cellulis diametro 1·4-2-plo longioribus; long. heterocyst. 8-9 μ; lat. heterocyst. 3-3·8 μ; long. spor. 19-28 μ; lat. spor. 6·2-9·2 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).
This characteristic species was abundant in stagnant water. It is chiefly remarkable for its narrow trichomes and the length of the heterocysts.

Family OSCILLATORIACEÆ.

Subfam. VAGINARIEÆ.

Genus SCHIZOTHRIX, Kütz.

Crass. trich. 1·2-1·4 μ.

Tanganyika.—On rocks, in a few fathoms, Niamkolo Harbour (9 Aug. 1904 ; no. 54).
Genus MICROCOLEUS, Desmaz.


Var. MONTICOLA, (Kütz.) Gomont.—Chthonoblastus monticola, Kütz.

Crass, trich. 3.6–4 μ.

Nyasa.—On rocks, Nkata Bay (23 June, 1904; no. 23).

Subfam. LYGNYEAE.

Genus PLECTONEMA, Thur.


Crass, fil. 32–52 μ; crass, trich. 27–42 μ.

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904; no. 36), Komba Bay (11 Oct. 1904; no. 135), and near Sumbu (13 Oct. 1904; no. 138).

Forma robusta: crass, fil. 60–80 μ; crass, trich. 42–59 μ.

Tanganyika.—Floating and dredged, Komba Bay (10 Oct. 1904; no. 134). This stout form was loaded with epiphytes.


Crass, fil. 18–23 μ; crass, trich. 15–17 μ.

Tanganyika.—With the preceding species (no. 134).

Genus LYNGBYA, C. Ag.


Crass, fil. 9.5–10.2 μ; crass, trich. 7–7.8 μ.

Tanganyika.—On shells, dredged in about 10 fathoms, Pemba (23 Nov. 1904; no. 174).

305. LYNGBYA MARTENSIANA, Meneghini, Consp. Alg. Eugan. (1837) p. 12; Gomont, l. c. p. 145, t. 3. fig. 17.—Oscillatoria turfosa, Carm. (1841).

Crass, fil. 8 μ; crass, trich. 6 μ.

Tanganyika.—On rocks in shallow water, Mbete (29 Sept. 1904; no. 114).

306. LYNGBYA VERSICOLOR, (Wartm.) Gomont, l. c. p. 147, t. 4. figs. 4, 5.

Crass, fil. 3.8–4.5 μ; crass, trich. 2.8–3.3 μ.

Nyasa.—On rocks, Nkata Bay (23 June, 1904; no. 23). Amongst various Alge scraped from bottom of s.s. ‘Guendolen’ at anchor S. end of Lake (15 June, 1904; no. 577).
Victoria Nyanza.—On rocks, Bukoba (17 Apr. 1905; no. 248).

Tanganyika.—On rocks in shallow water, Mbete (29 Sept. 1904; no. 114).


Tanganyika.—On rocks, Niamkolo Harbour (7 Sept. 1904; no. 87).


Victoria Nyanza.—Among Utricularia, swampy pool near Bukoba (20 Apr. 1905; no. 618) and in sheltered bay near Entebbe (1 May, 1905; no. 620).

309. LYNGBYA CIRCUMCRETA, sp. n. (Pl. 9. fig. 7.)

L. filis solitariis pelagiis et brevibus, spiraliiter contortis; spiris latis et arctissimis, anfractibus adnatis 2–9 (plerumque 2–2½); vaginis tenuibus, firmis, arctissimis et echrois; cellulis subquadratis vel diametro brevioribus, cytoplasmate pallide aegugineo et homogeneo; cellula apicali rotundato-truncata.

Crass, cell. 1·8–2·1 μ; long. cell. 1–2 μ; diam. anfract. 28–44 μ.

Victoria Nyanza.—In plankton, near Bukoba (April 1935; nos. 249 and 252). Also in sheltered bay near Entebbe (1 June, 1905; no. 620).

This species occurred floating in the plankton as closely coiled threads which have the appearance of small hoops. The filament grows in the manner of a flat spiral, the twists of the spiral being wide but very close together.

It is nearest to L. contorta, Lemm., but differs in the hoop-like coiling of its filaments, which are also of greater thickness, and in the much shorter cells. The coils of L. circumcreta are much wider than those of L. contorta and more exactly circular.

310. LYNGBYA PURPUREA, Gomont, l. c. (1892) p. 149.—Oscillatoria purpurea, Hook. f. & Harv.

Crass, trich. 1·7 μ.

Tanganyika.—Among Calothrix cartilaginea, sp. n., on inside of canoe (6 Jan. 1905; no. 205).


a. Crass, trich. 1·4–1·5 μ; long. cell. 3·5–5·5 μ.

Nyasa.—In plankton, near Mtangula (22 June, 1904; no. 20), and off
Vahambwera Point (24 June, 1904; no. 24). In swamp, Kambwelagoona near Karonga (27 June, 1904; no. 29).

b. Crass. trich. 1 μ; long. cell. 5–6 μ.

**Tanganyika.**—In plankton, Lofu River (5 Oct. 1904; no. 124).

This minute *Lyngbya* exhibited considerable variation. The range of diameter was from 1 μ to 1.5 μ, and the length of the cells from 3.5 to 6 μ. In all cases a strong puncta or large granule was visible on each side of the dissepiments. In some instances the filaments were regularly twisted into a lax spiral, in others they were only curved, and very rarely they were almost straight. The spiral specimens only differed from *L. Lagerheimii*, (Möb.) Gomont, in the slightly longer cells, and in some of them the apical cells were very slightly narrowed and faintly capitate as in *L. Nyassa*, Schmidle.

I place the plants observed under *L. bipunctata*, Lemm., mainly owing to the length of the cells. They appear to me to combine the characters of *L. Lagerheimii*, *L. bipunctata*, and *L. Nyassa*, three *Lyngbyas* which would perhaps be better regarded as constituting one species with well-marked punctae and with filaments which frequently become twisted into a lax spiral. Particularly interesting was the finding of narrowed and faintly capitate apical cells in the spirally twisted forms. Precisely the same plant was observed from stones in a swamp as occurred in the plankton.


Crass. cell. 1.5–1.8 μ.

**Tanganyika.**—In plankton, Niamkolo (Aug. 1904; nos. 39 and 52) and near Kala (19 Nov. 1904; no. 170).


**Tanganyika.**—In plankton off Niamkolo Island (29 July, 1904; no. 36).

Genus **Phormidium**, Kütz.


Crass. trich. 1.4–1.8 μ.


The varied habit of this species is worthy of comment.


**Tanganyika.**—On stones, shores of lake Niamkolo (1 Aug. 1904; no. 44). In swamp, Kituta (23 Aug. 1904; no. 72). Near Kala, both in the plankton.
and dredged from the bottom (19 Nov. 1904; nos. 170 and 171). In swampy pond, Mrumbi (27 Dec. 1904; no. 195). In swamp, Toa (10 Jan. 1905; no. 208). In plankton near Baraka (24 Feb. 1905; no. 240).

Crass. trich. 0·8 μ.
Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).
Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170). In swamp, Toa (10 Jan. 1905; no. 208). In plankton, middle of lake between Rumonge and Uvira (30 Jan. 1905; no. 218). Among Utricularia, mouth of Malagarasi River (16 Jan. 1905; no. 611).

Crass. trich. 3·8 μ.
Tanganyika.—On rocks below the water-level, Kassanga (10 Nov. 1904; no. 156).

318. Phormidium papyraceum, (Ag.) Gomont, ll. cc. p. 355; p. 193, t. 5. figs. 3, 4.
Crass. trich. 3·6 μ.
Tanganyika.—Epiphytic on Plectonema Wollei, Komba Bay (10 Oct. 1904; no. 134).

319. Phormidium inundatum, Kütz. Sp. Alg. (1849) p. 251; Tab. Phyc. i. p. 32, t. 45. fig. 3; Gomont, l. c. (1892) p. 172, t. 4. figs. 31, 32.
Crass. trich. 3·4·3 μ.
Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

320. Phormidium ambiguum, Gomont, l. c. (1892) p. 198, t. 5. fig. 10.
Crass. trich. 5·5–6 μ.
Tanganyika.—On rocks dredged in 2 or 3 fathoms, Niamkolo Harbour (7 Sept. 1904; no. 87), and on rocks just below water-level, Kassanga (10 Nov. 1904; no. 156).

321. Phormidium autumnale, (Ag.) Gomont, l. c. (1892) p. 187, t. 5. figs. 23, 24; J. Schmidt, in Bot. Tidsskr. xxi. (1899) pp. 348, 410.—Phormidium uncinatum, (Ag.) Gomont, 1890; l. c. (1892) p. 184, t. 5. figs. 21, 22.
Crass. trich. 5·8–6·2 μ.
Tanganyika.—On rocks, shallow water, Mbete (29 Sept. 1904; no. 114).
OF THE THIRD TANGANYIKA EXPEDITION.

Genus OSCILLATORIA, Vauch.


**Tanganyika.**—In plankton, Kituta Bay (27 Aug. 1904 ; no. 82).


**Victoria Nyanza.**—In swammy pools, Bukoba (20 Apr. 1905 ; no. 251).

**Tanganyika.**—In plankton, near Mbete (28 Sept. 1904; no. 105). Among Utricularia, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

324. OSCILLATORIA AMPHIBIA, Ag. in Flora, x. (1827) p. 632 ; Gomont, l. c. p. 221, t. 7. figs. 4, 5.—Oscillaria tenerima, Kütz. (1843).

Crass. trich. 3 μ.

**Victoria Nyanza.**—Swamp pool near Bukoba (20 Apr. 1905 ; no. 618).


Crass. trich. 3 μ.

**Nyasa.**—In swamp, Karonga (2 July, 1904 ; no. 34).


Crass. trich. 2·3 μ.

**Tanganyika.**—Among Utricularia, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

327. OSCILLATORIA TANGANYIKA, sp. n. (Pl. 9. fig. 9.)

*O.* trichomatibus solitariis natantibus et pelagiis, elongatis, olivaceo-viridibus, rectis vel subrectis, apicem versus longe attenuatis, apicibus curvatis vel interdum recurvatis, rotundatis vel rotundo-truncatis, inter cellulas constrictis ; cellulis subquadratis vel plerumque leviter brevioribus, apicem versus ad duplo longioribus ; cytoplasmate minute granulosos et interdum granulis magnis subrefringentibus (gas-vac.?) paucis farci ; cellula apicali plerumque valde curvata, nunquam capitata, extremitati rotundata vel subtruncata ; calyptra nulla.

Crass. trich. 10—12 μ ; crass. apic. trich. 6 μ ; long. cell. 6—10 μ ; long. cell. apical. 11—15 μ.

**Tanganyika.**—In plankton, near Kirando (1 Dec. 1904 ; no. 175) and near Baraka (24 Feb. 1905 ; no. 240).

This interesting Oscillatoria most nearly approaches *O. subuliformis*, Kütz., Linn. Journ.—Botany, vol. XXXVIII.
a species which occurs on maritime rocks about the tide-limits. It is, however, distinguished by its thicker and much straighter trichomes, by the conspicuous constrictions between the cells, and by its free-floating habit. *O. Tanganyika* is a remarkable species and has undoubtedly a closer affinity with *O. subuliformis* than with any other known species of the genus. So striking is this resemblance, and so different is *O. Tanganyika* from other species of the genus, that one feels justified in suggesting that these two species have had a common origin, *O. Tanganyika* having acquired certain distinctive characters as a result of its adaptation to a pelagic existence.


*Forma major*; crass. trich. 10–10·5 μ.

*Tanganyika.*—In swamp, Mbete (28 Sept. 1904; no. 108).

The specimens from Tanganyika are in perfect agreement with Schmidle's species except for the thickness. The trichomes are straight, with unattenuated and bluntly rounded extremities, and the cells are exceedingly short. The transverse cell-walls are bent as in specimens of *O. subbrevis* which I have recorded from Barbados in the West Indies (*vide* Journ. Bot. xlii. (1904) p. 292), some of them being concave and some convex to the apex of the trichome. The dark disc-shaped masses of intercellular (?) substance occur at irregular intervals along the length of the trichome.


Crass. trich. 4–4·2 μ.

*Tanganyika.*—Dredged from a few fathoms, near Kala (19 Nov. 1904; no. 171).

330. *Oscillatoria Cortiana*, Meneghini, *l. c.* p. 8; *Gomont, l. c.* p. 231, t. 7. fig. 17.

Crass. trich. 7–7·5 μ.

*Tanganyika.*—In plankton, near Maswa (14 Jan. 1905; no. 11).

Previously recorded only from thermal waters in Italy and Hungary.

Genus SPIRULINA, Turp.


*Nyasa.*—On stones on shore, Domira Bay (19 June, 1904; no. 17).

332. *Spirulina laxissima*, sp. n. (Pl. 9. fig. 6.)

Trichomata angustissima, solitaria, inter algas pelagias sparsas, in spiram laxissimam regularem diametro 4·5–5·3 μ aequaliter contorta, anfractibus 17–22 μ inter se distantibus; apicibus trichomatis rotundato-obtusis; cytoplasmate pallide aeruginoso et homogeneo, sine granulis.
Crass. trich. 0·7–0·8 μ; long. tot. trich. 21–275 μ.

**Tanganyika.**—In plankton, near Chamkaluki (15 Nov. 1904; no. 160) and near Kala (19 Nov. 1904; no. 170).

This species occurred in abundance in the two above-mentioned collections. The trichomes are exceedingly narrow and are chiefly remarkable for the laxness of the spirals. Some of them were very short, scarcely exceeding a single turn of the spiral, whereas others possessed as many as fourteen turns and reached a length of 275 μ.


Crass. trich. 3·5–4·8 μ. (Pl. 9. fig. 5.)

**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 34).

This species has a wide distribution in the tropics, having been described from Java, Ceylon, and Central Africa. Unfortunately, it was described as a "sp. nova" in each case, the name *Spirulina princeps* being the first one given to it.

The cell-contents are of a bright blue-green colour, and homogeneous in character except for a few scattered refractive granules, which are rarely absent. The trichomes are slightly variable in thickness, and in the width of the spiral and relative distance apart of the turns, but to my mind these differences are not of a specific nature. The width of the spiral varies within the extremes even in a single trichome, and the distance between the turns of the spiral varies at different parts of the same trichome.

The following table shows the differences of measurement between the described forms:

<table>
<thead>
<tr>
<th>Locality.</th>
<th>Thickness of trichome</th>
<th>Diameter of spiral</th>
<th>Distance apart of turns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java (Sp. Gomontii of Gutwinski).</td>
<td>3·8 μ</td>
<td>8·8 μ</td>
<td>11 μ</td>
</tr>
<tr>
<td>Ceylon.</td>
<td>4·5–5 μ</td>
<td>11–12 μ</td>
<td>9·5 μ</td>
</tr>
<tr>
<td>Africa (Nyasa) (Sp. gigantea of Schmidle).</td>
<td>3·4 μ</td>
<td>11–16 μ</td>
<td></td>
</tr>
<tr>
<td>Africa (Nyasa) (coll. by Dr. Cunnington).</td>
<td>3·5–4·8 μ</td>
<td>9–12 μ</td>
<td>10–12 μ</td>
</tr>
</tbody>
</table>
The following diagnosis takes into consideration the limits of variation for the species:

*Trichomata robusta et solitaria, inter algas varias sparsas, curta, in spiram laxam vel laxiusculam plus minusve subregulariter diametro 8-8-16 μ contorta; anfractibus 9-5-11 μ inter se distantibus; apicibus trichomatis obtusis vel rotundato-obtusis; cytoplasmate aerugineo-ceruleo et homogeneo, cum granulis minutis sparsis. Crass. trich. 3-5 μ.

*Geogr. distribution.*—Central Africa; Ceylon; Java.

**Family RIVULARIACEÆ.**

**Genus CALOTHRIX, Ag.**


Crass. fil. 10-12 μ (ad 16 μ); crass. trich. ad bas. 7-9:3 μ.

**Nyasa.**—*In* scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904 : no. 577).


Crass. fil. ad bas. 4.5-9 μ; crass. trich. ad bas. 2.8-5.8 μ.

**Nyasa.**—*On* *Cladophora,* Anchorage Bay (no. 11).

**Tanganyika.**—*On* *Cladophora* scraped from the bottom of Dr. Cunnington's dau (24 Jan. 1905 ; no. 216).

336. *Calothrix brevissima,* sp. n. (Pl. 10. fig. 8.)

*C. filis minutis et epiphyticis, culmis vetustis pelagiis affixis, gregariis et brevissimis, longitudine toto 53-94 μ, non vel levissimæ attenuatis; vagina firma, arcta, pæne cylindrica, tenui, hyalina et achroa; trichomatibus pallide olivaceo-viridibus, brevissimis, longitudine toto 30-62 μ, vix attenuatis, apice rotundato; cellulis inferioribus diametro subequilongis vel brevioribus, superioribus diametro duplo brevioribus, minute granulatis; heterocystis basilaribus singulis (rare biis) rotundato-hemisphaericis vel subglobosis.

Crass. fil. 5-7 μ; crass. trich. 3.8-5 μ.

**Victoria Nyanza.**—*In* the plankton, attached to decaying shreds of vegetable matter (probably old leaves and plant-stems), near Bukoba (21 Apr. 1906 ; no. 252).

This minute species occurred clustered round fragments of decaying stems and leaves which had collected in the tow-net. It is characterized by its extreme shortness, and is distinguished from all other species of the genus by the absence of any appreciable attenuation. The sheaths are firm and colourless, almost cylindrical, with open extremities, and they fit the trichomes very closely. The trichomes are rounded at both extremities, with the faintest indication of attenuation towards the apex, and the cells are much shorter than their length. There is a well-defined basal heterocyst of a
rounded-hemispherical shape, and sometimes a second heterocyst is developed after the trichome has shifted a short distance from the base of the sheath.

Forma angustior et longior.
Crass, fil. ad bas. 4-5·5 μ; crass, trich. 3·4-3·7 μ; long, toto fil. usque 130 μ.

**Tanganyika.**—Epiphytic on *Cladophora inconspicua*, clothing some of the young branches very thickly, in a few fathoms of water, Niamkolo.

Crass, fil. ad bas. 13·5-19 μ; crass, trich. 7·5-9·5 μ.

**Victoria Nyanza.**—On rocks just below the water-level, Bukoba (17 Apr. 1905; no. 248). This form approaches a species of *Tolypothrix*.

Crass, fil. ad bas. 7-10 μ; crass, trich. 5·5-8 μ.

**Tanganyika.**—Among *Utricularia* and other water-weeds in shallow water, mouth of Malagarasi River (16 Jan. 1905; no. 611).
Forma filis ad basin subrectis.
Crass, fil. ad bas. 6-9 μ; crass, trich. 4·5-6·4 μ.

**Nyasa.**—On rocks below level of water, Nkata Bay (23 June, 1904; no. 23).

339. *Calothrix cartilaginea*, sp. n. (Pl. 10. fig. 7.)
*C. strato compacto late expanso, cartilagineo, atro-viridi vel sordide aeruginoso, lignis vetustis affixo, 1 mm. crasso; filis densissime confertis, curvato-flexuosis, imbricatis, plerumque curtis, ad basin leviter bulboso-inflatis; vagina areta et firma, hyalina, sepe vix conspicua; trichomatibus brevibus, in pilum brevem attenuatis, inter cellulas constrictis; cellulis inferioribus diametro paulo brevioribus (rare triplo brevierioribus discreptiformibus), plerumque torulosis, superioribus tam longis quam latis vel diametro usque duplo longioribus, cellula basali parva, cellula apicali subconica; heterocystis nullis.
Crass, fil. ad bas. 5-10 μ; crass, trich. ad bas. 4·5-9 μ; hormogoneis torulosis usque 50 μ longis.

**Tanganyika.**—Scraped from the inside of a canoe (6 Jan. 1905; no. 205).
The trichomes of this species are rather short and somewhat variable in character. There are no heterocysts and the basal cell is generally considerably smaller than the cells just above it, a slight bulbous swelling being a general feature of the base of the trichome. The basal cells are shorter than their length, but in the upper parts of the trichome the cells are mostly longer than broad. In some of the trichomes each cell contains one or more prominent granules of large size, and occasionally in some of the thinner trichomes the basal region does not appear to be septate.
Calothrix cartilaginea should be compared with C. balearica, Born. & Flah., and C. juliana, Born. & Flah. From the former it is distinguished by the swollen bases of its trichomes, which are never decumbent, and by the much thinner sheath with no trace of lamellation. The cells are also considerably longer. From C. juliana it differs in its thinner stratum of darker colour, its narrower, much shorter, and more flexuose trichomes, and its longer cells.

Genus RIVULARIA, (Roth) Ag.; em. Thur.

Forma: crass. trich. 5-5-7 μ; crass. heterocyst. 5-5-6 μ.

Tanganyika.—Attached to floating decayed stems, Lofu River (5 Oct. 1904; no. 124).

341. RIVULARIA GLOBICEPS, sp. n. (Pl. 10. fig. 6.)
R. thallo parvo, submolle, 1-5-3 mm. lato, calce non indurato, hemisphaerico-globoso, caulibus vetustis affixo; filis confertis pressione facile secedentibus; vaginis hyalinis et amplis, vix conspicuis; trichomatibus intern cellulas constrictis, apice in pilum sublongum attenuatis; cellulis cylindricis inferioribus diametro 1½-4-plo longioribus, superioribus similibus vel duplo brevioribus, cum granulis paucis magnis; heterocystis magnis globosis, singulis vel raro binis, cum nodulo incrassato conspicuo juxta cellulam basalem.
Crass. trich. ad bas. 4-8-6 μ; crass. heterocyst. 10-12 μ.

Tanganyika.—Attached to old stems and leaves, floating in Kituta Bay (24 Aug. 1904; no. 74).

The large size of the heterocysts, which are globular and twice the diameter of the trichomes, is one of the most characteristic features of this species. The cells are cylindrical and in the basal parts of the trichomes are very long. They contain scattered conspicuous granules, which are chiefly located near the exterior, sometimes even projecting from the wall of the cell.

In the size of its trichomes R. globiceps most nearly approaches R. hematites, Ag., but it is at once distinguished by its smaller and much softer colonies, which are not incrusted with lime, by the large size of the heterocysts, and by the somewhat longer basal cells.

Genus GLÆOTRICHIA, J. Ag.

Forma thallo bulboso usque ad 15 mm. lato; vaginis plerumque diffuent-
ibus; heterocystis basilaribus, singulis, binis vel ternis, globosis, late ellipticis vel oblongis.

Crass. trich. ad bas. 7-9·5 μ; diam. heterocyst. 8·2-12·4 μ.

Tanganyika.—Floating in Mtondwe Bay, Niamkolo (13 Aug. 1904; no. 66).

Forma juvenalis?

_Tanganyika_—Floating in Mtondwe Bay, Niamkolo (13 Aug. 1904; no. 66).

Forma juvenalis?

_G._ thallo minuto subgloboso 170-230 μ lato molle et solido; trichomatis viridibus, curtis, in pilum brevem attenuatis; cellulis basin versus subrectangularibus (diameter 14-1½-plo longioribus) levissime tumidis, superioribus diametro usque 5-plo longioribus, valde granulosis; heterocystis basilaribus globosis; sporis ignotis.

Crass. trich. ad bas. 3-3·4 μ; crass. heterocyst. 5½-6 μ.

_Victoria Nyanza._—Among _Utricularia_, near Entebbe (1 May, 1905; no. 620).

343. _GLOEOTRICHA LONGIARTICULATA_, sp. n. (Pl. 10. fig. 5.)

_G._ thallo parvo subgloboso molle 750-900 μ lato; filis subconfertis, pressione facile secedentibus; trichomatis viridibus, curtis, in pilum brevem attenuatis; cellulis basin versus sublongum attenuatis, inter cellulas distincte constrictis; cellulis cylindricis, ad basin plurumque elongatis, diametro 3-7-plo longioribus (rare 1½-plo longioribus), superioribus sepe brevioribus (diametro 3-5-plo longioribus), non-nunquam granulo magno conspicuo ad polum unumquemque et cum granulis minuti numerosis; heterocystis basilaribus, magnis, globosis vel late ellipticis (rare oblongis); sporis breviter cylindricis, diametro 3-plo longioribus, polis rotundatis, episporio duplicate glabro et lutescente.

Crass. trich. ad bas. 4½-5·5 μ; crass. heterocyst. 8-9·5 μ; long. spor. 36-44 μ; lat. spor. 12·5-15 μ.

_Nyasa._—Floating in Anchorage Bay (10 June, 1904; no. 1).

This species is nearest to _Gleotrichia indica_, Schmiedle (in Hedwigia, xxxix. (1900) p. 174, t. 9. figs. 18, 19), from which it differs in the shorter filaments, in the absence of swollen cells next the heterocyst at the base of the trichome, and in the smooth outer coat of the spore. The spores are also shorter and the heterocysts more rounded.

There are well-marked constrictions between the cells, and the large granule (gas-vacuole?) at each pole is particularly conspicuous in the more elongated cells. The heterocysts are mostly of a broadly-elliptic shape and are markedly wider than the trichomes.

_G. longiarticulata_ differs from _G. echinulata_ (Conferva echinulata, Sm., Engl. Bot. t. 1878; Rivularia echinulata, Turn. ex Sm. l. c. in obs.), P. Richter (vide J. Schmidt, in Bot. Tidsskr. xxii. (1899) p. 491), in the narrower trichomes, with much longer cells, and in the shorter spores.
Order COCCOGONEÆ.

Family CHAMÆSIPHI NIAEÆ.

Genus CHAMÆSIPH ON, A. Br. & Grun.


Long. 30–37 μ; lat. 3'2–3'5 μ.

Tanganyika.—On Cladophora sp., shores of lake, Niamkolo (1 Aug. 1904; no. 44). On Chetomorpha Linum floating in Kituta Bay (26 Aug. 1904; no. 79).


Nyasa.—On Cladophora cris pata, Anchorage Bay (no. 11).

Victoria Nyanza.—On Cladophora cris pata, Bukoba (17 Apr. 1905; no. 247).

Tanganyika.—On Chetomorpha Linum, Niamkolo Bay (3 Aug. 1904; no. 40).

Family CHROOCOCCEÆ.

Subfam. CHRO OCYS TÆ.

Genus GLE OCHAETÆ, Lagerh.


Diam. cell. 8'5–15 μ; long. set. 54–196 μ.

Victoria Nyanza.—Among Utricularia, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Subfam. CHROOCOCCÆ.

Genus APHANO THECE, Näg.


Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Genus DACTYLOCOCOPSIS, Haeug.

348. DACTYLOCOCOPSIS AFRICANA, sp. n.

D. cellulis circ. 8–9 in familia fasciculatim aggregatis, in medio decussatim conjunctis; cellulis elongatis et cylindricis, diametro 37–42-plo longi-
OF THE THIRD TANGANYIKA EXPEDITION.

oribus, cum polis attenuatis et acutis; cytoplasmate homogeneo et pallide aëruginoso.

Long. cell. 75-88 μ; lat. cell. 1'8-2'5 μ.

**Victoria Nyanza.**—In plankton, near Bukoba (21 Apr. 1905; no. 252).

*D. africana* is distinguished from all other species of the genus by its stellate colonies of elongated cells, which are suddenly bent round each other in the middle after the manner of some forms of *Ankistrodesmus falcatus*, (Corda) Ralfs. In the length of its cells this species agrees with *D. acicularis*, Lemm. (in Ber. Deutsch. Bot. Ges. xviii. (1900) p. 309), but differs in the bent cells, forming star-shaped colonies, and in the absence of the bright refractive granules from the cytoplasm.

**Genus Merismopedia, Meyen.**


**Nyasa.**—On shores and among *Utricularia*, Domira Bay (19 June, 1904; nos. 17 and 579).

**Victoria Nyanza.**—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In plankton, near Baraka (21 Feb. 1905; no. 240).


**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 34).

**Victoria Nyanza.**—Near Entebbe (1 May, 1905; no. 620).

**Tanganyika.**—In plankton, near Chamkaluki (15 Nov. 1904; no. 160).


**Tanganyika.**—In plankton, Lofu (6 Oct. 1904; no. 130), and near Sumbu (13 Oct. 1904; no. 138).


**Tanganyika.**—In plankton, Vua Harbour (29 Oct. 1904; no. 150).

Var. remota, var. n.

Var. cellulis ut in forma typica sed remotis, coloniis plus minusve sub-irregularibus.

Diam. colon. (cell. 32-128) 52-146 μ; diam. cell. 7-9 μ.

**Tanganyika.**—In plankton, near Baraka (24 Feb. 1905; no. 240).

The cells were similar in size and colour to those of *M. elegans*, but were more or less remote from each other in the enveloping jelly. The colonies were also more irregular than any I have previously observed of *M. elegans*. A few of the cells in each colony possessed a single dark granule, very probably of the nature of a gas-vacuole.
Genus TETRAPEDIA, Reinsch.

353. TETRAPEDIA REINSCHIANA, Arch. in Grevillea, i. (1872) p. 46, t. 3, figs. 11–13.

**Nyasa.**—On shore, Domira Bay (19 June, 1904; no. 17). In swamp, Karonga (2 July, 1904; no. 34).


**Nyasa.**—In scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904; no. 577). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

Genus GOMPHOSPHERIA, Kütz.

355. GOMPHOSPHERIA APONINA, Kütz. Tab. Phyc. i. t. 31. fig. 3; Rabenh. Fl. Europ. Alg. ii. (1865) p. 56.

**Tanganyika.**—In plankton, off Niamkolo Island (29 July, 1904; no. 36). Among Cladophora on shores, Niamkolo (1 Aug. 1904; no. 44). In plankton, Vua Harbour (29 Oct. 1904; no. 150).


**Nyasa.**—In plankton, off Karonga (1 July, 1904; no. 30).

**Victoria Nyanza.**—In plankton, near Bukoba (21 April, 1905; no. 252).

Genus MICROCYSTIS, Kütz.


**Nyasa.**—In plankton, near Mtangula (22 June, 1904; no. 20), off Vahambwera Point (24 June, 1904; no. 24), and off Karonga (1 July, 1904; no. 30).

**Victoria Nyanza.**—In plankton, near Bukoba (April 1905; nos. 249, 250, and 252).


**Nyasa.**—In plankton, Anchorage Bay (13 June, 1904; no. 9).

**Victoria Nyanza.**—In plankton, near Bukoba (21 Apr. 1905; no. 252).


**Nyasa.**—In swamp, Karonga (2 July, 1904; no. 33).

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904; no. 36) and near Niamkolo (7 Sept. 1904; no. 88).


Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249). In sheltered bay, near Entebbe (1 May, 1905; no. 620).

Genus Aphanocapsa, Näg.


Tanganyika.—Dredged from a few fathoms, Kala (19 Nov. 1904; no. 171).

Genus Chroococcus, Näg.


Nyasa.—In plankton, Anchorage Bay (13 June, 1904; no. 9) and Monkey Bay (17 June, 1904; no. 15).


Nyasa.—Scrapings from bottom of s.s. ‘Guendolen’ at anchor S. end of lake (15 June, 1904; no. 577).


Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208).

366. Chroococcus pallidus, Näg. l. c. t. 1 a. fig. 2.

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).


Nyasa.—In swamp, Karonga (2 July, 1904; no. 33). In scrapings from bottom of s.s. ‘Guendolen’ at anchor S. end of lake (15 June, 1904; no. 577).

Tanganyika.—In plankton, Baraka (24 Feb. 1905; no. 240).
Class **PERIDINIEÆ**.

Order **PERIDINIALES**.

Family **GLENODINIACEÆ**.

Genus **GLENODINIUM**, Ehrenb.


**Tanganyika**.—In plankton, near Mbete (28 Sept. 1904; no. 105), Komba Bay (11 Oct. 1904; no. 135), and near Kala (19 Nov. 1904; no. 170).

Family **PERIDINIACEÆ**.

Genus **PERIDINIUM**, Ehrenb.

369. **Peridinium africanum**, Lemm., sp. n. (*Pl. 9. fig. 1.*)

*P.* pæna tam longum quam latum, 24-30 μ longum et 23-27 μ latum; corpore in partibus inæqualibus duabus a fossa transversa diviso, parte apicali majore; fossa transversa pene circulari; fossa longitudinali margine posteriore extensa, parte posteriore multe dilatata; membrana glabra, striis intercalaribus delicatissimis.

_Epivalva_ (*Pl. 9. fig. 1, d*) conica; tabula rhomboidea juxta apicem extensa; tabulis æquatoriis 7; tabulis apicalibus ventralibus hexagonis, tabulis apicalibus dorsali bus pentagonis, tabula dorsali quadrata pro tabulis apicalibus dorsali bus disposita. _Hyporalea_ (fig. 1, e) rotundo-conica, margine posteriori concavo; tabulis æquatoriis 5; tabulis antapicalibus 2, una minore et altera multe majore; margine ventrali tabule antapicalis spina robusta hyalino ornato.

_Cystis_ cordiformis, 20-5 μ longis et 22 μ latis; membrana crassa, glabra et hyalina (fig. 1, e).

**Nyasa**.—In plankton, Anchorage Bay (June, 1904; nos. 5, 9, and 10) and Monkey Bay (June, 1904; nos. 15 and 16).

**Tanganyika**.—In plankton, near Kala (19 Nov. 1904; no. 170).


_Var. apiculatum*, Lemm., var. n. (*Pl. 9. fig. 3.*)

*P.* rhomboideum, 41-42 μ longum et 40-41 μ latum; corpore ut in viso aspectu cingulato subcirculari, margine posteriori concavo et spinis brevibus inæqualibus duobus ornato, in partibus æqualibus duobus a fossa transversa diviso. Fossa transversa (Pl. 9. fig. 3, b) spiralis dispositione. Fossa longitudinali margine posteriore extensa sed a parte apicali exclusa; margine sinistro fossæ longitudinalis in alam compressam extenso, margine alæ cum papillis minutissimis numerosis (fig. 3, c).
Tanganyika.—In plankton, Komba Bay (11 Oct. 1904; no. 135) and near Kala (19 Nov. 1904; no. 170).

This variety differs from the typical form in the presence of the spines at the posterior margin, in the conical apical part of the cell, and in the absence of the small papillae which cover the sutures between the plates in the typical form.

Genus PERIDINIOPSIS, Lemm.

371. Peridiniopsis Cunningtonii, Lemm., sp. n. (Pl. 9. fig. 2.)

P. paullo longius quam latius, 31.5–38 μ longum et 27–31.5 μ latum, margine posteriore truncato; corpore in partibus inaequalibus duabus a fossa transversa diviso, parte apicali majori; fossa transversa (Pl. 9. fig. 2, a) conspicu spira
titer disposita; fossa longitudinali in partem apicalem extensa et margine posterio
e multis discata. Membrana delicatissime reticulata; striis intercalaris delicati.

Epivalva (Pl. 9. fig. 2, d) conica, cum tabulis equatoriiis 6; tabula rhomboidea apicem extensa; tabulis apicalibus 4, ventralibus 2 et dorsalibus 2. Hypovalva (Pl. 9. fig. 2, e) truncato-conica, cum tabulis equatoriiis 5, ve
tralibus 2 et lateralis 2 cum spina robusta brevi singula; tabulis antapicalibus 2, cum spina singula in tabula unaque.

Tanganyika.—In plankton, Komba Bay (11 Oct. 1904; no. 135), and near Kala (19 Nov. 1904; no. 170).

The body of this species resembles that of Peridinium quadridens, Stein, but differs in the number and arrangement of the plates and in the number of the spines.

This is the second described species of the genus Peridiniopsis. P. Borgei, Lemm. (in Arch. Bot. K. Sv. Vet.-Akad., Bd. ii. (1904) no. 2, p. 134, t. 1. figs. 1–5), has three antapical plates and no spines, whereas P. Cunningtonii has two antapical plates and six conspicuous spines. In both species the epivalve possesses six equatorial plates.

Genus CERATIUM, Schrank.

372. Ceratium Hirundinella, O. F. Mull.

Small forms with only two antapical horns: length 136–148 μ; breadth 50–54 μ; length of apical horn about 50–60 μ; length of 1st antapical horn about 30–44 μ; length of 2nd antapical horn about 10–12 μ. (Pl. 9. fig. 4.)

Victoria Nyanza.—In plankton, near Bukola (21 Apr. 1905; no. 252).

The species was very scarce, and the few specimens observed differed very much from any others which have come under my notice. They were small, with short horns, and the wall was strongly reticulated. The apical horn was short with a broad base and slightly curved, and only two antapical horns were present. The first antapical horn was attenuated from a broad base, apiculate at the extremity and turned inwards. The second antapical
horn was very short, acute, and slightly variable in its position relative to the first one, but in every specimen seen it was situated much nearer to the first antapical horn than has been described or figured for any European specimen. (Vide Lemmermann, in Arch. Bot. K. Sv.Vet.-Akad. ii. (1904) no. 2, t. 2, figs. 1–49; W. & G. S. West, in Trans. Roy. Soc. Edinb. xli. part iii. (1905) p. 494, fig. 1 A–D; in Trans. Roy. Irish Acad. xxxiii. sect. B, part ii. (1906) p. 94, figs. 1–9.)

IV. GENERAL SUMMARY OF THE INVESTIGATION.

1. The Algae observed in Dr. Cunnington’s collections can be summarized as follows:

<table>
<thead>
<tr>
<th>Genera</th>
<th>Species</th>
<th>Varieties and Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyceae</td>
<td>Chlorophyceae</td>
<td>Chlorelloides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chlorelloides</td>
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<td></td>
<td></td>
<td>Cladophora</td>
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<tr>
<td></td>
<td></td>
<td>Conjugatae</td>
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<td></td>
<td></td>
<td>Protococoidsce</td>
</tr>
<tr>
<td>Heterokontae</td>
<td>Confervales</td>
<td>1</td>
</tr>
<tr>
<td>Bacillariaceae</td>
<td>Centricae</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Pennate</td>
<td>18</td>
</tr>
<tr>
<td>Myxophyceae</td>
<td>Hormogonae</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Coccosione</td>
<td>10</td>
</tr>
<tr>
<td>Peridiniae</td>
<td>Peridinales</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>372</td>
</tr>
</tbody>
</table>

These results have added greatly to our knowledge of the geographical distribution of freshwater Algae in tropical Africa.

2. Of the above, 1 genus, 36 species, and 18 varieties and forms are described as new.

3. The plankton collected in Nyasa in June 1904 contained 48 species of Algae, which are chiefly interesting in comparison with Dr. Fülleborn’s more extensive collections from 1898 to 1900.

4. The plankton from Victoria Nyanza was collected in April 1905 and contained 58 species. Again, the chief interest of these collections lies in a
comparison with the material collected by Dr. Stuhlmann in October 1892. The Bacillariaceae and Myxophyceae are relatively few in number, and the phytoplankton is essentially Chlorophyceous, with all the features of a Desmid-plankton.

5. The phytoplankton of Tanganyika is much richer in number of species than that of Nyasa or Victoria Nyanza. It contained 85 species, of which 61 (72 per cent.) occurred in this lake alone. The Chlorophyceae were relatively few both as regards species and individuals, but the Bacillariaceae and Myxophyceae were both represented by more than the usual proportion of species, and occurred at certain times in prodigious quantities. The Protococceoideae and Bacillariaceae were especially evident during November, after which month there was a general diminution of the Algae accompanied by a great development of Nauplius larvae. Ten species and one variety of this phytoplankton were new.

Several of the species observed in the phytoplankton of this lake are usually marine or brackish in habit, and others more nearly approach marine species than freshwater ones. *Nitzschia Tryblionella*, Hantzsch, var. littoralis, (Grun.) Van Heurck, *Surirella striatula*, Turp., and *Chodatella subsalsa*, Lemm., are marine or brackish-water species. *Navicula distincta*, sp. n., and *Surirella Tanganyika*, sp. n., more nearly approach marine forms than freshwater ones, and *Oscillatoria Tanganyika*, sp. n., is much nearer the marine *Oscillatoria subaliformis*, Kütz., than any other described species. *Plectonema Wolleii*, Farlow, is another curious Alga in the plankton: certainly a freshwater species, but one which only differs from the marine *Lyngbya majuscula*, Harvey, in the scarce development of false branches—a character which may be due to change of environment. The occurrence of no less than three species of *Nodularia*, a genus which is typically of brackish habit, in the immediate vicinity of Tanganyika is also a noteworthy fact.

The Alga-flora of Tanganyika differs very much from that of Nyasa or Victoria Nyanza, but its peculiarities are all of them such as could be accounted for by the prolonged isolation of the lake. The definite outlet by the River Lukuga into the Congo system is relatively recent, having been established since the formation of the volcanic cones to the north of Lake Kivu. The damming up of the northern end of the Lake Kivu region added a large drainage-area to the Tanganyika lake-basin, and marks the close of the period of isolation. There is every reason to consider the presence of certain brackish-water Algae, and others with marine affinities, as evidence that during the period of prolonged isolation the water became increasingly saline. Our knowledge of the modifications which some Algae undergo owing to change of environment is in support of the view that those Algae of Tanganyika exhibiting marine affinities may have been produced by a gradual increase in the salinity of the water over an extended period of time. The relatively small proportion of Chlorophyceae in the plankton, and the large proportion of Bacil-
larieae and Myxophyceae, is also an indication that the water of the lake was at one time much more saline than it is at present.

Collections made within a few days of one another from different parts of Tanganyika differ so much, even in their dominant constituents, that it is not at all improbable that some of these plankton-organisms may occur in large shoals of more or less limited extent. From available evidence it is not possible, however, to make a definite statement on this point, as collections were not actually made in different parts of the lake at the same time; but the dominance of Anabaena Flos-aquæ var. circularis in some collections, and of Nitzschia nyassensis and Synedra Acus in others obtained very shortly afterwards from other parts, indicates that the plankton of the lake is by no means a uniform character. The Nyasa plankton collections also furnish evidence of a similar absence of uniformity, but, owing to their less comprehensive nature, to a much less marked degree.

In large bodies of fresh water, such as these Central African lakes, it would appear that a single sample of plankton obtained in a stated locality must not be regarded as representative of the plankton of the entire lake.

EXPLANATION OF THE PLATES.

PLATE 2.

Photomicrographs of plankton from Lake Nyasa.

Figs. 1-16 × 100; figs. 17-20 × 150.

10. Closteriopsis longissima; 11 & 12. Surirella Nyassa, with numerous attached Vorticelle or similar Infusoria.

PLATE 3.

Photomicrographs of plankton from Victoria Nyanza.

All × 100.

Figs. 1. Staurostrum cuspidatum; 2. Surirella Malonbe; 3 & 4. Surirella Fullebornii, var. elliptica; 5. Melosira nyassensis; 6 & 7. Masses of partially decomposed organic matter which form a feature of the plankton examined from this lake; 7 is probably the excreta of some animal.
OF THE THIRD TANGANYIKA EXPEDITION.


Note.—The quantity of decaying organic matter in the plankton of Victoria Nyanza is rendered very obvious by the numerous dark, ill-defined patches in the photographs.

PLATE 4.

Photomicrographs of plankton from Tanganyika.

Figs. 1–13 × 100; figs. 14–17 × 200.


6. *Oocystis lacustris*; 7 & 8. *Nitzschia nyassensis*. (This Diatom occurred in countless myriads in plankton collections from certain parts of Tanganyika. It is of great length and very slender, much resembling the elongated varieties of *Synedra Acus*, to which plant it should possibly be referred.)

The delicate curved lines in the photograph represent one of the minute plankton-species of the genus *Lyngbya*.


The dominating feature of this plankton is the short and much coiled variety of *Anabena Flos-aqua*. In this respect the plankton is remarkably similar to certain collections from Nyasa (vide Pl. 2, figs. 15 & 16).


PLATE 5.

Figs. 1–2. *Spirogyra equinoctialis*, sp. n. × 500. 1, single vegetative cell showing chloroplasts; 2, male and female gametangia, with zygospore in greatly swollen female gametangium.

3–4. *Debarya africana*, sp. n. × 500. 3, zygospore enclosed within the gametangium and conjugating-tube; 4, junction of vegetative cell (c.v.) and gametangium (g.), showing thickened walls of latter with curious pit-like structure in the end-wall.

Fig. 5. *Pediastrum Tetras*, (Ehrenb.) Ralfs, var. *longicorne*, Racieb. × 620.


7. *Crucigenia tetracantha*, sp. n. × 500.

Figs. 8–9. *Calacystis compositum*, sp. n. × 520. 8, small coenobium of eight groups of three cells each; 9, much larger coenobium.

Fig. 10. *Palmophyllum foliaceum*, sp. n. th., thallus, × 100; c., a few of the minute green cells, × 500.

Figs. 11–13. *Siphonosiphon polymorphus*, gen. et sp. n. 11, young colonies, × 100; 12, older and more elongated colony showing a few slight constrictions, × 100; 13, small portion of colony, × 620. 11 & 12 are only drawn in outline to show the hollow thallus.

14–17. *Chodatella subalsa*, Lemm. × 500. 15, cell containing two daughter-cells; 16 with four, and 17 with eight undeveloped gonidia (autosporas).

Fig. 18. *Ankistrodesmus nitzschioides*, sp. n. × 500.

19. *Pediastrum simplex*, Meyen. × 500. Small 4-celled coenobium in which one cell has been aborted.

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Fig. 20. *Pediastrum simplex*, Meyen. × 500. Curious abnormal form in which the coenobium is not strictly plate-like. Some of the cells, such as a, are like those of typical *P. simplex*; b is similar to the peripheral cells of *P. Boryamim*, and c like those of *P. Kaivraiskyi*, Schmidle; g., resting gonidium (aplanospore).


**Plate 6.**

7. *lacunatum*, sp. n. × 520.
8. *Tanganyikæ*, sp. n. × 520.
17. *Micrasterias Cunningtonii*, sp. n. × 520.
18. *Navicula obtusiuscula*, sp. n. × 500.
19. *Navicula Tanganyikæ*, sp. n. × 500.
20. *Navicula Tanganyikæ*, sp. n. × 500.
23. *Gyrosigma nodiferum*, (Grun.) nob. × 500.
24. *Micrasterias Cunningtonii*, sp. n. × 520.
25. *Navicula obtusiuscula*, sp. n. × 500.
27. *Navicula Tanganyikæ*, sp. n. × 500.
OF THE THIRD TANGANYIKA EXPEDITION.

Plate 9.

Fig. 1. *Peridinium africanum*, Lemm., sp. n. × 750. a, ventral view; b, dorsal view; c, hypovalve; d, epivalve; e, cyst. (After drawings by Lemmermann.)

2. *Peridiniumopsis Cunninghamii*, Lemm., sp. n. × 750. a, ventral view; b, dorsal view; c, lateral view; d, epivalve; e, hypovalve. (After drawings by Lemmermann.)

3. *Peridinium berolinense*, Lemm., var. *apiculatum*, Lemm., var. n. × 750. a, dorsal view; b, ventral view; c, lateral view. (After drawings by Lemmermann.)

4. *Ceratium Hirundinella*, O. F. Mull. × 500. Small reduced form from Victoria Nyanza. The markings are only shown on a small portion of the cell.


6. *laxissima*, sp. n. × 1000.

7. *Lyngbya circumcrescum*, sp. n. × 520. a, b, and c, three specimens to show the coiling of the filaments.


9. *Oscillatoria Tanganyika*, sp. n. × 500. a, b, and c, apices of three filaments; d, middle part of filament. The large granules are probably gas-vacuoles.

Plate 10.

Fig. 1. *Anabena Floraqua*, Bréb. forma. × 520.

2. "" var. *circularis*, var. n. × 520. a-d show normal coiling, the short filaments being terminated at each end by a heterocyst; e, a straight filament.

3. *Anabena Tanganyika*, sp. n. × 520. d, filament with spore (sp.).


5. *Gloeotrichia longiarticulata*, sp. n. a, floating colony, × 10; b-d, bases of trichomes; e and f, spores. b-f, × 520.

6. *Rivularia globiceps*, sp. n. a, colonies attached to floating fragment of leaf, natural size; b-d, bases of trichomes. × 520.

7. *Calothrix cartilaginosa*, sp. n. × 500. a-d, trichomes in different stages; e, middle portion of old trichome with well-marked sheath; f, hormeone.

8. *Calothrix brevissima*, sp. n. a-e, group of complete filaments, × 500; d and e each possess two basal heterocysts.

ADDENDA.

DESMIDIACEæ.


Long. 74 μ; lat. 29 μ; lat. constrict. 26 μ; lat. apic. 14 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).
Long. 74 µ; lat. 49 µ; lat. isthm. 45 µ.
**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).
This species has only previously been recorded from Madagascar.

Long. 80/4 µ; lat. 47 µ; lat. isthm. 21 µ.
**Victoria Nyanza.**—In swamp, Bukoba (20 Apr. 1905; no. 251).

**PROTOCOCCACEÆ (AUTOSPORACEÆ).**

**Tanganyika.**—In swamp, Kituta (23 Aug. 1904; no. 72).

**SCYTONEMACÆ.**

Crass. fil. 16·5-20 µ; crass. trich. 11-12 µ; long. heterocyst. 14·5-20 µ, lat. 10-11·5 µ.
Spore quadratae, angulis levissimae rotundatis; episporio glabro; long. et lat. 14 µ.
**Nyasa.**—In swamp, Karonga (2 July, 1904; nos. 33 and 34).
The filaments and pseudo-rami were elongated and flexuose. The strong hyaline sheaths, which were turning yellow or yellow-brown in the older portions, were firm and slightly lamellose. The cells were subquadrature, sometimes a little longer than the diameter, of a bright blue-green colour, and often contained a few large granules of much deeper colour. Some filaments were noticed with mature spores. They were seriate, as many as 40 occurring in a chain, and in form were quadrature with slightly rounded angles. Each spore had arisen from a single vegetative cell and possessed a smooth straw-coloured episporium. Borzi (in N. Giornale Bot. Ital. xi. 1879, p. 368) has described the occurrence of globose or ellipsoid spores in this genus, but those observed in *S. coactile* were all quadrature and reminded one very forcibly of the seriate spores of species of *Hapalosiphon*.

**CHROOCOCCACEÆ.**

378. ** Asterocystis africana**, sp. n.
Plantaæ minutæ et epiphytææ; filis brevibus, vaginatis, subdichotomæ ramosis, ramis late patentibus, e serie singula cellularum formatis; vaginis latis et hyalinis; cellulis oblongo-quadratis vel oblongis, diametro usque ad
duplo longioribus, polis subrotundatis; cytoplasmate lāete æruginoso et granuloso (fere ut in Chroococce turgido).

Long. cell. 5.5–10 μ; lat. cell. 4.5–5.5 μ; crass. vag. 11–15 μ (usque ad 27 μ).

**Tanganyika.**—Epiphytic on *Chatomorpha Linum*, floating in Kituta Bay (26 Aug. 1904; no. 79).

This plant belongs unquestionably to the Chroococcaceae, the cells having very much the same structure as those of *Chroococcus*. It would fall naturally into Hansgirg’s genus *Chroodactylon* (Ber. Deutsch. Bot. Ges. i. (1885) t. 3), but for the fact that Hansgirg has since placed both *Asterozystis*, Gobi (1879), and his own genus *Chroodactylon* (1885) as sections of “*Allogonium*, Kütz.” (*vide* Hedwigia (1887), Heft 1). Although Hansgirg was in error in reviving “*Allogonium*,” a name given by Kützing to a number of Algae of widely different affinities and all of which are now placed in other genera, yet he was evidently of the opinion that *Asterozystis* and *Chroodactylon* were scarcely distinct. It is for this reason that I have placed the African plant as a species of the former genus. Schmitz (in Engl. Natür. Pflanzenfam. 1 Teil, Abt. 2, p. 314) places *Asterozystis* in the Bangiaceae, but the species observed from Tanganyika is a typical Blue-green Alga.

The colonies of *Asterozystis africana* reach a diameter across the spreading branches of about 360 μ. The gelatinous sheath at the base of the primary filament is somewhat expanded and is firmly attached to the wall of the *Chatomorpha*, in which it makes a pit-like depression often 14 μ in depth.

**Naviculaceae.**


*Nyasa.*—In scrapings from bottom of s.s. ‘Guendolen’ at S. end of lake (15 June, 1904; no. 577).

**Gomphonemaceae.**


**Tanganyika.**—On the bottom of Dr. Cunningtons’s dau (24 Jan. 1905; no. 217).

The University, Birmingham, 19th March, 1907.
PLANKTON from VICTORIA NYANZA.
PLANKTON from TANGANYIKA.
AFRICAN ALGAE.
AFRICAN ALGAE.
AFRICAN ALGAE
AFRICAN ALGAE
INTERNATIONAL CATALOGUE OF
SCIENTIFIC LITERATURE.

The Royal Society has been engaged for some years past in arranging for the publication of an International Catalogue of Scientific Literature, beginning from the 1st January, 1901. Each science is represented in an annual volume containing lists arranged under authors and subjects, of all books and papers published during the year; these are contributed through official channels of information—abroad, by direct control of the respective governments—at home, by means of the various Societies which devote themselves to particular sciences; those Societies whose domains overlap having arranged for mutual cooperation.

The collection of title-slips for the United Kingdom of Great Britain and Ireland as regards

BOTANY

has been undertaken by the Council of the Linnean Society, and they appeal to all botanic workers for support in their endeavour to compile a complete record, by sending notices promptly of all botanic issues to the undersigned.

The fifth volume, for 1905, will shortly be issued.

B. DAYDON JACKSON,
General Secretary, Linn. Soc.
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The Catalogue of the Library may be had on application. Price to Fellows, 5s.; to the Public, 10s.

All communications relating to the general business of the Society should be addressed to the General Secretary, but letters on library business only may be addressed to the "Librarian."
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I. On the Distribution of the Species of Conifers in the several Districts of China, and on the Occurrence of the same Species in neighbouring Countries. By the late Maxwell T. Masters, M.D., F.R.S., F.L.S., Corresponding Member of the Institute of France (Académie des Sciences) ........................................... 198


London:
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WILLIAMS AND NORGATE.
1908.
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F. N. Williams, Esq.
Dr. A. Smith Woodward, F.R.S.
duplo longioribus, polis subrotundatis; cytoplasmate lâte aëriginoso et granuloso (fere ut in Chroococc turgido).

Long. cell. 5:5–10 μ; lat. cell. 4:5–5:5 μ; crass. vag. 11–15 μ (usque ad 27 μ).

**Tanganyika.**—Epiphytic on *Chætomorpha Linum*, floating in Kituta Bay (26 Aug. 1904; no. 79).

This plant belongs unquestionably to the Chroococcaceæ, the cells having very much the same structure as those of *Chroococcus*. It would fall naturally into Hansgirg's genus *Chroodactylon* (Ber. Deutsch. Bot. Ges. i. (1885) t. 3), but for the fact that Hansgirg has since placed both *Asterocystis*, Gobi (1879), and his own genus *Chroodactylon* (1885) as sections of "Allogonium, Kütz." (vide Hedwigia (1887), Heft 1). Although Hansgirg was in error in reviving "Allogonium," a name given by Kützing to a number of Algaë of widely different affinities and all of which are now placed in other genera, yet he was evidently of the opinion that *Asterocystis* and *Chroodactylon* were scarcely distinct. It is for this reason that I have placed the African plant as a species of the former genus. Schmitz (in Engl. Natur. Pflanzenfam. 1 Teil, Abt. 2, p. 314) places *Asterocystis* in the Bangiaceæ, but the species observed from Tanganyika is a typical Blue-green Alga.

The colonies of *Asterocystis africana* reach a diameter across the spreading branches of about 360 μ. The gelatinous sheath at the base of the primary filament is somewhat expanded and is firmly attached to the wall of the *Chætomorpha*, in which it makes a pit-like depression often 14 μ in depth.

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[Read 20th June, 1907.]

The recent researches of Mr. E. H. Wilson in Sze-Chuan have brought to light a remarkably large number of new Conifers, which have been described by myself in the 'Journal' of the Society* and elsewhere. To Dr. Henry we are also indebted for the discovery of new species in Central China and Yunnan. The discoveries of Delavay and Franchet had been previously noted by Franchet. This large accession of hitherto undiscovered species provides matter for the consideration of the botanical geographer, and it is with a view of facilitating his task that I now venture to lay before the Society some details relating to the distribution of the Coniferae and Taxaceae in the various provinces of China and in neighbouring countries. For reasons which will readily be understood, the figures given must be taken as only approximately correct, as they are likely to be more or less modified as errors are detected and our acquaintance with the details becomes widened. Some discrepancies between the figures and details here given and those published in former communications, especially in my paper on the Conifers of Japan†, are to be accounted for, not only by the increased number of species now known, but by the transfer of certain species from one genus to another; but these discrepancies do not affect the general conclusions arrived at.

The total number of species now known from China, inclusive of Formosa, amounts to 87, distributed through 23 genera, as shown in Table I.

Speaking broadly, a marked difference may be noted in the Coniferous floras of Northern, Southern, Central, and Western China respectively. Thus in the north we have such Pines as *Pinus Bungeana*, as well as *Picea obovata*, *Abies firma*, *A. Veitchii*, and two or three species of Larch, all indicating an approximation to the Flora of Japan and even of Northern Asia.

The Southern species are of a tropical or subtropical category. Among them are species of *Podocarpus*, also *Pinus Massoniana*, which, though it occurs in other parts of China, is more particularly a characteristic of the South, and indicates an approach to the Flora of the Philippine Islands, although there are no species in common. In Central China the Coniferous elements are mixed, but, so far as at present known, *Pinus Henryi* and *P. scipioniformis*

CONIFERS IN CHINA AND NEIGHBOURING COUNTRIES.

Table I.—Showing the Distribution of the Genera of Conifers in China and Japan.

<table>
<thead>
<tr>
<th></th>
<th>CHINA.</th>
<th>JAPAN.</th>
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<tr>
<td></td>
<td>Total</td>
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<tr>
<td>Libocedrus</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Thuja</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cupressus (including Chamaecyparis)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Juniperus</td>
<td>7</td>
<td></td>
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<tr>
<td>Cryptomeria</td>
<td>1</td>
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<td>Taxus</td>
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<td></td>
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<tr>
<td>Torreyana</td>
<td>2</td>
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<td>Ginkgo</td>
<td>1</td>
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<tr>
<td>Pseudotsuga</td>
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<tr>
<td>Abies</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Pseudolarix</td>
<td>8</td>
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<tr>
<td>Totals</td>
<td>87</td>
<td>42</td>
</tr>
</tbody>
</table>

are peculiar to this region, as well as Picea Neoveitchii, P. Wilsoni, and Abies Fargesii.

In South-Western China we have an approximation to the tropical Floras of Burma and neighbouring countries, as is evidenced by the presence of some species of Cephalotaxus, Podocarpus, Pinus yunnanensis, P. densata, and P. prominens. A relationship to the Floras of the Eastern Himalayas, Sikkim, and Assam is shown in certain species found in the West of China near the Tibetan frontier, especially certain species of Cephalotaxus, such as C. Oliveri, C. Mannii, Taxus baccata, certain species of Podocarpus, Pinus, Picea, Tsuga, Abies, and Larix.

The numbers of species in Japan, as indicated in Table I., show, on the whole, that there is a considerably less degree of relationship (so far as Conifers are concerned) between the Floras of the two countries than might have been anticipated. Hayata, however, points out that the Floras of Japan and Formosa have a close relation, notwithstanding the proximity of Formosa.
to the mainland of Southern China*. From the tables he gives it is apparent that Japan has 12 of the Formosan species of Conifers, or 70 per cent.; North China 7 = 41 per cent.; Central China 10 = 59 per cent.; India 1 = 6 per cent.

Japan and China have, says Hayata, a great number of Conifers in common with Formosa. But, so far as India is concerned, he finds only one species, Juniperus sinensis, common to the Floras of India, Japan, and Formosa. The same writer points out that North America has as many as 9 genera in common with Formosa, a fact which leads him to speculate on the possibility of a former land-connection between America and Formosa by way of the Aleutian and Kurile Islands, Japan, and the Loo-Choo Islands. Mr. Hayata shows that the Floras of Japan, Formosa, Central and North China are closely related to each other, forming one Chino-Japanese Flora, which he divides into two subdivisions or "florules," one including North China, Japan, and Formosa, the other including South and Central China.

With reference to the origin of Conifers still represented by living examples in the northern hemisphere, M. Flahault concludes from palaeobotanical evidence that they originated in the circumpolar regions of the Palaearctic continent. Thus species of Taxodium, Pinus, and Picea have been found in Tertiary or Oligocene deposits in Grinnell-land, lat. 81° 46' N.; whilst the Miocene of Greenland contains evidence of the presence of Taxodium, Glyptostrobus, Sequoia, Cephalotaxus or Taxus, Cupressus (§ Chamaecyparia), and Pinus. In the Miocene deposits of Spitzbergen, N. lat. 78°, the same genera with Picea and Abies, but excluding Cephalotaxus or Taxus, have been observed. Many of these genera have also been recognized in Siberia, Alaska, Sachalin, in polar Western America, and in Iceland. In Miocene times Sequoia, Taxodium, and Glyptostrobus existed in Western Europe. In Nebraska, U.S., at the same period Abies, Picea, and Larix were represented as they now are in Central Europe; whilst in more remote ages Araucarias were living in Oolitic times, Cedrus and Abies in infra-Cretaceous periods, and Podocarpus in Eocene times. These details are taken from Prof. Flahault's recent memoir on "Les progrès de la Géographie Botanique depuis 1884," in 'Progressus Rei Botanicae' (1907), p. 291.

The annexed Table II. gives an enumeration of all the species of Conifers known to inhabit Chinese territory. Their distribution in the several districts of the Empire—North, North-West, Central, East, West, South-West, South, and in the island of Formosa—is shown, together with an indication of the occurrence of the same species in neighbouring districts of Japan, Loo Choo, Corea, Manchuria, Eastern Himalayas, Assam, North Burma, Mongolia, and Siberia. So far as Tibet is concerned, the information at our disposal is at present too scanty to allow of definite statements. Wilson's researches on the

CONIFERS IN CHINA AND NEIGHBOURING COUNTRIES.

East Tibetan border are included in the columns relating to Western and South-Western China. Other indications point to an affinity between the species of Northern Tibet and Northern China.

The following remarks have reference to individual genera and species.

The Libocedrus was at first thought to be confined to Formosa, but it has since been found in Yunnan. Other species occur in New Zealand, the Chilian Andes, and N.W. America, but none has, so far, been detected in Japan. The genus is known to occur in the Cretaceous beds and in the Tertiary strata (Zeiller).

Thuja is represented by the widely-spread T. orientalis and by a species, T. sutchuenensis, found on the mountains of Sze-Chuan, and closely allied to the N.W. American T. plicata, Donn, and to the Japanese T. japonica. Three species are named as occurring in Japan, of which two are peculiar to that country.

Cupressus has one species peculiar to Formosa, whilst the elegant C. funebris is found also in Sikkim, but perhaps only in a cultivated state. C. sempervirens has been probably introduced. It is noteworthy that up to the present time no species of the section Chamaecyparis has been met with in China, nor any Retinospora (so called) such as are so common in Japan.

There are seven species of Juniperus indicated, but none peculiar to China unless as a varietal form. The species occur in the Temperate Himalaya, Japan, Siberia, and even Europe. J. sinensis is remarkable for the frequency with which it retains in adult life the juvenile or Retinospora stage of foliage, even on the same branch with the adult leaves. Five species of Juniperus are known from Japan, of which J. nipponica is peculiar to that country.

Cryptomeria is probably only cultivated in China, but native to Japan.

Taiwania is a newly described genus from Formosa (see Hayata, in Journ. Linn. Soc., Bot. vol. xxxvii. (1906) p. 330, pl. 16).

Glyptostrobus heterophyllus is peculiar to Southern China. It is allied to but distinct from the Taxodium of Florida, of California, and of Mexico*.

Of Cephalotaxus there are six species, of which only one, C. Fortunei, is peculiar to China. Three species are found in Japan, of which one is peculiar to that country. C. Mannii has been discovered in the Eastern Himalayas as well as in Western China.

Taxus is represented by T. baccata, which is well-nigh ubiquitous in the northern hemisphere. Whether there is one variable species or several specifically distinct is a question upon which botanists are not agreed†.

† See Pilger, in 'Pflanzenreich,' Taxaceae (1903), p. 110.
Table II.—Containing a list of all the species of Conifers known to be natives of China and showing their distribution in the various districts of the Empire as well as in neighbouring countries.

<table>
<thead>
<tr>
<th>Species</th>
<th>North China</th>
<th>North-West China</th>
<th>Central China</th>
<th>East China</th>
<th>West China</th>
<th>South-West China</th>
<th>South China</th>
<th>Formosa</th>
<th>Japan &amp; Lou Choo</th>
<th>Korea</th>
<th>Manchuria</th>
<th>E. Himalaya</th>
<th>Assam &amp; N. Burma</th>
<th>Mongolia</th>
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Torreya grandis and *T. Fargesii* are exclusively Chinese, whilst *T. nucifera* occurs also in Japan.

Ginkgo biloba, an interesting survival of over sixty species known in a fossil state, is found both in China and in Japan generally in a cultivated condition in the vicinity of the temples, but Mrs. Bishop records it as native both in Western China and in Northern Japan.

Dacrydium Beccarii of Parlatare is reported from Hainan, but I have no information concerning it. Pilger, in the 'Pflanzenreich,' *Taxaceae* (1903) p. 52, does not mention it as native to China.

Six species of Podocarpus are enumerated, but their identification is by no means certain. Two species are probably exclusively Chinese, viz., *P. argotetania*, Hance, and *P. sutchuenensis*, Franchet. The others are found also in Japan (three species), the Malay Peninsula, &c. Pilger mentions *P. chinensis*, of Blume, at p. 93, but gives no locality. The same author refers *P. argotetania* to a separate genus.

Cunninghamia sinensis is exclusively Chinese and Formosan.

Sciadopitys is exclusively Japanese.

Of *Pinus* no fewer than thirteen species are recorded from China. Of these at least seven, so far as at present known, are peculiar to that country. They are *P. scipioniformis*, Mast., *P. yunnanensis*, Franchet, *P. Armandi*, Franchet, *P. Bungeana*, Zuccarini, *P. Henryi*, Mast., *P. densata*, Mast., *P. prominens*, Mast. The remaining Chinese species are natives also of Japan, Korea, and Manchuria. *P. yunnanensis* is allied to *P. khasya*, from the Himalaya, to a species collected in Manipur by Sir George Watt, as well as to *P. insularis* from the Philippines *. Five species in all are recorded from Japan and Loo Choo (not including varieties).

*Picea*, Link, is exceptionally well represented in China, there being no fewer than fourteen species recorded, of which nine are endemic. One species belongs to the flat-leaved section, of which the Japanese *P. ajanensis* forms one member, *P. sitchensis*, from N.W. America, another, whilst S.E. Europe has its representative in *P. Omorica*. Other Chinese Spruces with four-sided leaves occur on the mountains of Western China, Sze-Chuan, Yunnan, and especially on the mountains by the Tibet border; such are *P. Watsoniana*, in addition to *P. purpurea* and *aesperata*. From Japan only five species have been recorded, *P. polita* being the only peculiar species.

It would thus seem that Western China was an important centre of distribution for species of *Pinus* and *Picea*, and to a less extent for species of *Abies*.

* See Brandis, 'Indian Trees' (1906), p. 690.
Keteleeria is represented by four species, all endemic and occurring in Central, Western, and Southern China, including one remarkable species, *K. Evelyniana*, discovered by Dr. Henry in Yunnan.

Tsuga has from three to five species enumerated, of which *T. chinensis* and *T. yunnanensis* are confined to China, the other species being found also in Japan, and one, *T. Brunoniana*, in the Eastern Himalayas. There are two American species, one on the Atlantic, the other on the Pacific side of the Northern United States. It seems probable that some of the reputed Chinese species will hereafter not be considered distinct, but as varieties of *T. Sieboldii*.

Pseudotsuga japonica, the analogue of the Douglas Fir of N.W. America, occurs in Japan and also in Formosa.

Abies, including the Silver Firs, is credited with seven species, of which some are common to Japan and four are peculiar to China. Of these four, two are remarkable species discovered by Wilson in the Min Valley and near Tatien-lu. Six species inhabit Japan, three exclusively. Some of the West Chinese species indicate an affinity with *A. Webbiana* and other East Himalayan species.

Pseudolarix Fortunei, Mayr, is the only representative of the genus, and occurs in Chekiang and Kiukiang.

Of the true Larches, Larix, eight species are enumerated, but they are not well defined, and it is probable that with increased knowledge some may be reduced. Four are recorded from China only, and one, *L. Griffithii*, which occurs in West Sze-Chuan, is found also in the Eastern Himalaya. A single species is peculiar to Japan.
On the Pre-Glacial Flora of Britain.

By Clement Reid, F.R.S., F.L.S., and Eleanor M. Reid, B.Sc.

(Plates 11-15.)

[Read 20th June, 1907.]

The plants living in Britain immediately before the cold of the Glacial Epoch have attracted attention for many years. A certain number of species were collected as far back as 1861 by the Rev. S. W. King. These were determined by Heer, and Lyell published his list, amounting to twelve species *. A few more were added later on; but in 1877, when the Geological Survey commenced the examination of the Norfolk and Suffolk coast, the list was still under twenty species.

In the course of this survey a number of seeds and leaves were collected (by C. R.), and this collection, which was mainly determined by Mr. Carruthers, amounted to nearly thirty species †. It is now in the Museum of Practical Geology, as is the King collection. This small list was of so much interest that after the survey was finished the work was continued during holiday visits. A collection of ripe seeds of British plants (so poorly represented in recent herbaria) was slowly formed, and the fossil flora gradually crept up to fifty-six species in 1890 ‡, and to seventy-eight in 1899 §.

The work of the last few years has led to the discovery of so many additions to this meagre list, that the time has now arrived for a revision of our pre-Glacial flora. This is the more necessary, as on the character of this flora depends the geologist's view of the climatic conditions which then prevailed. We want also to take a census of the plants, in order to understand what amount of change and extermination took place during the forced migrations consequent on the cold period which supervened. And, thirdly, we should like to know what variation the species have undergone during a period of many thousand years. *

As regards the certainty of the determinations, it may be as well to say at once that in the case of seeds and fruits—and it is on these that we mainly rely—there is seldom any doubt in either recent or well-preserved fossil specimens. Almost every species that can be distinguished by other characters can be distinguished also by the seed alone; and often the seed or fruit, though apparently undescribed, gives better specific characters than the whole of the rest of the plant. The cases where there is doubt are usually seeds of plants belonging to closely allied species, which give almost as much difficulty when we compare the whole plant. Thus we do not

§ C. Reid, 'The Origin of the British Flora,' 8vo, 1899.
pretend to be able to distinguish the different fruticose Rubi by their stones, nor can we find satisfactory specific characters in the carpels of Rosa, or of the Batrachian Ranunculi. The closely allied Stellaria media, S. Boraeana, and S. neglecta, however, have seeds noticeably different; Arum maculatum and A. italicum have seeds remarkably distinct.

Seeds (or the hard parts of fruits) being thus critically distinguishable, it seems advisable to place on record the evidence by which we have been guided in determining the fossil plants. This is the more necessary as many of the seeds are impregnated with pyrites, which tends to decompose and to destroy the specimen. For this reason it is important to preserve exact photographic representations, so that if the fossil itself disappears there may still be a satisfactory record of its discovery.

Fruits and seeds of our recent plants are seldom figured and described in such a way as to enable the botanist to recognise them specifically, especially if detached from the plant. Seeds are constantly described as smooth or shining, when in reality they have a highly characteristic sculpture, only masked by a coat of varnish. Our fossil fruits and seeds also are preserved in an altered state, the alteration in some cases being so great that their identity with the living plants is not suspected until recent seeds have been reduced by maceration or carbonising to a similar condition. It is not that the fossils are less determinable than the recent, often the intricate patterns on the outside are far clearer. But any botanist finding, for instance, fossil fruits of Conium in the state of preservation shown on Pl. 12. fig. 60 would not recognise them, unless he had treated the recent fruits in such a way as to remove their ridges. In this case slow carbonising shows the identity of the recent with the fossil fruit, and this carbonising also causes the recent fruit to shrink till it is as small as the fossil specimens. This difficulty of comparison has given much trouble, and in many cases we have had the fossil for years before we recognised it as being the seed or fruit of a common British plant.

It would need a large number of magnified photographs to illustrate all the details of cell-structure, etc., on which our determinations have been based; but the figures and descriptions now given should be sufficient at any rate to help the botanist, and to prevent the geologist and archaeologist from throwing away what looks like most unpromising material for the study of an ancient flora.

The mode of collecting and washing the material need not again be described; but a few words are required as to the best methods of preserving the seeds in such a state as to be fit for study. One remark, however, must be made as to the preliminary work. Fossil seeds if possible should not be allowed to dry, at any rate not after they have been taken out of the

* We have not thought it necessary to reproduce our photographs of the leaves, as the forms and venation of leaves are well known, and the specimens themselves are generally preserved in slabs of ironstone.
clay in which they are found. In drying they shrink, become distorted, or often crack and fall to pieces. It is generally necessary, however, to dry the lumps of clay in which the seeds are contained, or they will not fall to pieces when placed in water; but this drying when tightly packed in a rigid matrix does comparatively little harm. After the clay has fallen to pieces in water the seeds should be collected while still wet and transferred from dish to dish of clean water, till they are in a fit state for the next process.

Pyritised fossils can be preserved fairly well under water; but in this wet state they can neither be studied conveniently nor photographed. If absolute alcohol is used for drying, the seed shrinks and is injured. We wish to preserve them in such a way that they can be safely handled, turned over, compared side by side with recent seeds, and, if necessary, dissected. They must therefore be impregnated with some medium that will protect the pyrite granules from the air, that will prevent the seed from becoming distorted or falling to pieces, and that will leave the surface sculpture intact and in a state fit for photographing. The process must not be too elaborate, as we have to deal with thousands of seeds in a short time.

The method we now employ is as follows:—The specimens are removed a few at a time from the store-bottles in which they have accumulated, and are washed in clean water to remove the weak formalin or salicylic acid used for their temporary preservation. A thin film of wax (we have used "paraffin filtr. 45° Grünler & Co.") is melted on a glass plate or slide and allowed to harden. The seeds or leaves are removed from the water and are placed, still wet, on the prepared film; the plate is then immediately warmed from below to a temperature just sufficient to melt the wax. As the moisture evaporates from the upper surface of the specimen the wax is absorbed from the lower, and in a few minutes, unless the seed is very large, the process is complete, the whole seed is impregnated with wax, and it is rendered so tough that it can easily be handled.

When the seeds have absorbed as much wax as they can, they are transferred to a clean part of the plate and the superfluous wax is removed with warm filter-paper; or they can be allowed to cool thoroughly and then have their surfaces brushed with benzine. If one surface of the seed is better preserved than another, that surface should be placed in contact with the wax, for the lower surface remains uninjured and flat even if the upper surface suffers slightly.

In the determination of the species now to be recorded, we have received invaluable assistance from the British Museum and Kew collections, and from recent seeds supplied to us by Mr. James Groves. Dr. Rendle also has kindly examined our specimens belonging to the genera Najas and Zannichellia, the discoveries in the former genus being recorded in his monograph*.

collection of recent seeds is steadily growing, but there are still too many species of which we have been unable to obtain ripe fruits ourselves, or to find perfectly ripe fruits in the herbaria. Until, also, we can obtain a more complete series of Palaearctic plants, it will be impossible to say whether some of the various undetermined seeds belong to living or to extinct species; we have decided therefore not at present to describe any species as new, though in all probability two or three are no longer living.

The plant-remains from the pre-Glacial deposits of the Norfolk and Suffolk coasts belong to the following species:—

Ranunculacece.

Thalictrum flavum, Linn.
Ranunculus aquatilis, Linn.
R. sceleratus, Linn.
R. Flammula, Linn.
R. Lingua, Linn.
R. repens, Linn.
R. nemorosus, DC.
R. sp. 7.
R. sp. 8.
Caltha palustris, Linn.

Nymphaeacece.

Nymphaea lutea, Linn. (Nuphar luteum, Sibth. & Sm.).
Castalia alba, Woods (Nymphaea alba, Linn.).
Two undetermined species.

Papaveracece.

Hypecoum procumbens, Linn.

Violacece.

Viola palustris, Linn.
V. cf. hirta, Linn.
V. cf. Riviniana, Reichb.

Caryophyllacece.

Stellaria aquatica, Moench.
S. media, Villars.
S. Holostea, Linn.
Arenaria serpyllifolia, Linn.

Elatinece.

Elatine Hydropiper, Linn.

Hypericacece.

Hypericum quadrangulum, Linn.
H. hirsutum, Linn.

Rhamnacece.

Rhamnus Frangula, Linn.

Sapindacece.

Acer campestre, Linn.

Rosacece.

Prunus spinosa, Linn.
Spiraea Ulmaria, Linn.
Rubus Idaeus, Linn.
R. fruticosus, Linn.
Potentilla silvestris, Neck.
Alchemilla arvensis, Scop.
Pyrus Aria, Ehrh.
P. Malus, Linn.
Crataegus Oxyacantha, Linn.
C. sp. 2.

Haloragacece.

Hippuris vulgaris, Linn.
Myriophyllum spicatum, Linn.

Onagracece.

Trapa natans, Linn.
Circea lutetiana, Linn.

Umbelliferece.

Conium maculatum, Linn.
Apium sp.
Cicuta virosa, Linn.
Cherophyllum sylvestre, Linn.
Oenanthe Lachenalii, C. C. Gmel.
O. Phellandrium, Linn.
Æthusa Cynapium, Linn.
Pastinaca sativa, Linn.
Heracleum Sphondylium, Linn.
Torilis Anthriscus, Bernh.
CORNACEÆ.
   Cornus sanguinea, Linn.

CAPRIFOLIACEÆ.
   Viburnum Opulus, Linn.
   V. sp. 2.
   V. sp. 3?

RUBIACEÆ.
   Galium Aparine, Linn.

VALERIANÆ.
   Valeriana sambucifolia, Willd.
   Valerianella oltoria, Poll.

COMPOSITÆ.
   Eupatorium sp.?
   Bidens tripartita, Linn.
   Tussilago Farfara, Linn.
   Arctium sp.
   Carduus nutans, Linn.
   C. cf. nutans.
   C. palustris, Linn.
   C. heterophyllus, Linn.
   Centaurea sp.
   Picris Hieracioides, Linn.
   Crepis succiscifolia, Tausch.
   Leontodon autumnalis, Linn.

GENTIANÆ.
   Menyanthes trifoliata, Linn.

SOLANACEÆ.
   Solanum Dulcamara, Linn.

SCROPHULARINEÆ.
   Verbasum Thapsus, Linn.
   Limosella aquatica, Linn.
   Veronica Chamaedrys, Linn.

LABIATÆ.
   Mentha aquatica, Linn.
   Lycopus europaeus, Linn.
   Calamintha arvensis, Lam.
   Prunella vulgaris, Linn.
   Stachys sylvatica, Linn.
   S. arvensis, Linn.
   Ballota nigra, Linn.
   Ajuga reptans, Linn.
   Two undetermined genera.

PLANTAGINÆ.
   Littorella juncea, Berg.

CHENOPODIACEÆ.
   Chenopodium album, Linn.
   C. rubrum, Linn.
   Atriplex hastata, Linn.?

POLYGONACEÆ.
   Polygonum Convulvulus, Linn.
   P. aviculare, Linn.
   P. Persicaria, Linn.
   P. amphibium, Linn.
   Rumex maritimus, Linn.
   R. obtusifolius, Linn.
   R. Hydrolapathum, Huds.
   R. acutus, Linn.?
   R. Acetosella, Linn.

EUPHORBIACEÆ.
   Euphorbia amygdaloides, Linn.

URTICACEÆ.
   Ulmus montana, Stokes?
   Urtica dioica, Linn.
   U. urens, Linn.?

CUPULIFERÆ.
   Betula alba, Linn.
   Alnus glutinosa, Gaertn.
   A. sp.
   Carpinus Betulus, Linn.
   Corylus Avellana, Linn.
   Quercus Robur, Linn.
   Fagus sylvatica, Linn.
   Salix cinerea, Linn.
   S. sp. 2.
   S. sp. 3.

CERATOPHYLLÆÆ.
   Ceratophyllum demersum, Linn.

CONIFERÆ.
   Taxus baccata, Linn.
   Pinus sylvestris, Linn.
   Picea excelsa, Link.

HYDROCHARIDEÆ.
   Stratiotes Aloides, Linn.
THE PRE-GLACIAL FLORA OF BRITAIN.

TYPHACEAE.

Sparganium erectum, Linn.

ALISMACEAE.

Alisma Plantago, Linn.
Sagittaria sagittifolia, Linn.

NAIADACEAE.

Potamogeton natans, Linn.
P. heterophyllus, Schreb.
P. prelongus, Wulf.
P. perfoliatus, Linn.
P. crispus, Linn.
P. obtusifolius, Mert. & Koch.
P. pusillus, Linn.
P. trichoides, Cham.
P. pectinatus, Linn.
Zannichellia palustris, Linn.
Z. pedunculata, Reichh.
Najas marina, Linn.
N. minor, Alioni.

CYPERACEAE.

Eleocharis sp.
Scirpus fluitans, Linn.
S. lacustris, Linn.
S. Tabernamontani, C. C. Gmel.
Eriophorum vaginatum, Linn.
Carex dioica, Linn.
C. muricata, Linn.
C. cf. helodes, Link.
C. hirta, Linn.
C. acutiformis, Ehrh.
C. riparia, Curtis.
C. rostrata, Stokes.
C. sp. 9.
C. sp. 10.
C. vesicaria, Linn.

GRAMINEAE.

Phragmites communis, Trin.

FILICICES.

Osmunda regalis, Linn.

NOTES ON THE PLANTS.

THALICTRUM FLAVUM, Linn. (Plate 11, fig. 1.)
Achenes are not uncommon at several localities. They agree exactly with recent specimens.

RANUNCULUS AQUATILIS, Linn. (Pl. 11. figs. 2, 3.)
Achenes are abundant and variable; but we are unable to separate the different species of Batrachian Ranunculi from fruits alone. We must therefore leave them under the Linnean aggregate Ranunculus aquaticus.

RANUNCULUS SCCELERATUS, Linn. (Pl. 11. fig. 4.)
Indistinguishable from recent achenes. Found rarely at Beeston, Cromer, and Pakefield.

RANUNCULUS FLAMMULA, Linn. (Pl. 11. fig. 5.)
As yet only found at Pakefield.

RANUNCULUS LINGUA, Linn. (Pl. 11. fig. 6.)
Calls for no remark. Achenes have been found at Beeston and Pakefield.
Ranunculus repens, Linn. (Pl. 11, fig. 7.)

Achenes are common at several localities and are usually well-preserved. They are clearly distinguishable both by their shape and the character of their puncation from R. acris and R. bulbosus, neither of which has yet been discovered.

Ranunculus nemorosus, DC. (Pl. 11, fig. 8.)

An achene resembling R. repens, but larger, with wider, more bevelled margin, sides more coarsely pitted, and ridges between the pits rounded instead of sharp. This agrees with R. nemorosus and does not correspond with any other European form. The species belongs to woods and shady places in Central and Southern Europe. The fossil was found at Pakefield.

Ranunculus sp. 7. (Pl. 11, fig. 9.)

A single achene of Ranunculus found at Beeston is very large, elongate oval, with terminal style, and no margin, the sides are rounded but pinched in. We can find no Ranunculus with achenes resembling this; it must wait for more specimens.

Ranunculus sp. 8. (Pl. 11, fig. 10.)

An achene from Pakefield, in shape much like R. Lingua, but the surface-pits are not elongated. We cannot match this; but require more specimens for thorough examination.

Caltha palustris, Linn. (Pl. 11, figs. 11, 12.)

Several seeds have been found at Mundesley and Pakefield; but the testa is so fragile that they are difficult to preserve.

Nymphaea lutea, Linn. (Nuphar luteum, Sibth. & Sm.). (Pl. 11, fig. 13.)

Abundant at various localities.

Caltha palustris, Linn. (Pl. 11, figs. 11, 12.)

Several seeds have been found at Mundesley and Pakefield; but the testa is so fragile that they are difficult to preserve.

Nymphaea lutea, Linn. (Nuphar luteum, Sibth. & Sm.). (Pl. 11, fig. 13.)

Abundant at various localities.

Castalia alba, Woods (Nymphaea alba, Linn.). (Pl. 11, fig. 14.)

This species was recorded in 1861 by the Rev. S. W. King, but till lately we could obtain no corroborative evidence, and some of Mr. King’s specimens were certainly derived from a more modern deposit than the Cromer Forest-bed. We have now found two seeds at Pakefield. They are much crushed and damaged; but still show the very characteristic surface-sculpture, of which, however, we have not obtained a satisfactory photograph.

Nymphaeaceae sp. 3. (Pl. 11, fig. 15.)

Seed smaller than N. lutea and differing in shape and surface-pittings. It shows the characteristic funnel-shaped infolding of the testa, into which the embrvotega fits, and the surface-sculpture also suggests Nymphaeaceae.
We require more material for the determination of this interesting seed, which belongs to no living water-lily of which we have yet been able to examine seeds.

**Nymphaeaceae sp. 4. (Pl. 11. fig. 16.)**

Two or three much damaged seeds that appear to belong to a fourth species of water-lily have been found at Pakefield. Length 4·3 mm.; testa with conspicuous rectangular pits arranged in lines. These also must wait for further material.

**Hypericum procumbens, Linn. (Pl. 11. fig. 17.)**

Seeds of this plant are common at Corton and correspond exactly with those of the recent plant, which belongs to the Mediterranean region and Southern France.

All the species of this genus have the seed protected by a close mosaic of cubic crystals of oxalate of lime. These impress the testa with quadrangular pits; and traces of these thin-walled quadrangular pits are to be found on several of our specimens.

**Viola palustris, Linn. (Pl. 11. fig. 18.)**

Damaged seeds of *Viola* are common at various localities, but are seldom sufficiently well preserved for determination. Fig. 18 corresponds with *Viola palustris*.

**Viola, cf. hirta, Linn. (Pl. 11. figs. 19, 20.)**

Many of the seeds of *Viola* belong to a larger form, closely resembling *V. hirta*, but slightly more slender than our recent seeds of that species.

**Viola, cf. Riviniana, Reichb. (Pl. 11. fig. 21.)**

The majority of the seeds of *Viola* belong to a third species. They closely resemble *V. Riviniana*, but are larger than our recent seeds.

**Stellaria aquatica, Moench. (Pl. 11. fig. 22.)**
**S. media, Villars. (Pl. 11. fig. 23.)**
**S. Holostea, Linn. (Pl. 11. fig. 24.)**

These correspond so exactly with the recent seeds that no remark is needed. They were all found at Pakefield.

** Arenaria serpyllifolia, Linn. (Pl. 11. fig. 25.)**

One perfect seed and one fragment are all that we have found of this species.

**Elatine Hydropiper, Linn. (Pl. 11. fig. 26.)**

Several seeds have been found at Pakefield.

Linn. Journ.—Botany, Vol. XXXVIII.
Hypericum quadrangulum, Linn. (Pl. 11. fig. 27.)

H. hirsutum, Linn. (Pl. 11. fig. 28.)

The shape and sculpture of the testa in the different species of Hypericum are very characteristic, and the fossil seeds are well preserved. We have only as yet found these two species.

Rhamnus Frangula, Linn. (Pl. 11. fig. 29.)

Seeds are very scarce, and have only been found at Pakefield.

Acer campestre, Linn. (Pl. 11. figs. 30, 31.)

Trees of this maple must have overhung the small channel at Pakefield, for seeds, fragments of wings, and broken leaves are very plentiful.

Rubus Idæus, Linn. (Pl. 12. fig. 34.)

Two or three characteristic stones have now been found; it is much more scarce than R. fruticosus.

Potentilla silvestris, Neck. (Pl. 12. figs. 36, 37.)

The carpels are very variable, but all seem referable to this species.

Alchemilla arvensis, Scop. (Pl. 12. fig. 38.)

A few nuts of this plant have been found at Pakefield.

Pyrus Aria, Ehrh.

We have only seen one damaged leaf of this tree. It is too black to photograph.

Crataegus Oxyacantha, Linn. (Pl. 12. figs. 40–44.)

This species has only been found at Overstrand, where the fruits are very variable. Five have been figured, to show the range of variation.

Crataegus sp.? (Pl. 12. fig. 45.)

The fruit figured seems to belong to a second species of Crataegus. We have only one specimen, which was found at Pakefield.

Trapa natans, Linn. (Pl. 12. figs. 49–56.)

Several specimens are figured, to show the variability of these fruits.

Cirsium lutetiana, Linn. (Pl. 12. fig. 59.)

Two fruits of this plant have been found at Pakefield. They are in a peculiar state of preservation, having lost their hooked hairs.
Conium maculatum, Linn. (Pl. 12, fig. 60.)
These are well preserved, though the ridges have been lost. Even in Roman deposits, in which the fruits are very abundant, the ridges have disappeared.

Apium sp. (Pl. 12, fig. 61.)
Fruits of Apium occur, but are never well preserved. As a rule the state of preservation of the Umbelliferae is not satisfactory.

Cherophyllum sylvestre, Linn. (Pl. 12, fig. 64.)
Two or three fruits of this plant have been found at Pakefield.

Genanthem Lachenalii, C. C. Gimel. (Pl. 13, fig. 65.)
A few damaged fruits have been found at Pakefield. The skeleton photographed is one of the best.

Genanthem Phellandrium, Lam. (Pl. 13, figs. 66, 67.)
Fruits of this plant are abundant everywhere; but are usually much smaller than recent specimens.

Æthusa Cynapium, Linn. (Pl. 13, figs. 68, 69.)
A few fruits occur at Pakefield.

Pastinaca sativa, Linn. (Pl. 13, fig. 70.)
Occurs at Pakefield and Trimingham.

Heracleum Sphondylium, Linn. (Pl. 13, fig. 71.)
Three specimens seen; all have the obcordate fruit here figured.

Torilis Anthriscus, Bernh. (Pl. 13, fig. 72.)
Two characteristic fruits have been found at Pakefield.

Viburnum Opulus, Linn. (Pl. 13, fig. 74.)
Only two seeds have been found.

Viburnum sp. 2. (Pl. 13, figs. 75–77.)
At Pakefield about 30 or 40 flat or plano-convex seeds belonging apparently to a second species of Viburnum have been found. They are about the size of V. Tinus, but in other respects do not agree with that species. The fossil seeds are oval, the ventral face is flat or slightly rounded and channelled, the dorsal face has two ridges which are not quite symmetrical, the testa is very thick. Length 3 mm., breadth 2 mm.

At first, from their general appearance and their slight want of symmetry, these seeds were thought to belong to Lonicera; but in that genus the testa
is thin, not exceptionally thick as in our fossil. They appear to belong to Caprifoliaceae, but we can find no European plant to which they can be referred. Only three species of *Viburnum* now inhabit Europe.

**Viburnum** sp. 3. (Pl. 13, figs. 78, 79.)

About a dozen large woody seeds found at Pakefield seem to belong to a third species of *Viburnum*. Seed oval, flattened; ventral face slightly rounded and channelled, dorsal face rounded and obscurely, irregularly ridged longitudinally. Length 7 mm., breadth 5 mm. These seeds obviously belong to the same genus as the last, but are more than double the length. We can find nothing to correspond with them.

Many fossil species of *Viburnum* have been described, but always from leaves. Until we have further material, both recent and fossil, we cannot give a name to the Pakefield specimens.

**Galium aparine**, Linn. (Pl. 13, fig. 80.)

This plant occurs at Pakefield, but the fruits have entirely lost their outer coat and hooked bristles.

**Valeriana sambucifolia**, Willd. (Pl. 13, fig. 81.)

The only fruit of *Valeriana* is so crumpled that it cannot be photographed satisfactorily; it certainly belongs to this species.

**Valerianella olitoria**, Poll. (Pl. 13, fig. 82.)

One fruit, crushed so as to expose the seed, and a few detached seeds are all that we have seen. The coarse punctation of the seed is very marked, and characteristic of this species.

**Eupatorium** sp.? (Pl. 13, fig. 83.)

A minute composite fruit with linear shape and five sharp ridges would appear to belong to this genus, but we have not been able to identify it. *Eupatorium cannabinum* has not yet been found in pre-Glacial deposits, though its fruits are not uncommon in newer strata.

**Tussilago Farfara**, Linn. (Pl. 13, fig. 85.)

Two or three characteristic fruits have been found at Pakefield.

**Arctium** sp. (Pl. 13, figs. 86, 87.)

Two different forms of fruit of *Arctium* have been found; but we cannot satisfactorily determine them without more recent material.

**Carduus nutans**, Linn. (Pl. 13, figs. 88, 89.)

Not uncommon in the Cromer Forest-bed.
Carduus, cf. nutans, Linn.  (Pl. 13. fig. 90.)
Fruits like C. nutans, but with finer sculpture and without longitudinal ribs. We find this species occurring also in a deposit of slightly older date at Tegelen in the Netherlands. The Pakefield seeds vary considerably in size, the one figured is large.
Our series of recent fruits of Carduus is still very imperfect, and in herbarium specimens the fruits are seldom ripe. The fossil may belong to some well-known continental plant.

Carduus palustris, Linn.  (Pl. 13. fig. 91.)
A few fruits have been found at Pakefield.

Carduus lanceolatus, Willd. ?
This species has been recorded with doubt (‘Origin of the British Flora’) but the specimen was badly preserved and we can find no others.

Carduus heterophyllus, Linn.?  (Pl. 13. fig. 92.)
The coarse rugose sculpture of the fruit figured corresponds so closely with that of C. heterophyllus, that we must refer our fossil to that species. We have only one specimen, and this is the only plant at Pakefield that suggests northern rather than southern latitudes.

Centaurea sp.  (Pl. 13. figs. 93, 94.)
Two fruits of Centaurea have been found at Pakefield, probably representing two species. The fruit shown in fig. 94 corresponds with C. Calceolata, and with no other British form. But there are so many European species of this genus the fruits of which we have yet been unable to examine, that we hesitate to refer our fossil to a species belonging so markedly to dry soils.

Crepis succisaeefolia, Tausch.  (Pl. 13. fig. 96.)
Not uncommon at Pakefield.

Leontodon autumnalis, Linn.  (Pl. 13. fig. 97.)
Occurs rarely at Pakefield.

Verbascum thapsus, Linn.  (Pl. 14. fig. 102.)
A single seed has been found at Pakefield. The species in this genus are readily distinguished by their seeds.

Limosella aquatica, Linn.  (Pl. 14. fig. 103.)
Only one specimen has been found; but the seed is so small that it may easily be overlooked, or lost in washing the clay.
Veronica Chamædrys, Linn. (Pl. 14. fig. 104.)

Seeds of Veronica are not uncommon; but are usually decayed in such a curious way that they are not easily recognised. The determinable specimens belong to V. Chamædrys, and as yet we can find no trace of our three aquatic species.

Calamintha arvensis, Lam. (Pl. 14. fig. 109.)

Prunella vulgaris, Linn. (Pl. 14. fig. 110.)

A few nutlets of each of these have been found at Pakefield.

Stachys sylvatica, Linn. (Pl. 14. fig. 111.)

Not uncommon. The nutlets previously referred to S. palustris belong to this species. We cannot yet find S. palustris.

Stachys arvensis, Linn. (Pl. 14. fig. 112.)

Two nutlets from Pakefield show the characteristic rugosity and punctation of this species.

Ballota nigra, Linn. (Pl. 14. fig. 113.)

Rare at Pakefield.

Ajuga reptans, Linn. (Pl. 14. fig. 114.)

The illustration represents the only specimen yet found. It is unfortunately so crushed that it is difficult to show the characters in a photograph. The nutlet shows, however, the enormous aperture and reticulated back characteristic of this species.

Labiate, genus undetermined. (Pl. 14. fig. 115.)

Nutlets ovate, rounded above, sharp below, with a very sharp prominent ventral ridge; sculpture of fine, very regular punctation (thimble-pitting), without rugosity or tubercles. Length 1'6 mm., breadth 1'0 mm.

This belongs to no British plant. We have few fruits of foreign labiates to compare with it, and only unripe nutlets are usually to be found in herbaria.

Labiate, genus undetermined. (Pl. 14. fig. 116.)

Nutlet broad, very tumid and rugose, with sharp ventral ridge. Length 1'8 mm., breadth 1'25 mm.

This also belongs to no living British plant; but we have found a similar nutlet in a somewhat older deposit at Tegelen in the Netherlands.

Littorella juncea, Berg. (Pl. 14. fig. 117.)

Two fruits only have been found, but they correspond exactly with those of the recent plant.
Chenopodium album, Linn. (Pl. 14. fig. 118.)

C. rubrum, Linn. (Pl. 14. fig. 119.)

Call for no remark; they correspond with recent seeds.

Atriplex hastata, Linn. (Pl. 14. fig. 120.)

After examining a number of specimens we have come to the conclusion that the seeds previously referred to A. patula must all be referred to this species; but we can only find seeds of one size.

Polygonum convolvulus, Linn. (Pl. 14. fig. 121.)

A single nut with part of the perianth has been found at Pakefield.

Polygonum aviculare, Linn. (Pl. 14. fig. 122.)

A few nuts have been found; the one figured has part of the perianth attached.

Polygonum Persicaria, Linn. (Pl. 14. fig. 123.)

Nuts somewhat smaller than our recent specimens, but otherwise correspond.

Polygonum amphibium, Linn. (Pl. 14. fig. 124.)

Agrees exactly.

Rumex maritimus, Linn. (Pl. 14. figs. 125, 126.)

Abundant and somewhat variable. Two forms are figured.

Rumex obtusifolius, Linn. (Pl. 14. fig. 127.)

Shows the characteristic venation of the fruiting sepals.

Rumex Hydrolapathum, Huds. (Pl. 14. fig. 128.)

A very large nut with remains of the fruiting sepals can only be referred to this species.

Rumex acutus, Linn.? (Pl. 14. fig. 129.)

A specimen showing fruiting-perianth with no tubercle, without nut, seems very close to Rumex acutus. The venation does not correspond with either R. crispus or R. obtusifolius.

Rumex Acetosella, Linn. (Pl. 14. fig. 130.)

A nut in skeleton fruiting-perianth, showing the characteristic venation.

Ulmus montana, Stokes?

Leaves have been found in the ironstone of Happisburgh; but we cannot get a satisfactory photograph.
Urtica dioica, Linn. (Pl. 14. fig. 132.)
U. urens, Linn.? (Pl. 14. fig. 133.)

These two species are not uncommon; but the sculpture of the nut referred to *U. urens* differs slightly from our recent specimens.

Alnus glutinosa, Gaertn. (Pl. 14. figs. 135, 136.)
A. sp. (Pl. 14. figs. 137, 138.)

Cones and seeds of alder are very abundant and generally belong to *A. glutinosa*. At Pakefield there appears to be a second species, the seeds of which have a narrow somewhat stipitate base, and always differ somewhat in colour from the seeds of *Alnus glutinosa* with which they are mixed. We can find no recent alder to correspond with this. The cones are not sufficiently well preserved for us to distinguish them.

Sagittaria sagittifolia, Linn. (Pl. 15. fig. 152.)
A few carpels have been found, but none are well preserved.

Potamogeton natans, Linn. (Pl. 15. fig. 153.)
P. perfoliatus, Linn. (Pl. 15. fig. 156.)
P. obtusifolius, Mert. & Koch. (Pl. 15. fig. 159.)
P. pusillus, Linn. (Pl. 15. fig. 160.)

Fruits of *Potamogeton* are extremely abundant at nearly all localities; but the species vary from place to place. Thanks to Mr. James Groves we have been able to compare our fossils with a good series of recent fruits, and now make four additions to the list. One species previously recorded (*P. lucens*) must, however, be deleted as a wrong determination.

Cyperaceae.

Many species of Cyperaceae are found, but most of them are only represented by detached nuts without setae or utricles. We have only ventured to determine a few of the best preserved and most characteristic forms.

A few plants previously recorded are not included in the above list and notes, and have been omitted till they can be verified. The determinations may have been right; but in some cases the seeds have suffered so much from gradual decay of the pyrites, that we cannot now say whether they were right or wrong. In other cases we await more material before authenticating the determination. *Pinus montana*, for instance, has been recorded by Heer and Saporta; but we can find no cones belonging to this pine, though we have examined a large amount of material. Possibly the cones came from a later deposit, with Arctic plants, which overlies the Cromer Forest-bed, and is not included within the scope of this paper.
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General Conclusions.

This revision nearly doubles the number of plants recorded from British pre-Glacial deposits, for it includes 147 species. We have also various seeds and fruits in a perfectly determinable state, but belonging either to extinct forms, or more probably in the main to British or exotic species not represented in our recent collection. The determination of these is a very slow process; for a seed so peculiarly sculptured as to be readily determinable, if we happen to know the recent form, may be so wanting in generic or broader characters as to give no clue to guide us in our search. We have not thought it advisable to figure these incertae sedis, unless we could make a definite suggestion as to the families or genera to which they belong, or could draw up a clear botanical description. This is often impossible without destroying a unique specimen in order to examine its internal characters.

The mention of internal characters as applied to specimens of which nothing now remains but the testa or endocarp may seem absurd. It must not be forgotten, however, that in botany, as in zoology, soft parts impress their forms on indestructible hard parts, and convolutions of the embryo or vascular markings may be as well studied from the inside of the testa as in the interior of the skull of some extinct race of man. The illustration of the interior of the fruit of Ceratophyllum demersum (Pl. 14, fig. 143) will indicate how perfect may be this preservation.

Our pre-Glacial flora is found in a series of alluvial and estuarine deposits, which underlie the boulder-clay and stretch for nearly fifty miles along the Norfolk and Suffolk coasts, from Sheringham to Pakefield. The deposits consist of estuarine muds and gravels, apparently brought down by the Rhine, which at that period, after receiving numerous large tributaries—now separate rivers—seems to have flowed across the present bed of the North Sea. It probably entered the sea somewhere near Cromer. Unfortunately the estuarine deposits are very stony, contain ferruginous concretions, and show few drift fruits; they have therefore not yet been properly examined for plants. It is in these, if anywhere, that we should expect to discover the dry-soil exotic forms lately found higher up the Rhine, at Tegelen, in Limburg. At that place an ancient Rhine alluvium, somewhat older than the Cromer Forest-bed, contains a large flora, the plants showing drier conditions and slightly more southern affinities. The Tegelen list includes Magnolia Kobus, Juglans, Pterocarya caucasica, Vitis vinifera, several South European plants, and new species of Euryale and Stratiotes. It also contains a number of dry-soil North European plants, which help to complete the imperfect picture of the pre-Glacial flora left by our British fossils.*

The plants of our British pre-Glacial deposits, unfortunately, have been collected almost exclusively from the alluvium of small tributary channels,

* The Tegelen flora has been described by us in a communication sent to the Academy of Sciences at Amsterdam: Versl. K. Akad. Wetens. 2e Sect. xiii. n. 6 (1907).
not from the alluvium of the main river. These small stream-channels necessarily yield in the main the plants that lived in them, or grew on the adjoining wet meadows, or in moist woods not far away. A few winged seeds dropped in and others were brought by birds; but though the dry-soil element is gradually being discovered, it is only represented by perhaps one seed out of a hundred, the bulk of the specimens belonging to a few aquatic genera. This scarcity of dry-soil plants makes our pre-Glacial list at present a poor representation of the ancient British flora. We can only compare it with the plants now living in or around a Norfolk Broad and those that accidentally drift in.

Perhaps the first thing to strike a botanist on examining our list will be, how little the flora has altered in the many thousand years that have elapsed and during the various climatic changes that have intervened. It was driven out by the cold of the Glacial Epoch and came back little altered.

But closer study somewhat modifies these conclusions, for a good many exotic species occur, and it must be remembered that several if not most of the *incertae sedis* will almost certainly be exotic also. The non-British forms now recorded are *Ranunculus nemorosus*, two other species of *Ranunculus*, one or perhaps two water-lilies, *Hypecoum procumbens*, *Trapa natans*, two species of *Viburnum*?, two labiates, a second species of alder, *Picea excelsa*, and *Najas minor*. These give a decidedly peculiar appearance to the flora.

It is not very safe to deal with negative evidence, but there is another peculiarity in this fossil flora that only those who have handled a large amount of material will notice. A number of our plants have seeds and fruits so soft or decaying so readily that they seem never to be preserved in the fossil state. Such are *Ranunculus Ficaria*, most of the crucifers, leguminose, and many umbellifers and grasses; these we cannot expect to find save under very exceptional conditions. Certain of our common meadow and woodland plants, which we know, from the examination of more modern deposits, have seeds which preserve perfectly and abundantly, are, on the other hand, still missing in our pre-Glacial list. Disregarding plants which we find in deposits of Roman date, but no earlier, for these may be weeds of cultivation, we notice the absence of *Ranunculus acris*, *R. bulbosus*, *Lychnis Flos-cuculi*, *Potentilla palustris*, *Sambucus nigra*, *Taraxacum*, *Sonchus*, *Lamium*. The hazel, so abundant in our Neolithic submerged forests, is only represented in the Cromer Forest-bed by a few nuts, usually stunted and distorted in growth.

The pre-Glacial plants suggest climatic conditions almost identical with those now existing, though slightly warmer. This difference, however, may be largely due to the connection of Britain with the Continent while the plant-bed was forming. The influence of altered geographical conditions on our living fauna and flora has already been discussed (*op. cit.*) and need not be further commented on. Nothing in the present revision has tended to modify the conclusions already arrived at, except that the southern element
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in the flora is becoming more marked. Also, it now appears that it includes in all probability several extinct species. This brings it more into line with the pre-Glacial mammals and mollusca, both of which groups contain various extinct forms.

EXPLANATION OF THE PLATES.

**PLATE 11.**

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<th>Description</th>
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<tr>
<td>2.</td>
<td>Ranunculus aquatilis, Linn., carpels, {1}. Pakefield.</td>
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<tr>
<td>3.</td>
<td>R. sceletus, Linn., carpel, {1}. Pakefield.</td>
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<td>4.</td>
<td>R. Flammula, Linn., carpel, {1}. Pakefield.</td>
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<tr>
<td>5.</td>
<td>R. Lingua, Linn., carpel, {1}. Beeston.</td>
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<td>6.</td>
<td>R. repens, Linn., carpel, {1}. Pakefield.</td>
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<td>7.</td>
<td>R. nemorosus, DC., carpel, {1}. Pakefield.</td>
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<td>8.</td>
<td>R. sp. 7, carpel, {1}. Beeston.</td>
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<td>9.</td>
<td>R. sp. 8, carpel, {1}. Pakefield.</td>
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<td>10.</td>
<td>Caltha palustris, Linn., short seeds, {1}. Pakefield.</td>
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<td>11.</td>
<td>—— long seed, {1}. Mundersley.</td>
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<td>12.</td>
<td>Nymphaea lutea, Linn., seed, {1}. Pakefield.</td>
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<td>13.</td>
<td>Castalia alba, Woods, seed, {1}. Pakefield.</td>
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<td>14.</td>
<td>Undetermined species belonging to Nymphaeaceae, seed, {1}. Pakefield.</td>
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<tr>
<td>15.</td>
<td>Another undetermined species belonging to Nymphaeaceae, seed, {1}. Pakefield.</td>
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<td>17.</td>
<td>Viola palustris, Linn., seed, {1}. Pakefield.</td>
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<td>18.</td>
<td>V. cf. hirta, Linn., seed, {1}. Pakefield.</td>
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<td>19.</td>
<td>V. cf. Riviniana, Reichb., seed, {1}. Pakefield.</td>
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<td>S. media, Villars, seed, {1}. Pakefield.</td>
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<td>S. Holostea, Linn., seed, {1}. Pakefield.</td>
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<td>23.</td>
<td>Arenaria serpyllifolia, Linn., seed, {1}. Pakefield.</td>
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<td>24.</td>
<td>Elatine Hydropiper, Linn., seed, {1}. Pakefield.</td>
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<td>25.</td>
<td>Hypericum quadrangulum, Linn., seed, {1}. Pakefield.</td>
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<td>26.</td>
<td>H. hirsutum, Linn., seed, {1}. Pakefield.</td>
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<td>27.</td>
<td>Rhamnus Frangula, Linn., seed, {1}. Pakefield.</td>
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<tr>
<td>28.</td>
<td>Acer campestre, Linn., fruit wanting wing, {1}. Pakefield.</td>
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<tr>
<td>29.</td>
<td>—— part of wing, {1}. Pakefield.</td>
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</table>
Fig. 32. *Prunus spinosa*, Linn., nut, 1. West Runton.


40–44. *Crataegus Oxycanathus*, Linn., series showing variation in form at one locality, nuts, 6. Overstrand.


57, 58. — spine and abnormal spine, 6. Pakefield.


Plate 13.

Fig. 65. *Enanthe Lachenalii*, C. C. Gmel., skeleton carpel, 12. Pakefield.


67. — carpel, dorsal face, 12. Pakefield.


69. — carpel, ventral face, 12. Pakefield.


75. *V. ? sp.*, 2, seed, ventral surface, 6. Pakefield.

76. *V. ? sp.*, 2, seed, dorsal surface, 6. Pakefield.
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Fig. 77. Viburnum ? sp. 2, seed, inside, 6 Pakefield.
78. V. ? sp. 3, seed, ventral surface, 6 Pakefield.
79. V. ? sp. 3, seed, dorsal surface, 6 Pakefield.
80. Galium aparine, Linn., fruit, wanting bristles, 6 Pakefield.
81. Valeriana sambucifolia, Willd., fruit, 6 Pakefield.
82. Valerianella olitoria, Pohl., fruit, burst so as to show seed, 6 Pakefield.
83. Eupatorium sp.?, fruit, 12 Pakefield.
84. Bidens tripartita, Linn., fruit, 6 Pakefield.
85. Tussilago Farfara, Linn., fruit, 6 Pakefield.
86, 87. Arctium sp., fruits, 6 Pakefield.
88, 89. Carduus nutans, Linn., fruits, 6 Pakefield.
90. C. cf. nutans, Linn., fruit, 6 Pakefield.
91. C. palustris, Linn., fruit, 6 Pakefield.
92. C. heterophyllus, Linn.?, fruit, 6 Pakefield.
93. Centaurea sp., fruit, 6 Pakefield.
94. C. Calcitrapa, Linn.?, fruit, 6 Pakefield.
95. Pieris hieracioides, Linn., fruit, 6 Pakefield.
96. Crepis succisefolia, Tausch, fruit, 6 Pakefield.
97. Leontodon autumnalis, Linn., fruit, 6 Pakefield.
98. Undetermined Composite ?, 24 Pakefield.

PLATE 14.

Fig. 99. Menyanthes trifoliata, Linn., seed, 12 1 Pakefield.
100, 101. Solanum dulcamara, Linn., seeds, 12 1 Pakefield. (Fig. 101 is mounted in glycerine jelly, to bring out cell-structure.)
102. Verbasum Thapsus, Linn., seed, 12 1 Pakefield.
103. Limosella aquatica, Linn., seed, 24 1 Pakefield.
104. Veronica Chamaedrys, Linn., seed, 12 1 Pakefield.
105, 106. Mentha aquatica, Linn., nutlets (dorsal and ventral faces), 12 1 Pakefield.
107, 108. Lycopus europaeus, Linn., nutlets (dorsal and ventral faces), 12 1 Pakefield.
109. Calamintha arvensis, Lam., nutlet (ventral face), 12 1 Pakefield.
110. Prunella vulgaris, Linn., nutlet (ventral face), 12 1 Pakefield.
111. Stachys sylvatica, Linn., nutlet (ventral face), 12 1 Pakefield.
Fig. 112. *Stachys arvensis*, Linn., nutlet (ventral face), 12. Pakefield.


115. Undetermined labiate, nutlet (ventral face), 1. Pakefield.

116. Another undetermined labiate, nutlet (dorsal face), 1. Pakefield.


134. *Betula alba*, Linn., fruit showing part of wing, 12. Pakefield.


136. — cone, 1. Pakefield.


144. — fruit, outside, 1. Pakefield.

**Plate 15.**

Fig. 145. *Taxus baccata*, Linn., seed, 1. Happisburgh.

THE PRE-GLACIAL FLORA OF BRITAIN
THE PRE-GLACIAL FLORA OF BRITAIN.

Fig. 147. *Picea excelsa*, Link, cone, ¹, Mundesley.
149. —— seed, outside, ³, Pakefield.
150. *Sparganium erectum*, Linn. ², nut, ⁶, Pakefield.
151. *Alisma Plantago*, Linn., carpel, ¹, Mundesley.
152. *Sagittaria sagittifolia*, Linn., carpel, ¹, Pakefield.
156. *P. perfoliatus*, Linn., carpel, ³, Mundesley.
158. —— nut, ³, Beeston.
159. *P. obtusifolius*, Mert. & Koch, nut, ⁶, Mundesley.
162. *P. pectinatus*, Linn., carpel, ⁶, Pakefield.
165. *Najas marina*, Linn., fruit, outside, ⁶, Pakefield.
166. —— fruit, inside, ⁶, Pakefield.
168. *Eleocharis* sp., nut, ¹, Beeston.
172. *Carex dioica*, Linn., fruit, ³, Corton.
175. *C. hirta*, Linn., fruit, ⁶, Pakefield.
176. *C. acutiformis*, Ehrh., fruit, ⁶, Pakefield.
177. *C. riparia*, Curtis, fruit, ³, Pakefield.
179. *C. vesicaria*, Linn., fruit, ⁶, Corton.
180. *C. sp. 9*, nut, ¹², Pakefield.
181. *C. sp. 3*, fruit, ¹², Corton.

(Plates 16-19.)

[Read 20th June, 1907.]

The plants enumerated were collected by Dr. A. G. F. Wollaston on the recent expedition to Mt. Ruwenzori conducted by Mr. K. B. Woosnam, for the purpose of making natural history collections; these collections are now at the British Museum. Dr. Wollaston reached a height of over 15,000 ft., on one of the peaks which has been named in his honour by the Duke of Abruzzi.

A geographical account of the mountain-range known as Mt. Ruwenzori, with an excellent map, will be found in the Duke of Abruzzi’s paper entitled the “Snows of the Nile” in the Geographical Journal, xxix. (1907) pp. 121-147.

Previous Collectors.

Mt. Ruwenzori was discovered by Sir Henry Stanley, who saw the mountain to the south from Lake Albert Edward in 1888 and in the following year traversed its western slopes; one of his companions, Lieut. Stairs, climbed to a height of 10,700 ft. on its north-western spurs and collected 38 plants, of which the generic names are enumerated on p. 258 of H. M. Stanley’s ‘In Darkest Africa.’ The first botanical collection of any extent made on the Mt. Ruwenzori range was that of Dr. Stuhlmann in 1891. He ascended the valley of the Butagu on the west of the chain to a height of 13,300 feet. Mr. G. F. Scott Elliot in 1895 made five excursions towards the central ridge, approaching it on the east by the valleys of Yeria, Wimi, Mobuku, and Nyamwamba, and on the west from the Butagu valley. In the last he reached 13,000 ft. Later Sir H. Johnston reached a height of about 15,000 ft. on the east slopes of the peak which he named Kiyanga. On this expedition some plants were collected by Mr. Doggett and presented to the Royal Gardens, Kew. Several of these are identical with Dr. Wollaston’s plants. In 1906 the Duke of Abruzzi led the successful expedition on which so many of the different peaks were scaled for the first time. He was accompanied by Dr. Roccati as collector. Collections have also been recently made by Mr. Dawe, of the Botanic Gardens at Entebbe.

Notes on the Vegetation.

We are indebted to Dr. Wollaston’s notes for information on the types of vegetation at various altitudes; we have added a general account of the results obtained in working out his collections. The plants were mainly collected from two camps: one at about 3500 ft. altitude on the south-east slopes of the range, between the mountains proper and Lake Ruisamba; the other at an altitude of 6500 feet in the Mubuku valley, the most important valley on the east side of the range. Expeditions were made to intermediate
and higher altitudes, the highest camp being at about 12,500 ft., whence plants were collected to the snow-level, which may roughly be said to be at 14,500 ft. on the east side of the mountains. The time of year was from January to July: January was a month of fine weather; February, March and April were very wet in the mountains. From the middle of April, when a move was made to the lower camp near Lake Ruisamba, the weather was almost continuously fine. Most of the flowering plants had ceased to blossom by the end of May, and butterflies, which were exceedingly abundant during the latter part of April and May, were almost absent from the lower slopes in June.

The following is a brief summary of the general aspect of the country and the more striking forms of the vegetation seen at various altitudes.

It will be seen that the present collections illustrate the botany only of a restricted portion of this great mountain-range, confined to Mt. Kyanga (recently named Mt. Baker by the Duke of Abruzzi) and the valleys leading up to it. It remains for future explorers to provide means for the study of the botany of the other large mountains to the north and west.

3000-4000 feet. Beyond the wide belt of papyrus and swamp, which surrounds Lake Ruisamba, is a park-like country of shortish grass with scattered trees, mostly acacias, and intersected by deep ravines, in which is found a thick jungle of two species of fleshy euphorbia, a large-leaved fig (Spathodea campanulata) with magnificent clusters of scarlet flowers, a tangle of vines and asclepiads and a conspicuous white sweet-scented jasmine (Jasminum Schimperi). Two species of epiphytic orchids were found in these jungles.

The plants collected include a number of wide-spread tropical species, such as Sida spinosa, Hibiscus cannabinus and H. micranthus, Melia Azedarach, Desmodium lasiocarpum, Cassia mimosoides, Erythrina alsinoides, Plumbago zeylanica, Ipomoea calycina, Amaranthus caudatus, Euphorbia hypericifolia and Panicum pungens; Aeschynema Catechu and Ipomoea Wightii are of eastern affinity, occurring in tropical Asia but not passing into west tropical Africa. Others are more or less widely spread tropical African or tropical South African species, as Pavonia macrophylla, Corchorus trilocularis, Vernonia cinerascens, Craterostigma plantagineum, Strychnos hermonthica, Sopubia ramosa, Ruellia patula, Celosia trigyna, and Ornithogalum Ecklonii. Other species are east tropical African, such as Grewia similis (at 4000 ft.) and Hibiscus ethiopicus (also South African), while Hibiscus crassinervis, Turrea nilotica, Helina mystacinus, Jasminum Schimperi (Abyssinia), Barleria Grautii, are more northern “Nile Land” types, and Mellera lobulata, Adhatoda Engleriana, Lisochilus Livingstonianus of more southerly distribution (Uganda, the Mozambique district and British Central Africa). A western affinity is represented by Spathodea campanulata, a west tropical African species which finds the eastern limit of its distribution on Mt. Ruwenzori, Thunbergia.
fasciculata, a Cameroons plant, and Mucuna Poggei (found at 4000 ft.). Schizoglossum eximium is restricted to Ruwenzori; and the following are new species: Aloe Wollastoni, Chlorophytum ruwenzoriensis, and Baphia Wollastoni (at 4000 ft.), allied to the West African B. angolensis.

4000-5000 feet. About this level there is a good deal of native cultivation, chiefly bananas, manioc, Indian corn and beans. At this altitude the huge "elephant-grass" growing from 10 to 15 feet high is the most important feature of the vegetation, and conspicuous among it are the pretty little trees of Erythrina tomentosa with tufts of crimson flowers.

The following were collected at 5000 ft.:—Tephrosia paniculata (Angola and Uganda); Fleurya podocarpa, a widely spread tropical African species; Crinum seabrum, a more northern type (Abyssinia and the Nile Valley); and a new composite, Guizotia collina.

5000-6000 feet. Cultivation and elephant-grass still continue, with species of Ipomoea climbing about the stems of the grass, and the very handsome red-and-yellow Gloriosa virescens (var. splendid, var. nov.), which is found up to 7000 ft. A few small patches of forest with a good many ferns, polypodiums and others fill the bottom of the valley at this level.

The plants collected at 6000 ft. include some widely distributed tropical species, such as Vigna luteola, Psophocarpus palustris, Ageratum conyzoides and other composites, with a new variety of Laggera alata, a common tropical African and Asiatic species; some widely spread tropical African species, such as Desmodium Scalpe (also India), Pentas purpurea, Melanthera Brownei (also South Africa), Platystoma africanum (also India), Cyathula cylindrica (also S. Africa and Madagascar), and Crinum giganteum. A marked east tropical affinity is shown by Eriojena montanum, Rhamphicarpa Herzfeldiana, Osbeckia denseflora (Mozambique), Helichrysum Justinianum, Sourchus Bipontini var., and Indigofera longeflora (Abyssinia); Brilliantaia patula is a Cameroons plant also found in Uganda. Streptocarpus ruwenzoriensis (also in Usambara), Isoglossa rausorica, Triumfetta ruwenzoriensis and Gynura ruwenzoriensis, the two latter also collected at 7000 ft., represent an endemic distribution; and the following are novelties: Thoubergia ovata, Colens gracilentus, and Pentas pubiflora; a variety of the last occurs at 7000 ft.

6000-7000 feet. The banana is not cultivated much above 6000 ft. and the elephant-grass ceases at the same level. Above this is a zone of shrubs, conspicuous amongst them being Acanthus arborensis with mauve flowers, two or three yellow-flowered Papilionaceae and a handsome Solanum with prickly leaves and a large yellow fruit. The first of the tree-lobelias (L. Gibertia) is found in the open places on sunny slopes. Wild bananas are found in shady places up to 7000 feet and beyond. Dracaenas, reaching a height of thirty feet and upwards, are found in groups beside the streams. Millet and colocasia are cultivated up to 7000 ft., above which level cultivation ceases. A large number of species was collected at 7000 ft., the majority of which are
more or less widely distributed in the highlands of tropical Africa. Of these
a minority occur on both sides of the continent; such are:—Ranunculus
membranaceus (Abyssinia, Kilimanjaro, Zambesi Highlands and Huila),
Pavonia Schimperiana (Abyssinia to Cameroons and Angola), Kosteletzkya
adoensis (Abyssinia to Nyasaland and Cameroons), Cassia didymobotrya (east
Africa and Angola), Discopodium penninervium (Uganda and Nyasaland
and Cameroons), Micromeria bijora (east tropical and South Africa and
Cameroons), Plantago palmata (Kilimanjaro to Cameroons), Rumex Steudelii
(east tropical Africa and Cameroons). Twice as many are restricted to
Eastern Africa including the Central Lake district: such are Polyala
persicarifolia, Sida rhombifolia, Geranium aculeolatum, Coreopsis
abyssinica, Laetevia abyssinica, Lysimachia africana, Moschusma multiflorum, Plectranthus
Schimperi, Rumex abyssinicus, which have a northward range, generally as
far as Abyssinia; and others with a more southern or restricted distribution,
such as Torilis gracilis (Usambara, Milani), Cynoglossum geometricum
(British East Africa and Shire Highlands), Solanum aculeolatum (Uganda,
Shire Highlands and South Africa), Lissichilus Krebsii (a South African species
found in the highlands of Portuguese East Africa and Milani), Diasia
Stairi (Kenia, Kilimanjaro), and the endemic species Vernonia ruwenzorenisis,
Lissichilus ruwenzorenisis and Satyrium crus-caudae. At this altitude were
also collected the north temperate species Sanicula europaea and Orobanche
minor. The following novelties were found:—Begonia Wollastoni allied to
B. Johnstonii from Kilimanjaro and Kenia, Pentas pubiflora var. longistyly,
Pavetta ruwenzorenisis, also collected by Scott Elliot at 7000–8000 ft. and in
Uganda, Grumilea megistostlcta, Vernonia Wollastoni, Conyza scariosa, Seneio
Wollastoni, Plectranthus Wollastoni, Peperomia ruwenzorenisis, closely allied
to P. Stuhlmannii, another endemic species, and Polystachya bicarinata.

Between 7000 and 8000 feet is found the biggest forest of Ruwenzori. A
large Dombeya with clusters of white flowers is very noticeable, and one of the
finest trees. though not very numerous, is a Podocarpus. A sweet-scented
begonia (probably Begonia Wollastoni) is found about the lower trunks, and
tree-ferns occur in shady places and on the banks of the streams.

At 8000 feet were collected the widely spread tropical African highland
species Stachys aculeolata (Cameroons, Clarence Peak Fernando Po, and
Abyssinia), Begonia Meyeri-Johnniis, previously found on Kilimanjaro, and
Habenaria Rendlei, previously collected by Scott Elliot at 6000–7000 ft.
Also Hibiscus diversifolius var. granatensis, a tropical South American variety
which is also recorded from Uganda.

8000–9000 feet. The slope of the mountains becomes much steeper, and the
forest thins out into open spaces covered with bracken and occasional big
trees, having very much the appearance of the higher slopes of the New Forest.
This gives way to a belt of small tree-heath (Erica arborea) and Podocarpus,
and so to the zone of bamboos, which begin on the east side of Ruwenzori
at about 8500 feet and continue up to 10,000 ft., while on the western slopes they begin at 7000 feet.

9000–10,000 feet. The big tree-heaths begin about 9500 feet, their branches are covered with long wisps of grey lichen. A good many terrestrial orchids were found at this level (Epipactis africana, Cynorchis auncamptoides, Satyrium crassicaule and Polystachya gracilenta), all endemic species previously collected at similar altitudes by Scott Elliot and Stuhlmann, and two new species of Polystachya were found on rocks, while the epiphytic Angrevum Scottii, found previously by Scott Elliot, was again collected. A big bushy Impatiens, the endemic species L. ruwenzoriensis with a coral-red flower, was also found. Ferns, notably polypodiums and a long narrow-leaved hart’s-tongue (?), are numerous, and the biggest of the alchemillas, A. ruwenzoriensis, forms large silvery beds. A Helichrysum (H. argyrocoryle, sp. nov.) in the moist places and a small yellow orchid (Polystachya Doggettii) on the rocks contribute agreeable touches of colour.

In addition, the following novelities were collected at 9000 ft.:—Senecio jugicola, Coleus latidens, Pycnothys Elliotii, and a remarkable amaryllidaceous plant which seems to represent a new genus (Choananthus) combining in some respects the characters of Hamanthus and Cyrtanthus. At 10,000 ft., two new species, Thalictrum rhynclwcarpjim, a species widely spread on the mountains of tropical and South Africa, a variety of Cotyledon Umbilicus known also from the mountains of Abyssinia and Kilimanjaro, several endemic species (Rubus Doggettii, Solanum ruwenzoriensis, Mimulopsis Elliotii and Arisema ruwenzoricum), and a new species, Coleus ciclica.

10,000–11,000 feet. This is the zone of moss par excellence. It forms round cushions on the trees (most of them Erica arborea) and masses two feet deep on the ground and amongst the fallen logs, where the hyraxze make their burrows. Two tree-lobelias (L. Deckenii and L. Stuhlmanni) appear at this level, also a fine tree-hypericum with a big yellow flower. A blue violet (Viola abyssinica) is found in the more open spaces. At 11,000 ft. were found two new species, Conyza montigena and Calamintha parrula, and the widely spread north temperate Cerastium vulgare.

11,000–12,000 feet. Helichrysums (including a new species H. Wollastoni), tree-lobelias, tree-heaths and tree-seneios are the most conspicuous plants at this altitude, though the two latter attain their greatest growth above 12,000 feet. A handsome Rubus (R. ruwenzoriensis) with a pink flower and a large but tasteless fruit is fairly abundant, and a small Sedum (S. ruwenzoriense, sp. nov.) grows on the rocks. The plants found at 12,000 feet include Alchemilla geranioides, a species allied to A. cinerea from Kilimanjaro, Alchemilla argyrophylloides, a new species allied to A. argyrophylla from Kilimanjaro, Senecio syeephyllus (previously collected by Scott Elliot), the tree-seneio, S. adiualis allied to S. Johnstoni from Mt. Kilimanjaro and S. keniense from Mt. Kenia; several alpine species which have been found on the mountains of
Abyssinia and Kilimanjaro—Ranunculus oreophytes, Cardamine obliqua and Subularia monticola; Hypericum keniene (also on Mt. Kenya) and Pwencodeanum Kersteni (also on Kilimanjaro).

12,000-15,000 feet. The tree-heaths cease about 12,500 ft., but the senecios continue much further, almost to 14,000 ft. A fourth species of Lobelia (L. Wollastoni, allied to L. Rhynchoptalam from the mountains of Abyssinia) appears at about 12,500 ft, and is found growing on the steepest slopes almost up to the snow-line. L. Deckenii, which grows only on the level terraces in very moist ground, does not occur above 13,000 feet. Helichrysums, sometimes forming bushes four or five feet high, grow most luxuriantly in this region, one species (JET. Stuhlmanni, var. latifolium var. nov.) being found nearly up to 15,000 ft. A small Arabis (A. alpina) was found at 14,000 ft., and a rush (Lucula Johnstonii), a grass (Poa glacialis) and mosses were found growing up to the level of permanent snow.

To this zone belong the following plants:—Galium serrato-hamatum, sp. nov. (at 12,500 ft.), Helichrysum Stuhlmanni (at 13,000 ft.), Senecio gymnooides, sp. nov. (at 12,500 ft.), Rubus ruwenzoriensis and Sedum ruwenzoriense, sp. nov. (at 12,500 ft.), the latter closely allied to S. Volkensii from Kilimanjaro. At 12,500 ft. were found two Cyperaceae, Carpha Emini (previously collected by Stuhlmann at 10,000 ft.) and Carex ruwenzoriensis. At 14,000 ft. was found an interesting new alchemilla (A. subnivalis).

Appended are some notes by Mr. Woosnam on the arborescent senecios and lobelias, both of which are long-lived.

"With regard to the length of life of the lobelias and senecios on Ruwenzori, it appeared to me that both must live to a great age. The senecios undoubtedly attain the greatest age, which I do not think would be too much to estimate at anything from 50 to 100 years or even more. The senecio appears at first as a small plant not unlike a cabbage, gradually the stem lengthens and gives out branches with the tuft of bright green leaves at the end; as the plant grows the old leaves shrivel and droop, hanging down the stem one upon another till the upper parts of the branches near the green tuft are transformed into great swollen masses of dead leaves tightly packed together. This accumulation of old leaves is the greatest proof of age, and also there are very few dead trees that have fallen lying among the others, and these had all been there for many years. How often the senecios flower I cannot say, but I do not think the act of flowering means death as it does with the lobelias, and I should say that the senecio flowers every few years.

"The lobelias also live to a great age, but not so long as the senecios. In the case of the lobelias the period which occupies so long a time is before they come into blossom, which might be 15 or 20 years, and the proof of this is also the accumulation of leaves below the flower-spike, or in the case of L. Stuhlmanni the marks where the old leaves have fallen off. Once a lobelia has
reached the stage of producing a flower-spike and bursting into blossom, it has (in comparison to the length of time taken before that stage) reached the end of its life; it may perhaps take 12 months for the spike to finish blossoming, then the whole plant withers and dries up and stands probably for several years longer before it falls and is swallowed up by the moss. In *L. Stuhlmanni* the leaves do not die and remain on the plant, but all fall off, leaving the stem bare except for the green leaves. In *L. Deckenii* none of the leaves ever fall off, and the stem is entirely concealed from sight from the ground up to the spike, which is nearly three times as large in circumference as in any of the other lobelias, but I think the life of *Deckenii* is shorter than the others. In *L. Wollastoni* some leaves fall off and some remain hanging down, so that it usually has a portion of exposed stem, 3 or 4 feet long, below the leaves. In *L. Giberroa* the leaves fall off as in *Stuhlmanni*. There is another point about *Deckenii*. When we visited Ruwenzori I saw only one *Deckenii* in blossom, there were hundreds of tall dead ones and as many young ones a foot or so high; this looks as if this species had periods of flowering, all the plants coming into flower at the same time every few years.

"*L. Deckenii* is confined to the flat swampy bottoms of the higher valleys and does not grow on the sloping hillsides which are covered with *L. Wollastoni*; this latter may be seen by hundreds in all stages of development from seedlings to full bloom."

**MONOCOTYLEDONS.**

By A. B. Rendle.

**ORCHIDAE.**


Previously collected by Scott Elliot at the Katonga River, Uganda.


S.E. 3500 ft. June. "Flowers yellow."

*Distib.* British East Africa and British Central Africa.

The flowers of *L. Livingstonianus* are described as purple or white veined with purple-white. Dr. Wollaston describes the flowers of the plant found on Ruwenzori as yellow. I can find no other differences.


E. 7000 ft. February. "Flowers yellow and brown."

*Distib.* British Central Africa; South Africa.

The bracts are longer and more pointed than usual in this species.

E. 7000 ft. February. "Flowers yellow and brown."
Previously collected by Scott Elliot on Ruwenzori at 6000 to 7000 ft. on the Eastern side, and at Kivata.

Polystachya doggetthi, Rendle et Rolfe, sp. nov.
Planta sicca nigrescens, Polystachya Rendlei, Rolfe, affinis sed ut apparet caule breviori uni- vel bi-folio; foliis lineari-oblongis, obtusis; bracteis brevibus, late ovatis, truncatis, breviter acuminatis; floribus luteis, galeatis; sepalo dorsali triangulari-ovato, concavo, sepalis lateralis lib late triangularibus, subobtusis, sepalum dorsale vix excedentibus, mento valde obtuso; petalis e basi angusto spathulato-lanceolatis, obtusis, sepalis paullo brevioribus; labello breviter unguiculato, trilobato, lobis lateralis late rotundatis, lobo medio minore subrotundo, disco glabro, verruculoso; columna brevissima.

Hab. Ruwenzori E. 10,000 ft. On rocks. February. "Flowers yellow."
Also 8500-11,000 ft. W. G. Doggett. (Herb. Kew.) "Flowers-primrose-yellow."

Folia 5-nervia, 8.5-12 cm. long., 1.1-1.7 cm. lat. Pedunculus basi vaginatus, compressus, cum racemo simplice 5-7-floro, vel interdum paucitier ramoso, 10-15 cm. long. Bracteae 4-3 mm. long. Flores subsessiles. Sepalum dorsale 9-10 mm. long., 5-6 mm. lat.; sepala lateralia 1 cm. long., mentum 8-9 mm. long. Petala 7-8 mm. long. Labellum 9 mm. long., 5 mm. lat.

Near P. Rendlei, Rolfe, from Nyasaland (Mt. Milanji and Zomba), but apparently a lower-growing plant, and distinguished by its short truncate bracts, larger flowers, and lip with glabrous uncrested disc.

P. Woosnami, sp. nov.
Herba parva foliis tribus oblongo-linearibus vel linearibus; scapo compresso, hispidulo; racemo simplici, brevi, denso; bracteis setaceo-acuminatis; floribus parvis luteis cucullatis; sepalis apice acuminato crassatis, sep. dorsali concavo late ovato, sep. lateralis oblique triangularibus 4-nerviis, mento conico; petalis minimis lineari-oblongis; labello e basi longo cuneato trilobato, lobis lateralis late rotundatis, lobo medio duplo minore suborbiculare papilloso; columna brevi, crassa.

Planta, pseudobulbo exciso, 15 cm. long. Folia ad 13.5 cm. long. et vix 1 cm. lat. Scapus cum bracteis tribus pæne ad racemum vaginatus cum racemo (vix 2 cm. excedente) 8.5 cm. long. Bracteae inferiores vix 1 cm. long., supra breviore, ad racemi apicem comose. Flores sub sessiles, anguste cucullatae, vix 1 cm. long. Sepalum dorsale 4 mm. long., 2 mm. lat.; sepalá laterália 9 mm. long., mentum vix 4.5 mm. long.
Petala 2 mm. long. vix 1 mm. lat. Labellum 7-5 mm. long. vix 4 mm. lat., cum venis tribus longitudinalibus, antice in venis et venulis papillosum. Columna 2 mm. long.

Near Polystachya Adansonii, Reichb. fil., from Angola, in habit, but has longer narrower flowers arranged in a shorter more crowded raceme with longer floral bracts, and differs also in the details of structure of petals and lip.

Polystachya bicarinata, sp. nov.
Planta habitu P. cultrata, floribus autem duplo majoribus, sepalo dorsali ovato-oblongo, acuto, 3-nervio, sepalis lateralis falcate triangulares, acuto, 3-nervio; petalis quam sepalis brevioribus, oblongo-spathulatis, abrupte subacutis, 3-nerviis; labello e basi lato trilobato, lobis lateralis rotundatis, lobo medio his subaequali, breviter apiculato, disco cum crista linguiformi; columna crassa, brevi.

Folium late oblongum, ad basin angustatum, plurinervium, 16 cm. long., pæne 4 cm. lat. Seclusus cum panicula densiuscula folio brevior. Bracteae amplae, 5 mm. long. Flores albi, circa 1-5 cm. long. Sepala 1 cm. long., dorsale 5 mm. lat., lateralia 7 mm. lat. Petala vix 7 mm. long., vix 3 mm. lat. Labellum 8-5 mm. long., 7 mm. lat., lobus medius 4 mm. long., et lat. Columna 2 mm. long.


Closely allied to P. cultrata, Lindl., but distinguished by its much larger bracts and flowers and characters of the lip.

W. 10,000 ft. August. Flowers white, growing in long grass.

Previously collected by Stuhlmann at 8200 ft., and by Scott Elliot (fruiting specimen) at Butagu, 8000 ft.


Previously collected by Scott Elliot on Ruwenzori at 7000 (Butagu) and 8000 ft.

E. 9000 ft. In fruit; February.—W. 10,000 ft. In flower; August.

“Flowers greenish-yellow.”

Previously collected by Scott Elliot on Ruwenzori at Butagu, 8000 to 10,000 ft.

E. 8000 ft. February. “Flowers green.”

Previously collected by Scott Elliot on Ruwenzori at 6000 to 7000 ft.
W. 10,000 ft. August. “Flowers blue.”
Distrib. Ruwenzori, previously collected by Stuhlmann 8200 ft., and Scott Elliot 9000 to 10,000 ft. (Butagu and Kivata).

“Flowers pink.”
Distrib. Ruwenzori, previously collected by Scott Elliot at Wimi, 6000 to 7000 ft., and Butagu, 10,000 ft.

Disa Stairsii, Kränzl. in Gard. Chron. ser. 3, xii. (1892) 728.
W. 7000 ft. August. “Flowers purple.”
Distrib. Mt. Kenya, 10,400 ft. (Gregory); Ruwenzori, Butagu Valley, 10,000 to 12,000 ft., and Yeria Valley, 10,000 ft. (Scott Elliot, also Stairs); Kilimanjaro, 8000 to 10,000 ft. (Volkens).

Zingiberaceæ.

Amomum angustifolium, Sonnerat, Voy. Indes. iii. 276.
Distrib. East and West tropical Africa, also Madagascar and Mauritius.
Collected by Scott Elliot in the Semliki Valley, and on the west side at the foot of Ruwenzori.

Amaryllidaceæ.

Crinum scabrum, Herb. in Bot. Mag. t. 2180.
E. 5000 ft. March. “Flowers pink and white.”
Distrib. Abyssinia to the Nile Valley.

W. 6000 ft. July. “Flowers white and pink.”
Distrib. Nyasaland, South, Central and West tropical Africa.

Hæmanthus multiflorus, Martyn, Icon. cum descript.
Distrib. Widely spread in tropical Africa.
Collected by Scott Elliot on Ruwenzori in forest at 8000 ft.

Choananthus, gen. nov. (Greek χοανόν, a funnel.)

Perianthium anguste infundibuliforme, tubo longo angusto, fauce nuda, lobis multo brevioribus latis erecto-patentibus. Stamina ad perianthii fauceem inserta, filamentis latis anguste triangularibus apice acuminatis, antheris
PLANTS COLLECTED ON MT. RWENZORI.

Plants collected on Mt. Rwenzori.

H. rhizomata, foliis magnis ovalibus multinerviis, basi in vaginas angustas semet involventes contractis; scapo multifloro (specimine 25), floribus puniceis, quasi umbellatis, demum recurvatis; bracteis spathaceis membranaceis angustis brevibus; pedicello gracile quam flore breviore; tubo perianthii sursum gradatim ampliato, lobis ellipticis vel elliptico-oblongis, apice cucullato puberulis; staminibus lobos vix aequalibus; ovario ovoideo.

Hab. Ruwenzori E. 9000 ft. In flower February.

Foliי lamina 3 dm. long., 1 dm. lat. Scapus 3-3 dm. long., 5 cm. lat. Pedicellus ad 2-5 cm. long.; flos 6 cm. long., tuba c. 4 cm. long., fauce c. 1-2 cm. lat., lobis vix 2 cm. long., 8-10 mm. lat., interioribus paullo brevioribus et obtusioribus. Ovarium c. 5 mm. long.

Closely allied to Ch. cyrtanthiflorus, but the flowers have a wider tube with a broader throat and broader limbs. The leaf is also broader and the inflorescence bears twice as many flowers.

LILIACEÆ.

Aloe Wollastoni, sp. nov.

Herba caulescens (?), foliis crassis, parvis, ensiformibus, haud maculatis, marginibus corneis cum dentibus validis uncinatis frequentibus armatis; scapo pauciter ramoso nudo, racemis densiusculis paniculatis; bracteis


The foliage resembles that characteristic of other tropical African species of Hemanthus, and the few-celled ovary and berried fruit also point to the same genus, but the shape of the flower is different from that of any known species. The flowers resemble those of a Cyrtanthus, especially the South-African C. carneus, having the long narrow tube and short broad lobes of that species. I therefore venture to separate as a new genus these two alpine species, namely, the new one collected by Dr. Wollaston and a very closely allied species recently collected by Mr. Dawe at 8000 to 9000 ft. on the same mountain, and described by Mr. Wright under the name Hemanthus cyrtanthiflorus (in Journ. Linn. Soc., Bot. xxxvii. (1906) 529). In Ch. cyrtanthiflorus an ovoid bulb grows from a rhizome 3 cm. thick, while in Ch. Wollastoni Dr. Wollaston states that the leaves and scape spring direct from the stout rhizome. A similar absence of a bulb occurs in the Uganda species Hemanthus Radcliffei, where scape and leaves spring from the apex of a short stout rhizome, and the association of bulb and rhizome occurs in other tropical African species of that genus, as in H. multiflorus.
scariosis, ovatis, acuminato-aristatis, reflexis quam pedicellis brevioribus; perianthio roseo cylindraceo, super ovarium constricto, segmentis liberis quam tubo duplo brevioribus, externis trinerviis, internis plurinerviis; filamentis vix exsertis; antheris et apice styli protrusi; capsulo immaturo oblongo.

Hab. Ruwenzori S.E. 3500 ft. May. Flowers pink.
Folia 14–15 cm. long, e basi 2.5–3 cm. lat. sensim angustata, spinis 3 mm. long., 5–7 mm. inter se distantibus. Racemi 4–6 cm. long.; bracteae trinerviae, 1 cm. long. vel breviores. Flores circa 3 cm. long., segmenta 10–12 cm. long.
Apparently near Aloe amanensis, A. Berg., from East Usambara, which I know only from the description, but which has larger spotted leaves with smaller teeth. The bracts and flowers resemble those of A. lateritia, Engl., from Mt. Kilimanjaro, but the leaves are much smaller than in that species and the marginal teeth are less continuous.

Chlorophyllum Ruwenzoriense, sp. nov.
Herba minor, foliis radicalibus circa 5 rigidulis, lamina e petiolo tenue anguste lanceolata, acuminata, sicca subamnembranacea, glabra, cum nervo mediano et venis parallelis utrinque (circa 9) frequentissime et regulariter lineatis; scapo cum racemo brevi densiusculo quam foliis breviore; bracteis scariosis longe acuminatis; floribus inter majores in axillis geminis, pedicellis medio articulatis quam bracteis duplo brevioribus; perianthio albo rotato-expanso, lobis anguste lanceolatis, trinerviis; stamina erectis perianthio brevioribus; antheris dehiscentibus flexuosis.

Folia ad 23 cm. long., lamina circa 15 cm. long. ad 13 mm. lat. inclusa; scapum cum racemo 5–8 cm. long., 12–18 cm. lat. Bracteae, in parte racemi inferiore 1.5 interdum 2 5 cm. long., e basi triangulari-ovato, acuminato vel aristuliferae. Pedicelli e 6 mm. longi. Petala 13 mm. long., 3–3.5 mm. lat. Stamina, cum antheris viridescentibus 3 mm. longis, vix 9 mm. long. Stylus stamina excipens.
Near my C. fusiforme, from Uyui, East Africa, which it resembles in habit, but has more rigidulous, more distinctly petioled glabrous leaves, and larger flowers.

Distrib. Widely spread in tropical Africa.

Ornithogalum Eckloni, Schlecht. in Linneae, xxv. 1177.
Distrib. East tropical Africa, Angola, South Africa.
GLORIOSA VIRESCENS, Lindl., var. SPLENDES, var. nov.
Planta egregia foliis late lanceolatis vel ovatis apice acuminato cirrhosis, floribus flavo-rubris quam in typo majoribus cum petalis latioribus. Folia ad 15 cm. vel longiora et 5 cm. lat. Flores sicci cum petalis patentibus sepe 16 cm. diam., petala 6–8 cm. long., 2.5–3.5 cm. lat. 
_Hab._ Ruwenzori E. 6000 to 7000 ft. January. “Flowers yellow and red.”
A very fine plant, distinguished from other forms of the species by its larger flowers with broad oval petals tapering to the base.

COMMELINACEÆ.

ANEILEMA BENINIENSE, Kunth, Enum. iv. 72.
E. 7000 ft. January.
Also collected by Scott Elliot in the Butagu Valley. 
_Distrib._ Widely distributed in tropical Africa.

JUNCACEÆ.

E. 13,000 ft. February.

AROIDEÆ.

E. 10,000 ft. April.
Originally collected by Scott Elliot on Ruwenzori at 7000 to 8000 ft. in the forest at Kivata.
The specimen is of interest in view of an uncertainty as to the nature of the leaf. Mr. Elliot’s specimens, to which our knowledge of the species has hitherto been restricted, comprise an inflorescence with some unattached leaves, one of them with a pedate arrangement of the leaflets, the other with radiating leaflets. Mr. Brown says (_ib._): “Both leaves may possibly belong to the inflorescence, but more complete material is needed to decide, as I have never seen a species of _Arisema_ having both radiating and pedately arranged leaflets; such a difference has hitherto been considered of sectional value.” In Dr. Wollaston’s specimen the leaf has pedately arranged leaflets and is attached to the inflorescence.

CULCASEA SCANDENS, Beauv. Fl. Owari. i. 4, t. 3.
E. 7000 ft. January.
_Distrib._ Widely distributed in tropical Africa.
A. B. Rendle: Monocotyledons.

Cyperaceae.


E. 12,500 ft. February.
Previously collected by Stuhlmann at 10,000 ft.

E. 12,500 ft. February.
Previously collected by Stuhlmann and Doggett at similar elevations.

Gramineae.

S.E. 3500 ft.—E. 7000 ft.
Distrib. Widely spread in the tropics.

Cymbopogon cymbarius, nom. nov.

(Andropogon cymbarius, Linn. Mant. ii. 303.)
E. 7000 ft. January.
Also collected by Scott Elliot at 5300 ft. and 7000 ft.
Distrib. East and West tropical Africa, Mascarene Islands, with a variety in South Africa.

E. 14,000 ft.
Previously collected by Doggett at similar altitudes.

Dicotyledons.

Polytetalae.

By Edmund G. Baker.

Ranunculaceae.

Beni, Semliki. 3000 ft. July.
Distrib. of subsp. Nile Land, Mt. Kilimanjaro, Lower Guinea; also India.

10,000 ft. February.
Also collected by Scott Elliot.
Distrib. Widely spread on the mountains of tropical Africa. Also in Orange River Colony and on the Katberg, &c.
PLANTS COLLECTED ON MT. RUWENZORI.

E. 12,000 feet. February.

R. MEMBRANACEUS, Fres. in Mus. Senckenb. ii. 270. (R. pinnatus, Oliver, Fl. Trop. Afr. i. 9.)
E. 7000 feet. February.
Distrib. Nile Land, Mozambique District, Lower Guinea.

CRUCIFERÆ.

E. 12,000 ft. February.

E. 13,000 ft. and 14,500 ft. February.

A widely spread species in Europe, N. Asia, N. America, &c.

Prof. Oliver considers A. albida, Stev., to be synonymous with A. alpina.

SUBULARIA MONTICOLA, A. Br. in Schweinf. Fl. Æth. 76.
E. 12,000 ft. February. And on shore of small crater lake, 10,000 ft., March.

VIOLARIEÆ.

VIOLA ABYSSINICA, Steud. ex Oliver, Fl. Trop. Afr. i. 105.
E. 11,000 ft. February.
Also collected by Scott Elliot (No. 7523) in bamboo forest.
Distrib. Widely spread on the mountains of tropical Africa.

POLYGALACEÆ.

POLYGALA PERSICARIAE FOLIA, DC. Prod. i. 326.
E. 7000 ft. February.
Distrib. Nile Land, Mozambique District, Lower Guinea. Also in India, &c.

CARYOPHYLLACEÆ.

CERASTIUM VULGARE, Linn. Sp. Pl. 627.
E. 11,000 ft. April.
HYPERICACEÆ.

E. 12,000 ft. February.
This identification is doubtful, as I have seen no good description of this species.
Distrib. Mt. Kenia.

MALVACEÆ.

Sida rhombifolia, Linn., var. (Sida riparia, Hochst.)
E. 7000 ft. February.
Distrib. of variety. Mountains of Abyssinia.

S.E. 3500 ft. May.
Distrib. A widely spread tropical weed.

S.E. 3500 ft. June.
Also collected by Scott Elliot at Kedung Ndogo (No. 6615).
Distrib. Tropical and South Africa.

P. Schimperiana, Hochst. ex Rich. Tent. Fl. Abyss. i. 52, forma.
E. 7000 ft. January.
“Shrub 5–10 ft. high; flowers white.” A form with rather small, not very deeply-lobed, pubescent leaves, less hairy than in P. tomentosa, Hochst.
Distrib. of type. Nile Land, Mozambique District.

Kosteletzkya adoensis, Masters, in Oliver, Fl. Trop. Afr. i. 194.
E. 7000 ft. January.
Also collected by Scott Elliot (Nos. 7748 & 7754).
“Herbaceous; flowers blue.”
Distrib. Nile Land, Mozambique District.

Hibiscus cannabinus, Linn. Syst. ed. x. 1149.
S.E. 3000 ft. June.
“Herbaceous, 6–10 ft.; flowers yellow.”
Distrib. Widely spread in tropical Africa. Also India and other parts of Asia and subtropical Australia.

E. 8000 ft. January.
Distrib. of variety. Tropical S. America; also recorded from Uganda.
PLANTS COLLECTED ON MT. RUWENZORI.

Hibiscus micranthus, Linn. f. Suppl. 308, 310.
S.E. 3500 ft. May.
“Herbaceous; flowers blue.”
*Distrib.* Widely spread in tropical Africa. Also occurs in India, Ceylon, Arabia.

S.E. 3500 ft. June.
“Herbaceous; flowers red.”
*Distrib.* Nile Land.

H. æthiopicus, Linn. Mant. ii. 258.
S.E. 3500 ft. June.
Collected by Scott Elliot on Maungu (No. 6740), also in Karagwe (No. 8140).
*Distrib.* East tropical and South Africa.

**TILIACEÆ.**

“Herbaceous; flowers yellow.”
The type was collected by Mr. Dawe at an altitude of 6000 ft.
*Distrib.* Mt. Ruwenzori.

S.E. 4000 ft. June.
“Bush 15–20 ft.; flowers pink.”
*Distrib.* Nile Land, Mozambique District.

Corchorus trilocularis, *Linn. Mant. 77.*
S.E. 3500 ft. May.
“Herbaceous; flowers yellow.”
*Distrib.* Tropical Africa.

**GERANIACEÆ.**

E. 7000 ft. January.
Collected also by Scott Elliot (Nos. 7577–7651)
“Herbaceous; flowers pink.”
*Distrib.* East tropical Africa.
E. 7000 ft. March.
*Distrib.* A weed of cultivation and waste ground in nearly all warm countries.

E. 10,000 ft. February.
"Herbaceous, 4–12 ft.; flowers red."
*Distrib.* Mt. Ruwenzori.

I. Eminii, *Warb. l.c., ex descript.*
E. 7000 ft. January.

**MELIACEÆ.**

S.E. 3500 ft. May.
*Distrib.* Widely distributed.

S.E. 3500 ft. May.
The plant collected by Mr. Dawe in N.W. Ankole agrees with the above. *T. robusta*, Gürke, from Usambara, is very closely allied.
*Distrib.* Nile Land.

**CELASTRACEÆ.**

(Celastrus gracilipes, *Welw. ex Oliver, Fl. Trop. Afr.* i. 361.)
E. 7000 ft. February.
"Tree, 20–30 ft.; flower white; fruit red.
*Distrib.* Upper and Lower Guinea.

E. 10,000 ft. March.
I have to thank Mr. Sprague for this identification.

**RHAMNACEÆ.**

S.E. 3500 ft. June.
*Distrib.* Nile Land, Mt. Kilimanjaro.

*Linna. Journ.*—*Botany, Vol.* XXXVIII.
AMPELIDÉE.

E. 7000 ft. January.
Distrib. Central African Lake-Region.

LEGUMINOSÉ.

E. 7000 ft. January.
Distrib. Lower Guinea, Nyasaland.

E. 9000 ft. February.
Distrib. Mt Kilimanjaro, Cameroons, Clarence Peak, Mt. Milanji and Ruchigga.

E. 6000 ft. February.
Distrib. Mt. Kilimanjaro, Mt. Kenia, Manganya Hills. Also in tropical Asia.

E. 6000 ft. January.
Also collected by Scott Elliot (No. 7767 at 6000-7000 ft.).
Distrib. Abyssinia.

E. 5000 ft. April.
A form with smaller leaflets than type.
Distrib. of type. Lower Guinea, Uganda.
There is another species of Tephrosia in the collection gathered at an elevation of 3500 ft. It is closely allied to T. bracteolata, but the flowers are only in bud.

Smithia (Kotschya) ruwenzoriensis, sp. nov.
Frutex erectus, ramulis viscido-setulosis; stipulis lanceolatis; foliiis breviter petiolatis, foliolis circ. 20–30 lineari-oblongis sapissime alternis, costa submarginali, apice mucronatis, margine antico recto vel subrecto ciliato, petiolo communi setuloso; racemis axillaribus quam folii sapissime longioribus apice versus densifloris; bracteolis ad apicem pedicelli 2 oblongo-lanceolatis vel anguste lanceolatis, margine ciliatis, acutis levissime falcatis; calyce setoso-fimbriato, labio superiore apice bilobato, labio inferiori ultra medium 3-lobato, lobis lateralis oblongis vel
oblongo-lanceolatis acutis, infimo lanceolato illis angustiore apice acuto; corolla calyce longiore, vexillo obovato unguiculato carinam et alas paulullo excedente, alis inaequaliter oblongis, apice rotundatis, basi unguiculatis, carina naviculariformi, basi unguiculata, apice rotundata; ovario stipitato, articulis sепissime 2, stipite glabro; stylo gracillimo glabro.


Hab. Ruwenzori.
Folia 4-0-5'0 cm. long. Foliola 8-10 mm. long., ± 2 mm. lat. Bracteolae ad apicem pedicelli ± 5 mm. longe. Vexilli lamina 8-9 mm. long., 7-8 mm. lat., ungu ± 2 mm. long. Alæ cum unguibus ± 1'1 cm. long. Carina cum ungue ± 1'1 cm. long. Calycis lab. superius ± 8 mm. long.

Noticeable on account of the rather dense racemes generally slightly longer than the leaves, the distinctly stipitate, glabrous, generally biarticulate ovary, slender style, and the lanceolate slightly falcate bracteoles.

Desmodium Scalpe, DC. Prod. ii. 334.
6000 ft. January.
Distrib. Nile Land, Upper Guinea, Mozambique District; Lower Guinea. Also in Natal, East India, &c.

D. lasiocarpum, DC. Prod. ii. 328.
Semliki Valley. 3000 ft. July.
“Herbaceous; flowers red.”
Distrib. Widely distributed in tropical Africa.
A common Indian and Malayan species.

Vigna luteola, Benth. in Mart. Fl. Bras. xv. i. 194, t. 50. fig. 2.
E. 6000 ft.
Distrib. Widely distributed in tropical Africa. Also a plant of the Cape, tropical Asia, America.

E. 6000 ft. January.
Also collected by Scott Elliot (No. 7748).
Distrib. Widely distributed throughout the Tropics.

Baphia (Delaria) Wollaston, sp. nov.
Frutex ramulis cortice griseo-glabris vel glabriusculis, foliis breviter petiolatis oblongo-lanceolatis vel oblongis vel lanceolatis apice longe
Plants collected on Mt. Ruwenzori.

Acuminatis apice ipso obtusis basi cuneatis vel rotundatis subcoriaceis superne glabris, nervo medio subus pilosulo, nervis lateralisbus tenuibus subbus sub lente tenuiter reticulatis; pedicellis solitariis axillariusbus tenuibus vel in racemum brevissimum dispositis; bracteolis reniformis semiornibicularibus brevissimis; calyce spathaceo subcoriaceo glabro prater apicem puberulum quam vexillum breviori; petalis pallide flavis secessis et detectorems, vexillo late subovato-orbiculari subsessili, alis inaequilateraliter oblongis unguiculatis, carina apice obtusa basi breviter unguiculata; ovario glabro saepe 4-ovulato, apice in stylum attenuato.

Species B. angolensis, Welw., et B. bipindensis, Harms, affinis ab ambabus, differt calyce crassiori subcoriaceo, ab illa pedicellis parum brevioribus et apicem versus pilosulis ab hac ovario glabro.


“Shrub. Pale yellow.”
Folia 4-8 cm. long., 2-0-2.8 cm. lat.; petioli 2-3 mm. long. Bractee ± 1.5 mm. longe. Calyx 1.5 cm. long. Vexillum ± 2.0 cm. long. Carina ± 2.0 cm. long.

The following short clavis indicates the position of this plant with its nearest allies:—

* Ovarium glabrum vel subglabrum.
† Pedunculi 8-15 mm. Vexillum ± 1 cm. long. fide Harms.
Baphia Preussii, Harms. Cameroons.
†† Pedunculi 2 cm. attingentes. Vexillum in spec. nost. hau bene evolutum.
B. angolensis, Welw. Angola.
††† Pedunculi 1-3 cm. attingentes secipisme breviores. Vexillum ± 2 cm. long.
B. wollastonii, sp. nov. Mt. Ruwenzori.
†††† Pedunculi 1-3-2.3 cm. Vexillum 1.3 cm. longum.
B. barombiensis, Taub. Cameroons.
** Ovarium subsericeo-pubescentis.
B. bipindensis, Harms. Cameroons.

E. 6000 ft. January.
“Herbaceous; flowers yellow.”
Distrib. Nile Land, Mozambique District.

E. 4000 ft. July.
“Climbing; flowers pale yellow.”
Distrib. Upper and Lower Guinea.
**Cassia didymobotrya**, *Fres. in Flora*, xxii. (1839) 53.
E. 7000 ft.
"20–30 ft.; flowers yellow."
*Distrib.* Nile Land, Lower Guinea, Mozambique District.

S.E. 3500 ft. June.
*Distrib.* Widely distributed.

E. 7000 ft. January.
*Distrib.* Lower Guinea, Mozambique District, Uganda.

S.E. 3500 ft. June.
*Distrib.* East tropical Africa.
A common Indian species.

**Albizia Brownei**, *Walp. Rep.* i. 928.
S.E. 3000 ft. June.
"Tree, 70–80 ft.; flowers pink."
*Distrib.* Upper Guinea, Lower Guinea.

**ROSACEÆ.**

E. 10,000 ft. February.
There is a specimen of this plant in *Herb. Kew.* collected by Mr. Dawe (No. 559).
*Distrib.* Mt. Ruwenzori.

E. 12,500 ft. February.
*Distrib.* Mt. Ruwenzori.

E. 11,000 ft. April.
The type was described from specimens collected by Scott Elliot (No. 8109) at an altitude of 12,000 ft., and by Mr. Dawe at 10,000–11,000 ft. (No. 613).
*Distrib.* Mt. Ruwenzori.
E. 12,000 ft. February.
The type was collected by Mr. Dawe at an altitude of 8,000–11,000 ft.
(No. 678). It is allied to A. cinerea, Engl., from Mt. Kilimanjaro.
Distrib. Mt. Ruwenzori.

Alchemilla argyrophyllmoides, sp. nov.
Suffrutex caule repente, ramis primariis elongatis ramulos breveux axillares numerosos emittentibus, praeter stipulas vaginantis sericeo-pilosis; stipulis tenuiter scariosis brunneis marginie ciliatis; foliis subsessilibus vel brevissime petiolatis subcoriaceis tripartitis, lobo medio majore oblan-
ceolato-obovato apice tridentato serraturis quam lobis A. argyrophylla, Oliver, multo brevioribus, lobis lateraliibus angustioribus oblongololaeolatis vel oblongo-oblanceolatis apice haud lobatis omnibus sericeo-pilosis; cymis axillaribus paucifloris floribus pedicellatis; perianthii tubo turbinato, lobis exterioribus lineari-lanceolatis, interioribus multo majoribus ovatis apice subacutis; staminibus 4 filamentiis quam perianthii lobis ex-
terioribus brevioribus; carpellis 2–3 glabris oblique ovoideis stipitatis, stylo tenui instructis.
Species A. argyrophylla, Oliver, affinis, differt foliorum lobo medio antice tridentato haud trilobato, carpellis sepissime paucioribus.
Hab. Ruwenzori E. 12,000 ft. February.
In flower February. Also collected by Mr. Dawe on Mt. Ruwenzori
(No. 615).
Folia 8 mm.—1 cm. long., lobo centrali 2–0 mm.—3–5 mm. lat. Perianthii
lobi exteriores vix 1 mm. longi, interiories ± 1-5 mm. longi.

Alchemilla subnivalis, sp. nov.
Suffrutex diffusus, caule repente ± piloso, ramis primariis in speciminibus
mihi obviis haud valde elongatis ramulis axillares numerosos emittentibus; sti-
pulis membranaceis pallide brunneis vaginantibus ± pilosis; foliis cuneato-obo-vatis coriaceis margine antice brevissime trilobatis, lobo medio
minore, supra loco costarum et nervorum lateraliium insculptis utrinque
pilosis basi in petiolum brevem attenuatis; cymis axillaribus paucifloris
floribus breviter pedicellatis; calyces tubo glabro statu floriferi turbina-
to; perianthii lobis exterioribus minoribus, interioribus late trian-
gulari-ovatis apice obtusis omnibus margine ciliatis; carpellis circ. 4
stipitatis glabris, stylo tenuissimo 1¼–2-plo longiore instructis.
Species A. argyrophylla, Oliver, affinis, differt ambitu foliorum valde
diverso lobis laminan stricte terminantibus haud alte trilobatis.
Hab. Ruwenzori E. 14,000 ft. February.
Folia cum petiolis 8–10 mm. long., 5–6 mm. lat. Calyces tubus ± 2 mm.
longus, lobis interiories ± 1-5 mm. longi. Carpella ± 75 mm. longa.
This interesting little plant is distinguished from its near allies by the
shape of the leaves, which are cuneate obovate and very shortly petioled and terminate by three short lobes directed forwards. Flowers are difficult to find on our material.

The following clavis indicates the position of these two novelties in relation to the nearest allies. All are pilose or generally sericeo-pilose and have brown, membranous, sheathing stipules.

* Folia cuneato-obovata brevissime trilobata, lobis laminam stricte terminantibus. 
  ** Alchemilla subnivalis, sp. nov. Mt. Ruwenzori.

** Folia tripartita, lobis lateralibus quam lobo centrali angustioribus illius margine integro.
  † Lobo centrali late oblancoelato usque ad 3-5 mm. trifido. 
  A. argyrophylla, Oliver. Mt. Kilimanjaro.

†† Lobo centrali oblancoelato-obovato usque ad 0,5 mm. dentato.
  A. argyrophylloides, sp. nov. Mt. Ruwenzori.

*** Folia trilobata, lobis omnibus margine anteriore argute serratis.
  A. Stulmanni, Engler. Mt. Ruwenzori.

**** Folia flabellatim 3–5-lobata, margine anteriore serrata.
  A. ruwenzoriensis, Rolfe. Mt. Ruwenzori.

In addition to the plants already mentioned, Mr. G. F. Scott Elliot collected on Mt. Ruwenzori at 7000–10,000 ft. a plant which seems to agree closely with A. Volkensii, Engler, the chief difference being the carpels in the plant from Ruwenzori are more numerous.

CRASSULACEÆ.

Sedum ruwenzoriense, sp. nov.

S. caule humifuso repente ad nodos inferiores radicante sparse foliato ramen- taceo; foliis ligulati-oblongi vel subspathulatis tenuiter membranaceis, apice obtusis basi cauli petiata alternis vel suboppositis; inflorescentia corymbosa, ramulis tenuibus curvatis; sepalis linearis-lanceolatis, basi breviter auriculatis petalis subacute oblongis; petalis flavis linearis-oblongis apice obtusis vel subaequis; filamentis filiformibus, antheris breviter ovatis; carpellis ellipticis marginis hyalinis sursum in stylos abrupte attenuatis, stylo tenui quam carpeilla dimidio breviore, stigmatic parvo capitellato.

Species S. Volkensii, Engler, affinis, differt foliis sepsissime linearis-oblongis floribus paullo majoribus, carpellis sursum in stylos abrupte attenuatis. carpellis sepsissime apice obtusis.

Hab. Ruwenzori E. 12,500 ft. In flower February.

“Flowers yellow.”

Folia 1,0–1,8 cm. longa, 3,0–4,0 mm. lat. Sepala ±6 mm. longa. Petala ±6 mm. longa. Carpella 2,5 mm. longa, 1,2 mm. lat. Stylus ±1 mm. longus.
PLANTS COLLECTED ON MT. RUWENZORI.

E. 7000 ft. January.
Distrib. of var. Mozambique District.

(Umbilicus botryoides, Hochst. in Schimp. Pl. Abyss. ii. n. 1300.)
E. 10,000 ft. February.
Distrib. of var. Mountains of Abyssinia, Mt. Kilimanjaro.

MELASTOMACEAE.

E. 6000 ft. January.
This agrees with Dr. Gilg’s description, with the exception that the petals in Dr. Wollaston’s plant are broader.
Distrib. Mozambique District.

TRISTEMMA INCOMPLETUM, R. Br. in Tuckey’s Congo, Appendix, 435.
7000 ft. January.

BEGONIACEAE.

BEGONIA (§ Rostrobegonia) WOLLASTONI, sp. nov.
Herba elata, caule eramoso carnoso terete glabro; foliis mediocreriter vel longiscule petiolo petiolatis, petiolo glabro, obliquis, ambitu ovatis apice acuminatis sinu sublateraliter posito, margine distincte inaequaliter serratis, lamina membranacea utrinque sparsissime pilosa et subitus ad nervos venasque pilis allbidos sparsissime vestita, nervis ±10 radiantis omnibus iterum atque iterum furcatis nervo intermedio penninervio, venis laxe reticulatis subus subprominentibus; stipulis magris persistentibus ovato-oblongis glabris; inflorescentiis dichotome furcatis; bracteis tenue membranaceis, pedunculis tenuibus glabris vel glabrescentibus; floribus secus el. detectorem puniceis, fl. ♂ sepalis 2 suborbicularibus, petalis 2 quam sepalis multo minoribus obovatis; staminibus numerosissimis basi in columnam brevem connatis superioribus liberis aequaliter radiantis antheris rotundatis; fl. ♀ quam fl. ♂ manifeste minoribus, sepalis 2 obovato-orbicularibus et petalis 2 subaequalibus; ovario trialato, stylis a basi liberis horum lobis profunde fissis ramiis flabellatim pluripartitis, lobis ultimis apice dense papillosis, fructibus perfecte evolutis haud visis.
Ab *B. Johnstonii*, Oliver, differt foliis laterioribus margine serratis hanc erenatis, etc. in fl. ♂ sepalis quam petalis multo majoribus.

*Hab.* Ruwenzori E. 7000 ft. In flower March.

"Flowers pink."

Folia 10–13 cm. long., 6:5–8:0 cm. lat. Petiolis 5:0–10:0 cm. longi, leviter apice crassiusculi, annulo setarum instructi. Stipulae 1:2–1:5 cm. longae. Fl. ♂ sepala ± 2:5 cm. longa et lata, petala 1:4 cm. longa. Fl. ♂ sepala ± 9 mm. longa.

Evidently allied to *B. Johnstonii*, Oliver, and *B. Engleri*, Gilg. Differs in the male flowers having sepals much longer than the petals.

**Begonia Meyeri-Johannis, Engl. Hochgebirgsfl. 305.**

8000 ft. January.

*Distrib.* Mt. Kilimanjaro.

**UMBELLIFERÆ.**

**Sanicula europaea, Linn. Sp. Pl. 339.**

E. 7000 ft. January.


**Peucedanum Petitianum, A. Rich. Tent. Fl. Abyss. i. 327.**

E. 7000 ft. January.


E. 12,000 ft. February.

*Distrib.* Mt. Kilimanjaro.

Mr. Wright informs me that "*Peucedanum dissectum*, Dawe, Report, p. 46, is Mr. Dawe's name for the plant described in Sir H. H. Johnston's 'Uganda Protectorate,' i. p. 326, as *Anthriscus dissectus*. The original specimen consisted of leaves and detached fruits, the latter certainly belonging to *Anthriscus*. Specimens sent by Mr. Dawe, No. 598, have the fruits attached and are correctly referred to *P. dissectum.*" These latter are very closely allied to the plant collected by Dr. Wollaston.

**Torilis gracilis, Engl. Hochgebirgsfl. 301.**

7000 ft. February.

Also collected by Scott Elliot (No. 6833) at 7000–8000 ft.

*Distrib.* Mozambique District. And the forma *umbrosa*, Engl.: Mozambique District and Mt. Ruwenzori.
PLANTS COLLECTED ON MT. RUWENZORI.

GAMOPETALÆ.

By Spencer Le M. Moore.

The collection includes the following well-known plants:—Adenostemma viscosum, Forst., 7000 ft.; Ageratum conyzoides, Linn., 6000 ft.; Dichrocephala latijolia, DC., 6000 ft.; Plucheia Dioscoridis, DC., 3500 ft.; Eclipta erecta, Linn., 3500 ft.; Gymnura cernea, Benth., 6000 ft.; G. crepidioides, Benth., 6000 ft.; Sonchus asper, Hill, 3500 ft.; Ecolurus alsinoides, Linn., 3500 ft.; Leucas martinicensis, R. Br., 7000 ft.; and Leonotis nepetfolia, R. Br., 7000 ft.

RUBIACEÆ.

PENTAS PURPUREA, Oliver, in Trans. Linn. Soc. xxix. (1873) 83, var.

E. 6000 ft. January.

Distrib. Nile Land, Mozambique, Lower Guinea.

PENTAS PUBIFLORA, sp. nov.

Herbacea, ascedentes, caule subteretis sursum ramulosos mox lineis duabus pubescentibus exemptis glabro novellis dense pubescentibus, foliis ovato-lanceolatis lanceolatis acutis vel caudato-acuminatis basi in petiolum brevem angustatis supra scabriuscule puberulis subtus pubescentibus costis secundarum utrinque 10–13 leviter arcuatis, stipulis a basi setiferis setis pubescentibus, corymis ovatis, pubescentibus vel ascalicibus dense pubescentibus floribus pro rata parvulis subsessilibus pentameris, calyceis dense pubescentibus lobis triangulidi-deltoides 2 (vel 1) linearis-lanceolatis quam reliquis multo majoribus, corollae tubo extus dense pubescentibus faucibus villosulis lobis tubum laud semicircumscibitis linearis-lanceolatis acutis extus dense pubescentibus, staminibus longo infra faucibus insertis filamenti glabris antheris exsertis, disco eminente pubescenti, ovario 2-loculo, styllo incluso glabro.


Folia modica 6-0–10-0 cm. long., 2-0–3-5 cm. lat., membranacea, subtus grisea. Stipularum setae circa 0-6 cm. long. Cymae 5-0–9-0 cm. long., adusque 10-0 cm. diam. Pedicelli circa 0-1 cm. long. Flores albi. Calyceis lobi majoris circa 0-3 cm. long., reliquis 0-175–0-15 cm. Corollae tubus sursum leviter amplificatus, intus pubescentus, 0-15 cm. long., basi 0-125 cm., faucibus 0-2 cm. diam.; lobi 0-2 cm. long. Filamenta 0-2 cm., antherae 0-12 cm. long. Ovarium hemisphericum, dense pubescentus, 0-15×0-15 cm. Stylus 0-2 cm., hujus rami 0-1 cm. long. Capsula sparsim pubescenta, longitrorsum costata, disco elevato coronata et calyceis lobis adusque 0-15–0-4 cm. auctis instructa, in toto 0-3 cm. long., vix totidem lat.
Known from its congener, among other features, by the very short and densely hairy corollas. The affinity is with *Pentas herbacea*, Hiern, from Golungo Alto.

**Var. longistylo**. Corollae paulllo breviores (0·5 cm. long.) neenon extus-paullulum minus pubescentes. Anthere subsessiles, incluse. Stylus exertus, cum stigmatc 0·6 cm. long.


Apparently a long-styled form of the species.

**Pavetta ruwenzoriensis**, sp. nov.

*Arbuseula* ramulis validis tetragnonis pubescentibus dein puberulis novellis-albo-hirsutulis, foliis sat amplis ellipticis apice cuspidato-acuminatis ipso obtusiunculis basi in petiolum piloso-pubescentem longe sensimque angustatis membranaceis utrobique præsertim vero fac. inf. puberulis costis secundariis utrinque 11–12 patulis sub margine subito arcuatis, stipulis inferne longe cuneatis dorso pubescentibus superne lineari-subulatis pilosis, corymbis axillaribus sublaxe multifloris pedunculis longis validis erecto-ascendentibus max minite puberulis fulcis, floribus 4-meris, pedicellis puberulis quam calyx brevioribus, calycis tubo (ovario) subspheroideo puberulo limbo ultra ovarium longiusculum producto ut lobi lineari-subulati glabro, corollae tubo elongato intus piloso-puberulo lobis oblongis obtuse acutis tubum plus quam semiaequantibus, filamentis brevibus crassiusculis antheris exsertis, stylo corollam longe excedente crassiusculo puberulo, stigmatic angusto fusiformi integro, bacca maxime cruda reliquis calycis limbis exuti coronata.

Hab. Ruwenzori E. 7000 ft. January. (Also Ruwenzori, 7000–8000 ft., Scott-Elliot, 7833; and Uganda, id., 7399.)

Folia, adulta 12·0–14·0 cm. long., 5·5–7·0 cm. lat., in sicco olivacea; coste ord. sec. tenues, pag. sup. planae, pag. inf. eminentes; petioli circa 2·0 cm. long. Stipularum pars connata 0·4–0·5 cm. long., harum pars libera 0·4 cm. long. Pedunculus circa 14·0 cm. long. Pedicelli 0·2–0·5 cm. long. Corymbi circa 10·0 cm. diam. Flores albi. Ovarium 0·2 cm. long. Calycis limbus in toto 0·8–0·9 cm.; lobi circa 0·05 cm. long. Calycis reliquia baccaem coronantes circiter 0·05 cm. long. Corollae tubus 1·85 cm. long., 0·2 cm. diam.; lobi circa 1·0 cm. long., 0·3 cm. lat. Filamenta 0·13 cm. long.; antherae lineares, tortae, 0·85 cm. long. Stylus 4·7 cm. long.

Known by the elliptical pilose-puberulous leaves, the long stout axillary peduncles, the calyces with relatively long glabrous limb and lobes leaving a distinct rim behind them upon their detachment, which appears to happen immediately after opening of the flower, and the long pube-rulous styles with narrowly fusiform stigma.
Grumilea megistosticta, sp. nov.

Arbor ramulis compressis cerebro foliosis cortice sulcato max circumdantis diisecule glabris novellis pubescentibus, foliis breviter petiolatis oblongo-ovatis cuspidato-acuminatis apice acutis basi obtusis leviter rotundatis papyraceis supra glabris subus in costa media et costulis piloso-hirsutulis in axillis costarum secundariarum glandula (domatio) pellucida maxima omnis utroque opacis fac. in. vero pallidioribus, stipulis late ovatis obtusis integris extus minute pubescentibus, floribus in cymis paucifloris abbreviate minute pubescentibus pauiculam longe superatam digestis, bracteis brevissimis ovatis, pedicellis quam ovarium brevioribus, ovario subsphaeroidali fulvopubescente, calyce ovarium excedente leviter angustato dentibus triangularibus obtusis fere glabro, corollae tubo basi angustato inde dilatato etus minute puberulis semidiviso, staminibus exsertis, styllo breviter exserto ramis oblongis obtusis quam se ipse brevioribus, bacca —.


Arbor sec. cl. collectorem circa 12-metralis ("30–40 ft. high"). Folia solemniter 7-0–100-0 x 3-5–5-0 cm.; costa secundaria utrinque 9–11, patentes, juxta marginem dichotomae, utrinque praevertit attamen pag. inf. eminentes; glandulae axillares ellipticae, 0-15 x 0-1 cm., quaeque a costa sua secundaria subito decurva marginata; petioli ± 1-0 cm. long., raro 2-0 cm. Stipulae fere 1-0 cm. long. Panicula 3-0 cm. long. Pedicelli incrassati, 0-05 cm. long. Flores albi. Ovarium 0-1 cm., calycis limbus totus 0-175 cm., hujus lobi 0-025–0-05 cm. long. Corolla in toto 0-7 cm. long.; tubus 0-35 cm., humectatus basi 0-1 cm., fructus 0-3 cm. diam.; lobi 0-35 cm. long., fac. sup. prominule 1-nervosi. Filamenta paullo infra fuentes inserta, 0-25 cm. long.; antherae late oblongae, 0-13 cm. long. Stylus vix 0-4 cm. stigmatis rami 0-12 cm. long.

Although without fruit, this seems to be a Grumilea rather than a Psychotria. It is known at sight by the extremely large gland-like domatia in the axils of the secondary nerves.


Distrib. Nile Land and Upper Guinea.

Galium serratohamatum, sp. nov.

Herbaceum, ramis sat elongatis gracilibus hispidulo-scabridis infra nodos hispidis ipsos ad nodos pilis longis acriteris ferrugineis onustis, foliis pro verticillo 6 sessilibus oblongis vel oblongo-linearibus apice breviter spinulosi imtempti basi leviter angustatis margine serratis serraturnis retrorsis...
spinulosis uninervibus in sicco nigrescentibus, floribus viridibus 4-meris in cymis abbreviatis (sc. quam folia brevioribus) 2-4-floris ramulos breves laterales terminantibus et a foliis parvis 1-4-bracteatis dispositis, pedicellis ovarium aequantibus vel eo brevioribus longioribus, ovario oblate sphaeroidice glablo vel fere glabro, fructu parvo subsphaeroidice glablo vel sparsim hispidulo.

*Hab.* Ruwenzori E. 12,500 ft. February.

*Folia* ± 1.0 cm. long., 0.2-0.3 cm. lat., firme membranacea, in sicco marginibus plerumque revolutis : spinula terminalis circa 0.1 cm. long., sepe uncinata ; serrature adusque 0.03 cm. alt. Cymae cum ramulo sufflscente circa 0.5 cm. long., hispidulae. Pedicelli 0.025-0.1 cm. long. Ovarium 0.05×0.075 cm. Flores circa 0.25 cm. diam. Corolla lobi sulcata, 0.15 cm. long. Filamenta 0.05 cm., antherae 0.025 cm. long. Fructus 0.12×0.1 cm.

Distinguished from varieties of *G. Aparina*, Linn., by the leaves with distinctly serrated margins, the short inflorescences, and small fruits.

**COMPOSITÆ.**


E. 7000 ft. January.

*Distrib.* Nile Land, Mozambique District.

**VERNONIA (§ Lepidella) WOLLASTONII, sp. nov.**

Herbaeae, caule erecto verisimiliter rariramose bene folioso pluristratiato parce pubescente novellis dense fulvo-pubescentibus, foliis parvis brevipetiulatis lanceolatis acuminatis basi acutis margine distantер serrulatis serraturis induratis vulgo arrectis membranaceis pag. sup. cito costis puberulis exemptis glabris pag. inf. ad costas appresse pubescentibus albi glandulis minimis sessilibus perlucentibus onustis, capitulis parvis 12-flosolesulosis in corymbum terminale folia excedentem laxum pluricephalum rari-bracteatum digestis, bracteis folia mentientibus sed is lisernequi minoribus, involueri graciliter pedunculati campanulati pubescentis 3-serialis phyllis extimis subulatis quam inferiora lanceolata acuminata in sicco dilute straminea plane brevioribus, flosoles ex involucro longe eminentibus, acheniis cylindricis 5-costatis piloso-pubescentibus necon glandulis minimis lucentibus instructis, pappi setis scabriusculis albis achenea 2-plo excedentibus squamellis brevibus angustissime linearibus glabras.

*Hab.* Ruwenzori E. 7000 ft. January.

*Folia* solemniter 4.0-6.0 cm. long., 1.2-1.5 cm. lat., accedunt alia multo minora ex ramulis juvenilibus abbreviatis orta ; costae secundariae utrinque circa 8, parum arcuatae, pag. sup. planæ, pag. inf. paullo
eminentes; petioli circa 0·5 cm. long., pubescentes. Corymbus 7·0–10·0 x 12·0–14·0 cm.; hujus bractea 2·0–4·0 cm. long. Pedunculi proprii sepius 1·0–1·5 cm. long., rarissime adusque 0·2 cm. imminuti, pubescentes. Involucrum 0·6 cm. long., 0·65 cm. diam.; phylla extima circa 0·2 cm., interiora 0·55 cm. long., haec subscariosa, 3-nervia (intima vero sepe 1-nervia). Corollae extus sparsissime glandulosae tubus superne leviter ampliatus, 0·6 cm. long.; lobi anguste oblongi, 0·3 cm. long. Styli rami circa 0·2 cm. long. Achenia 0·3 cm. long.; pappi setae 0·6–0·7 cm. long.; squamellae 0·05–0·075 cm. long.

Nearest V. syringaejolia, O. Hoffm., a species which Dr. Hoffmann refers to § Cyanapis, although the outer pappus seems to me to be of squamellae, though very narrow ones. From this it differs entirely in leaf, also in the smaller heads with only half the number of florets, the pubescent involucres, &c. V. Biafra, Oliver & Hiern, referred in the 'Flora of Tropical Africa' to § Lepidella although its squamellae are no wider than those of V. syringaejolia, is also closely allied to the new plant, but, inter alia, its involucres are quite different.

S.E. 3000 ft. June.
Distrib. Nile Land, Lower Guinea.

7000 ft. January.
" A shrub 5–10 ft. high. Flowers white."
Distrib. Restricted to Ruwenzori.

Conyza scariosa, sp. nov.
C. caule gracili crebro foliato longitrorsum pluristriato cito glabrescente, foliis sessilibus lineari-oblongis vel anguste oblongo-linearibus acutis basi brevissime amplexiculibus margine distanter serrulatis membranaceis supra glabris subitus in nervis margineque leviter hispidulis, capitulis mediocribus multiflosulosis in corymbum terminalem sparsim bracteatum folia longe excedentem laxisculum digestis, pedunculis propriis gracilibus excedentibus vel subaequantibus minute pubescentibus, involucris hemisphericis glabri vel sumnum leviter puberuli 3-seriatis phyllis oblongo-obovatis obtusissimis margine apice-que late scariosi longitrorsum plurinervosis extimis quam interiora brevioribus, receptaculo convexisculo foveolato foveolis similliferis, flosculis fem. multiseriatis hermaph. pluribus albis, flosculorum fem. corollis apice denticulatis nequaquam ligulatis, achenis oblongis com-
pressis glabris, pappi setis achenia longe exceedentibus 1-seriatis scabridis sordide albis.

**Hab.** Ruwenzori E. 7000 ft. January.

Folia modice 2.5–3.0 cm. long., ± 0.5 cm. lat., costae costulaque (pag. inf. magis aspectabiles) eleganter reticulatae. Corymbi circa 10 cm. long., summum 8–0 cm. diam. Bracteae foliaceae, lineares, 0.05–0.2 cm. long., summa angustissimae. Pedunculi proprii solemniter 0.5–1.0 cm. long. Involucrum 0.6 × 0.6 cm.; phylla extima 0.4 cm. long., intermedia circa 0.5 cm., hae adusque 0.25 cm. lat.; paeue adsum intima circa 0.15 cm. lat., omnia in sicco dilute brunea. Flosculorum fem. corolla circa 0.15 cm. long., flosculorum hermaph. 0.4 cm. long., horum lobi 0.1 cm. long. Achenia 0.1 cm., pappus 0.35 cm. long.

At once distinguished from its African congeneres by the broad very obtuse scarious leaves of the involucre.

**CONYZA MONTIGENA, sp. nov.**

*C. caule gracile subtereti crispe pubescente cito glabro longitrorum striato brunneo-rubescente, foliis sessilibus lanceolato-oblongis margine integris vel hinc illinc dentulati membranaceis utrinque glabris, capitulis pro rata mediofrubus multiflorosulosis in corymbo terminali pauciibracteato polycephalo folia sequente vel leviter exceedente dispositis, pedunculis propriis exceedentibus gracilibus pubescentibus, involuci hermaph. 3-serialis phyllis lineari-lanceolatis (intimis angustioribus) acuminatis unimervibus subsacriosis, receptaculo convexusculo foveolato foveolis simbrilliferis, flosculis fem. pauciserialibus hermaph. complurimis flavicantibus, flosculorum fem. corollis breviter ligulatis ligula a stylo plane superato, acheniis adhuc crudis oblongis (basi vero leviter angustatis) compressis serico-puberulis, pappi setis 1-seriatis sordide albis scabriusculis.

**Hab.** Ruwenzori E. 11,000 ft. February.

Folia 2.0–4.5 cm. long., 0.7–1.3 cm. lat., pag. inf. pallidiora, eleganter reticulata. Corymbus 2.5–3.0 cm. long., 4.0–6.0 cm. diam. Bracteae lineares vel lineari-oblonge, ± 0.5 cm. long. Pedunculi proprii modice 0.5–1.0 cm. long. Involucrum 0.6 × 0.7–0.8 cm.; phylla 0.55 cm. long., intermedia 0.15 cm., intima 0.1 cm. lat. Flosculorum fem. corolla tubus 0.2 cm. long.; ligula 0.1 cm. long. Flosculorum hermaph. corolla in toto 0.4 cm. long.; lobi vix 0.1 cm. long. Achenia 0.1 cm., pappus 0.4 cm. long.

The flowering heads are much like those of *C. gigantea*, O. Hoffm., except for the presence of the distinct though short ligule to the outer florets. In addition the leaves of the two are very different, and whereas the heads of *C. gigantea* are closely compacted, those of *C. montigena*, besides being fewer, are much more laxly arranged.
LAGGERA ALATA, Sch. Bip. ex Oliver, in Trans. Linn. Soc. xxix. (1873) 94, var. DENTATA, var. nov. Differs only from some of the more hairy forms of the species in the toothed wings to the stem.

E. 6000 ft. January.

Distrib. Common (the type) in tropical and subtropical Africa. Also a Mascarene and tropical Asian species.

HELICHRYSUM (Argyreia § Elegantissima) ARGYROCOTYLE, sp. nov.

Herbacea, caule erecto forsan simplici tereti fistulosu araneoso-puberulo vel pubescente crebro folioso, foliis medioeribus sessilibus lanceolato-oblongis apice mucronatis basi obtusis leviterve rotundatis uninnervibus membranaceis supra scabriusculis subitus pubescentibus, capitulis medioeribus homogamis multitubulosus in corymbo terminali laxo pluricephalo bracteato folia excedente vel requante araneoso-pubescente ordinatis, bracteis foliaceis junioribus imminutis, involucro hemispheericui multiserialis phyllis extinis comparate brevibus interioribus gradatim longioribus lamina sat elongata lineari-lanceolata (phyll. intimorum lineari) acuminata radiante nitente instructis, receptaculo plano alveolato nudo, floresculis inclusis, corollis 5-lobis, antherarum caudis sparsim setaceo-camosis, stylis ramis apice subcapitatis, acheniis cylindricis glabris, pappi setis uniseriabibus scabridis sordidis.

Hab. Ruwenzori E. 10,000 ft. February.

Planta saltem 30-0 cm. alt. Pili glandulosi in omnibus partibus pubigeris cum simplicibus plus minus intermixti. Folia radicalea desunt: caulina inferiora 7-5 x 2-0 cm., superiorea 3-0-6-0 cm. long., 1-2-1-8 cm. lat. Corymbi 4-0-10-0 cm. long., 8-0-15-0 cm. diam. Bractee sepsissime 0-7-2-5 cm. long., plerumque lineares vel lineari-lanceolatae, suusum attenuate, araneoso-puberulae. Pedunculi proprii solemniter 2-5-3-5 cm. long., patentes. Capitula 1-25 x 1-5 cm. Involucr phylla extina basi araneosa, 0-6-0-7 cm. long., intermedia 0-85-0-9 cm., intima 1-0-1-1 cm. long. Receptaculum 0-5 cm. diam. Corollae 0-25 cm. long. Antherarum loculi 0-8 cm., caudae 0-3 cm. long. Achenia agre 0-1 cm., pappus 0-3 cm. long.

Near H. elegantissimum, DC. (H. formosissimum, Sch. Bip.), from which it is easily distinguished by the smaller leaves, the smaller heads with more pronouncedly acuminate involucral leaves, and the small corollas.

To this is to be referred Scott Elliot's No. 8010 (Ruwenzori, 9000-10,000 ft.), which I formerly (Journ. Linn. Soc., Bot. xxxv. (1902) 333) named "H. elegantissimum, DC."

HELICHRYSUM (Argyreia § Elegantissima) WOLLASTONI, sp. nov.

H. caule erecto crebro folioso dense albo-araneoso lanuginoso, foliis sessilibus lanceolato-oblongis apice mucronatis uninnervibus chartaceis supra laxe
araneosis tandem verisimiliter glabris subitus densissime dilutissime ulvo-
floccoso-tomentosis, capitulis mediocribus multiflocculosus heterogamis in
corymo brevi racemiformi paucicephalo satis laxo bracteato dense
lanuginoso dispositis, pedunculis propriis quam capitula brevioribus vel
ea subquantius dense lanuginosis, bracteis foliis similibus nisi minori-
bus, involucri late ovoidei pluriseriati phyllis interioribus gradatim longi-
oribus extimis lamina ovato-lanceolata intermedii lanceolata intimis
lineari-oblonga coronatis acutis tandem radiantes exterioribus purpureis
interioribus argyreis nitentibus, receptaculo plano nudo alveolato,
flosculis paucis extimis feminis, corollis 5-lobis, antherarum caudis
simplicibus, styli ramis subcapitatis, acheniis cylindricis (ima basi
dilatatis) glabris, pappi setis paucis 1-serialibus scabridis albis.

Hab. Ruwenziro E. 12,000 ft. February.

Speciminis unici mihi obvii caulis simplex, 24-0 cm. alt., robustus (sc. basi
0-8 cm. lat.), in sicco prominenter striatus. Folia 4-5-8-0 cm. long.,
1-0-1-7 cm. lat., summa in bracteas transeuntia. Corymbus 6-0 × 6-0 cm.
Bractee ± 1-5 cm. long. (infimae fere adusque 4-0 cm.), araneosae.
Pedunculi proprii patentes, 1-0-2-0 cm. long. Capitula 1-8 × 1-2 cm.
Involucri phylla extima 0-8-0-9 cm., intermedia 1-0-1-1 cm., intima
1-2 cm. long. Receptaculum 0-5 cm. diam. Corollae 0-25 cm. long.
Antherarum loculi 0-075 cm., caudae 0-05 cm. long. Achenia (adhuc
cruda) 0-065 cm. long. ; pappi setae 0-35 cm. long.

In leaf intermediate between H. Gadielmi, Engl., and H. Lentii, Volk. & O.
Hoffm. It differs from both in the racemiform inflorescence and the
shorter, more spheroidal heads with shorter and relatively broader
involucral leaves. The three, when more specimens are forthcoming,
may perhaps be considered forms of a single polymorphic species.

E. 13,000 ft. February.

H. Stuhlmanni, O. Hoffm., var. latifolium, var. nov. Folia quam ea typi
insigniter breviora necnon latiora, sc. circa 2-5 × 0-6-0-7 cm.
E. 14,800 feet.

Though at first sight very different in foliage and decidedly more woolly,
apparently a high-level variety and not a distinct species.

Distrib. So far the species is known only from Ruwenziro and
Kilimanjaro.

H. fetidum, Moench, Method. 575.
E. 6000 ft. January.

Distrib. Nile Land and Mozambique District. Also South Africa.

LINN. JOURN.—BOTANY, VOL. XXXVIII.
PLANTS COLLECTED ON MT. RUWENZORI.

**Helichrysum setosum**, *Harr. in Fl. Cap. iii.* 231.
E. 7000 ft. January.
*Distrib.* Nile Land, Mozambique District. Also South Africa.

**Melanthera Brownei**, *Sch. Bip. in Flora*, xxvii. (1844) 673.
6000 ft., January; and 5000 ft., March.
*Distrib.* Widely distributed through tropical Africa. Also a South-African plant.

**Guizotia collina**, sp. nov.
Herbacea, caule erecto gracili distanter folioso scabride hispidulo tandem fere glabo, foliis sessilibus linearis-oblungis obtusis basi sepe levissime amplexicaulibus margine serrulatis coriaceis pag. sup. scaberrimis inf. scabro-hispidulis, capitulis in cymis brevibus penticepsphalisis terminalibus vel ramulos sparsim foliosos coronatibus hispidulis dispositis, pedunculis propriis quam capitula brevioribus, involucri phyllis exterioribus herbaceis elongatis linearis-lanceolatis obtusis (apice callosis) hispidis quam phylla interiora lanceolato-oblonga acuta dorso sparsim hispidulo-pilosa multo longioribus, ligulis 12 oblongo-ovatis apice 3-dentatis 9-nervosis, disci corollis basi tomentosis, acheniis (nondum maturis) tetragonis glabris.
*Hab.* Ruwenzori E. 5000 ft. March.
Folia 4-0-9-0 cm. long. : circa 1-0 cm. lat. ; marginibus in sicco sepissime revolutis, fac. inf. pallida. Cymae 2-0-4-0 cm. long. Pedunculi proprii 0-2-1-5 cm. long., hispidei. involuci phylla exteriora 1-5 cm. long., ± 0-3 cm. lat. ; interiora 3-nervia, 0-5×0-25 cm. Receptaculi paleae anguste oblongo-obovatae, apice truncato-rotundate, 3-nervis, 0-6 cm. long. Ligule 1-2 cm. long., summum 0-5 cm. lat. Disci corollae 0-4 cm. long. Achaeniae 0-2 cm. long. vel paululum longiora.
Known by the hispid and scabrous clothing of various organs, the narrow undivided leaves, the narrow and relatively elongated outer involucral leaves, &c.

E. 7000 ft. January.
*Distrib.* A Nile Land plant.

E. 6000-7000 ft. January.
*Distrib.* Restricted to Ruwenzori.

E. 7000 ft. March.

*Distrib.* East and West tropical Africa.


E. 12,000 ft. February.

*Distrib.* Restricted to Ruwenzori.


E. 12,000 ft. February.

*Distrib.* Restricted to Ruwenzori.

**Senecio gynuroides**, sp. nov.

Elatus, caule subtereti striato glabro vel summum obscure puberulo, foliis lanceolato-oblongis breviter acuminatis e basi rotundata subito in petiolum brevem acuminatis margine calloso-dentatis membranaceis supra glabris subitus appresse pilosulis petioli auriculis duabus late ovatis sparsim dentatis instructis, capitulis mediocribus homogamis disoideis multiflosculosis in corymbo terminali subsessili subumbellato periancicphalo raribracteato digestis, bracteis parvis linearibus, pedunculis propriis arrectis elongatis sc. capitula magnopere excedentibus bruneo-puberulis, involucri subhemisphaerici glabri phyllis 20 anguste lineari-oblongis breviter acuminatis anguste marginatis aditis calycei phyllis pluribus lineari-subulatis ut involucri phylla microscopice puberulis, flosculis exsertis, antheris basi vix auriculatis, styli ramis truncatis appendice filiformi brevissimo onustis, acheniis cylindricis 10-costatis albo-setosis, pappi setis glabris albis.

*Ieb.* Ruwenzori E. 12,500 ft.

Planta ex schedis cl. detectoris “10–15 ped.” alt. *Foliorum limbus 10*0 cm. long., summum 3*0–3*5 cm. lat., in sicco castaneo-olivaceus; costa secundariae utrinque circa 10, ascendentes; costularum rete delicatulum, pag. inf. solum aspectabile; petioli basi dilatati, circa 1*0 cm. long., horum auricule 0*8 × 0*7 cm. Pedunculi proprii 5*5 cm. long. Bracteae +0*5 long. *Involuterum 1*0 × 1*2 cm.; calycei phylla circa 0*6 cm. long., raro 1*0 cm. attingentia. Flosculi lutei. *Corollarum tubus superne gradatim dilatatus, 0*9 cm. long., inferne vix 0*02 cm., faucibus 0*15 cm. diam.; lobi triangulares, 0*12 cm. long. Antherae incluse. *Styli rami vix 0*2 cm., appendix 0*02 cm. long. Achenia fere 0*2 cm., pappus 0*9 cm. long.

Near *S. macropappus*, Sch. Bip., which has different leaves and inflorescences, a different calyculus (*i.e.* leaves longer and relatively much narrower), larger corollas, &c.
Senecio Jugicola, sp. nov.

S. caule erecto robusto angulato pluristratiato rariramoso brunneo-pubescente demum scabriusculo, foliis petiolatis lanceolato-oblongis acutis obtusisve basi rotundatis margine serrato-dentatis summis perpaucis imminutis et in bracteas transcutentibus supra costa media puberaula neglecta glabris subitus laxe nee non appresse piloso-pubescentibus, corymbo foliis subaequilongo polycephaio patulo pubescente, bracteis parvis linearisubulatis puberulis, capitulis parvis heterogamis radiatis circa 25-flosculosis pedunculis quam sese nunc paulllo longioribus nunc brevioribus fultis, calyceuli phyllis perpaucis abbreviatis subulato-linearibus, involucro tubulo-cylindrici puberuli phyllis 8 oblongis infra apicem angustatis apice ipso acutis nunc angustissime nunc latius marginatis, ligulis 6 ex involucro eminentibus late oblongis 3-dentatis 4-nervibus luteis, disci corollis exsertis, styli ramis truncatis peniciliatis, acheniis (hucusque erudis) cylindrico-turbinate aliamento compressis 10-costatis glabris, pappi setis scabriuscolis albis.

Hab. Ruwenzori E. 9000 ft. February.

Folia matrura ±10 cm. long., et 4 cm. lat., papyracea; costa secundaria utrinque 12–15, ut costa centralis pag. inf. magis perspicieae, paullum arcuate; petioli 1–0–1,5 cm. long., araneoso-pubescentes. Corymbus circa 100 x 120 cm.: ramuli adusque 2–5 cm. long. Bracteae ±0,5 cm. long. Pedunculi proprii sepissime 0,2–0,5 cm. long. Involucrum aegre 0,5 cm. long. Calyceuli phylly vix 0,15 cm. long., marginae lanuginosa. Radii corollarum tubus 0,3 cm. long.; ligula 0,3 x 0,15 cm. Disci corollarum tubus sursum leviter ac gradatim amplificatus, 0,4 cm. long.; lobi 0,075 cm. long., oblongi, obtusi. Anthere subinclusae, basi obturissimae auriculatae. Styli rami 0,1 cm., achenia 0,1 cm., pappus 0,45 cm. long.

The description of S. serophularifolius, O. Hoffm., a plant not seen by me, reads somewhat like, but its leaves are different in shape, margin, and clothing, the capitula have fewer florets, &c.

Senecio Wollastoni, sp. nov.

S. caule angulato pluristratiato glabrescente distantior folioso foliis (paucis superioribus solumnodo visis) sessilibus lanceolatiis vel lanceolato-oblongis obtuse acutis basi distincte angustatis margine dupliciter serrato-dentatis membranaceis supra glabris subitus tenuiter araneosis mox glabrescentibus costis secundariis utrinque adusque 20, capitulis medioembris heterogamis circa 30-flosculosis in corymbo terminali laxe pluricepsphalo leviter araneoso bracteato digestis, pedunculis propriis gracilibus capitula bene excedentibus, bracteis parvis linearisubulatis araneosis, calyceuli phyllis panis parvis anguste linearisubulatis acutis araneosis, involucri campanulati levissimae araneosi phyllis 13 oblongis sursum deltoideis apice
acutis sphaeielatis et puberulis margine membranaceis, ligulis 6-8 anguste lineari-oblongis comparate elongatis, disci corollis breviter exsertis, styli ramis truncate penicillatis, acheniis exterioribus compressiusculis interioribus cylindricis 5-costatis glabris, pappi setis scabridis albis.

_Hab._ Ruwenzori E. 7000 ft. January.

Caulis exempli, duorum a me scrutatorum 0'3-0'4 cm. diam., hinc inde reliquis pubis araneosae instructus ceteroquin glaber, ex axillis gemman brevissimam dense albo-araneosae-tomentosam sepe efferens. _Folia_ 9-0-14-0 cm. long., 2'-0-4'-5 cm. lat., perpanca summam minora; costae secundarie pag. magis aspectabiles, angulis variis costa centrali supra impressae, subitus admodum prominenti insertae, sepe undulatae, paululum arcuatae; costulae arcute reticulatae. _Corymbi_ circa 10'-0 X 10'-0-12'-0 cm. _Bracteeae_ ±0'-5 cm. long. Pedunculi proprii 1'-0-3'-0 cm. long. _Calyci_ phylla 0'-2 cm. long. Involucrum 0'-8 cm. long, summum 0'-6 cm. diam. _Ligula_ (limbus) 1'-0 cm. X 0'-22'-5 cm. apice obscure 3- denticulata, 4-nervis. Disci corollarum tubus sursum subito dilatatus, pars attenuata 0'-4 cm., pars dilatata 0'-32'-5 cm. long.; _lobi_ vix 0'-15 cm. long. _Antherae_ exsertae, obscure auriculateae. _Styli_ ramis puberuli, 0'-12 cm. long. _Achenia_ 0'-2 cm., pappus 0'-8 cm. long.

To be inserted in the genus next _S. ochrocarpus_, Oliver & Hiern, and _S. denticulatus_, Engl. Easily distinguished from both, _inter alia_, by the leaves distinctly narrowed at base, and without an araneose tomentum on the underside, and the much longer and relatively narrower ligules.

**Sonchus Bipontini,** _Aschers. in Schweinf._ _Beitr. Fl. Aethiop._ 160.

S.E. 3500 ft. June.

Var. _pinнатifidus_, Oliver & Hiern, _in Fl. Trop._ _Afr._ iii. 458.

E. 6000 ft. January.

_Distrib._ (of type and variety). East tropical Africa.

**Lactuca Abyssinica,** _Fres. in Mus._ _Senckenb._ iii. (1839) 72.

E. 7000 ft. January.

_Distrib._ Nile Land.

**Campanulaceae.**

(E. G. Baker.)

**Lobelia (§ Rhynochopetalum)** _Wollastoni_, sp. nov.

Planta gigantea; foliis tenuiter coriaceis sessilibus late linearibus circ. 8-9-plo longioribus quam latis utrinque glaberrimis (adulterioribus) margine tenuissime serrulatis apice acutis costa crassa in sicco albicante instructis nervis lateribus numerosis superne insculptis subitus subprominentibus et reticulatis pallidioribus; racemo dense bracteato, bracteis linearis lanceolatis margine dense pilosis apice acuminatissimis flore aperto circ
PLANTS COLLECTED ON MT. RUWENZORI.

1½ plo longioribus; pedicellis tenuibus brevibus; calycis tubo campanulato extus piloso laciniiis lineari-lanceolatis quam tubo subtriplo longioribus quam petalis subduplo brevioribus margini pilosis; corolla secus cl. detectorem corolae; filamenti pubescentibus quam antheris atro-violeceis circ. 2½ plo longioribus, antheris 2 anterioribus tenuiter barbatis; stylo infra stigma dense piloso.

Species *Lobelia Telekei*, Schweinf., affinis, differt bracteis circ. 1½ plo quam floribus longioribus haud florem decies superantibus, floribus majoribus, foliis glabris. Ab *L. Rhynchopetalum* differt bracteis angustioribus pilosis et calyceis laciniiis brevioribus.

*Hab.* Ruwenzori E. 12,500–14,500 ft.

Blue spike 10–15 ft.; dried leaves cling to the lower part of the stem. In flower April 3, 1906.

Folia in specimine nostro ±25 cm. longa et 30 cm. lata. Bracteae ±6½ cm. longae. Flores ±4½ cm. longae. Calycis tubus ±5 mm. longus, laciniae ±1½ cm. longae. Petala ±3½ cm. longae. Filamenta ±2½ cm. longae. Antherae ±1½ cm. longae. Stylus ±2½ cm. longus.

Mr. Dawe (in Journ. Linn. Soc., Bot. xxxvii. 538, 539) records four species of *Lobelia* Sect. *Rhynchopetalum* as occurring on Mt. Ruwenzori, *L. Gibberoa* from 6–7000 ft., *L. Stuhlmannii* from 3800–11,000 ft., *L. Deekenii* 11,000 ft., and *L. Rhynchopetalum* from about 12,000 ft. up to the glaciers.

The plant here described is probably identical with the last of these from Mt. Ruwenzori, but it seems to differ in certain particulars from the *L. Rhynchopetalum* of the high mountains of Abyssinia, and I have therefore ventured to separate it.

In addition to the above, Dr. Engler records (*Pflanzenw. Ost-Afr.* C. 401) *L. Telekei* from Mt. Ruwenzori at 3800 metres.


F. 10,000–12,000 ft. April.

“Blue spike about 15 ft.” Leaves fall off lower part of stem.

Dr. Gilg informs me this agrees with the specimens at Berlin. I have made the following notes on the flowers:—

Bractee lanceolate acuminitassimae quam flores parum longiores sepe 5½–6½ cm. longae, oculo nudo glabrae sub lente margine tenuiter ciliolatae; calycis tubus campanulatus ±3½ mm. longus, laciniae anguste lanceolate quam corolla breviores ±2½ cm. longae; petala ±3 cm. longa. Antherae atro-violeceae ±1½ cm. longae. Filamenta ±5 mm. longa verisimiliter tandem multo longiora.
ERICACEÆ.

9000–10,000 ft. February.
Distrib. Nile Land. Also Mediterranean Region and the Comoro Islands.

PRIMULACEÆ.

E. 7000 ft. January.
Flowers purple (pale lilac, Engler: white?, Pax & Knuth).
Distrib. Nile Land, Mozambique District. Also Transvaal.

PLUMBAGINÆÆ.

S.E. 3500 ft. June.
Distrib. Common in old world tropics.

OLEACEÆ.

S.E. 3500 ft. June.
Distrib. Abyssinia.

ASCLEPIADEÆÆ.

E. 7000 ft. January.

S.E. 3500 ft. May.
So far as known, restricted to the neighbourhood of Ruwenzori.

CONVOLVULACEÆ.

(Dr. A. B. Rendle.)

S.E. 3500 ft. May.
Distrib. Tropical and South Africa; India.

S.E. 3500 ft. June.
Distrib. East tropical and South Africa, Madagascar and tropical Asia.
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BORRAGINEÆ.

E. 7000 ft. January.
Distrib. South Nile Land and Nyasaland.

SOLANACEÆ.

Solanum runcoriense, C. H. Wright, in Johnston, Uganda Protectorate, i. 326.
E. 10,000 ft. February.
Not known except from Ruwenzori.

E. 7000 ft. February.
Distrib. Mozambique district. Also in South Africa.

Discopodium peninnervium, Hoehst, in Flora, xxvii. (1844) 22.
E. 7000 ft. January.
Distrib. Nile Land, Nyasaland, and Upper Guinea.

SCROPHULARIACEÆ.

Craterostigma plantagineum, Hoehst. in Flora, xxiv. (1841) 609.
S.E. 3500 ft. June.
Distrib. East tropical Africa, Lower Guinea.

E. 7000 ft. February.
Distrib. British East Africa and Uganda, Nyasaland, Upper Guinea.

Rhamphicarpa Herzfeldiana, Vatke, in Linnaea, xliii. (1880–82) 311.
E. 6000 ft., January; and 7000 ft., February.
Distrib. Nile Land and German East Africa.

S.E. 3500 ft. May.
Distrib. Nile Land, Congo Free State, South-west Africa. Also in Egypt and Arabia.

Sopuba ramosa, Hoehst. in Flora, xxxvii. (1844) 27.
S.W. 3500 ft. July.
Distrib. A common plant in tropical Africa.
OROBANCHEÆ.

OROBANCHE MINOR, Satt. in Trans. Linn. Soc. iv. (1798) 179.
E. 7000 ft. February.
Distrib. East tropical Africa. Also in Europe and Mediterranean region.

GESNERACEÆ.

6000 ft. January.
Distrib. Ruwenzori neighbourhood and Usambara.

BIGNONIACEÆ.

SPATHODEA CAMPANULATA, Beat. Fl. Ovcr. i. 47.
S.E. 3500 ft. May.
The true plant and not S. nilotica, See. The present is the most easterly recorded habitat of this Upper and Lower Guinea and Congo Free State species.

ACANTHACEÆ.

Semiliki Forest. 3000 ft. August.
A Cameroons plant. Differs from the type in the narrower involucral leaves (5.5 x 2.3 cm.), the shorter pedicels (0.7 cm.), the narrower bracteoles (2.0 x 1.4 cm.) pilose-puberulous on both sides, the corolla-tube with a broader throat (1.8 cm. diam.) and the large filaments (about 1.6 cm. long). But the species is such a remarkable one and so different from all the rest, that I am of opinion these differences will not be deemed essential when a full series of specimens comes to hand.

THUNBERGIA (§ Euthunbergia) OCULATA, sp. nov.
Scandens, caule gracili secus lineae duas prope nodos puberulo eteeroquin glabro, foliis longipetiolatis cordatis apice cuspidato acuminatis margine dentato-lobulatis basi palmatis 7-nervibus tenititer membranaceis utro-bique scabriusculis, floribus in axillis solitariis pedunculis elongatis piloso-puberulis fultis, bracteolis majusculis ovato-oblongis obtuse acutis basi late truncatis utrinque scabriusculis margine hispidulo ciliatis, calyceis dentibus inter se inaequalibus linearibus vel linearis-setaceis pubescentibus, corollæ mediocriis tubo basi attenuato superne infundibuliformi limbi lobis inter se subaequalibus rotundato-obcordatis, filamentis brevibus latis antheris late oblongis apice obtuse acutis loculis securis suturam piloso-villosis basi villosis stam., duorum ambobus basi curvato-calcaratis duorum loculo unico solummodo calcarato, ovario late ovoideo.
apice obtuso glabro, stylo brevi, stigmatic bilabiato labis firmis inter se inaqualibus (postico paullo longiore) rotundatis, capsula —.

Hab. Ruwenzori. 6000 ft. January.

Foliorum limbus 6.5-8.0 x 4.5-5.5 cm., fac. inf. pallidior, costulis arctissime reticulatis, glandulis pellucidis microscopicis cereberrime indutus, petioli 5.0-8.0 cm. long., sepe angustissime alati. Pedunculi 8.0-12.0 cm. long. Bracteole 2.8-3.0 cm. long., eleganter reticulata. Calyx totus 0.5 cm., dentes 0.18-0.35 cm. long. Corolle tubus 3.0 cm. long., ima basi 0.4 cm. lat., tune ad 0.3 cm. coarctatus, inde subito ad 0.55 cm. dilatatatus, faucibus paullo ultra 1.0 cm. lat.; limbus fere 4.0 cm. diam.; lobi 1.8 cm. long., summum 2.0 cm. lat. Antherae 0.6 x fere 0.2 cm., harum calcara admodum curvato, vix 0.2 cm. long. Ovarium 0.15 cm. long.; stylus 1.25 cm. long., glaber; stigmaticus lobus alter 0.175 cm., alter 0.1 cm. long., 0.12 cm. lat.

This can be told at once from all forms of T. alata, Boj., to which it is undoubtedly allied, by the long-stalked, cordate, dentate-lobulate leaves, the very long peduncles and the relatively large bracteoles.


E. 6000 ft. January.

A Cameroons plant found in the Uganda Protectorate (Toro) in 1906 by Dr. Bagshawe.


Semliki Valley. July.

Hitherto known only from Kavirondo, Uganda.


E. 10,000 ft. February.

So far as known, restricted to the neighbourhood of Ruwenzori.


S.E. 3500 ft. June.

Distrib. East and West tropical Africa.


S.E. 3500 ft. June.

Distrib. Uganda Protectorate and Mozambique District.

ACANTHOPALE CONCERTIFLORA, C. B. Clarke, in Dyer, Fl. Trop. Afr. v. 64.

E. 7000 ft. January.

Distrib. Ruwenzori District and Nyasaland.
Barleria Grantii, Oliver, in Trans. Linn. Soc. xxix. (1875) 127.
S.E. 3500 feet. May.
Distrib. Southern Nile Land.

Crossandra guineensis, Nees, in DC. Prod. xi. 281.
Without locality.
Distrib. A West African plant recently found by Dr. Bagshawe in the Uganda Protectorate.

Smaller in leaf and much less hairy than the type, otherwise similar to it.
Distrib. British East Africa.

E. 6000 ft. January.
Restricted to the neighbourhood of Ruwenzori.

S.E. 3500 ft. June.
Distrib. German East Africa, Uganda (Bagshawe).

Diplrrrrera maculata, Nees, in DC. Prod. xi. 485.
Distrib. Abyssinia; reported recently from Rhodesia.

Hypoestes triflora, Roem. & Schult. Syst. i. 141.
Distrib. Nile Land and Upper Guinea. Also in India.

H. verticillaris, R. Br. Prod. 474.
E. 7000 ft. January.
Distrib. Common in most parts of tropical Africa.

Labiate.

Platystoma africanum, Beauv. Fl. Ovar. ii. 61.
E. 6000 ft. January.
Distrib. Nile Land, Mozambique District, Upper and Lower Guinea. Also in India.

Moschosma multiflorum, Benth. in DC. Prod. xii. 49.
7000 ft. January.
Distrib. Abyssinia and Usambara.

Hoslindia opposita, Vahl, Enum. Plant. i. 212.
S.E. 3500 ft. June.
A somewhat remarkable form of this common African and Malagasy species. With large leaves 12–13 × 4.5–5 cm., on petioles nearly 2 cm. long.

E. 7000 ft. (the first figure indistinct). January.  
*Distr.*, Abyssinia.

**Plectranthus** (§ Germania) **Wollastonii**, sp. nov.  
Herbaceus, caule erecto tetragono patule hirsutulo, foliis submediocribus petiolatis ample cordatis apice obtuse acutis margine subtiliter crenatis membranaceis atrinque sed praeertim pag. inf. sparsim piloso-pubescentibus in sicco brunneacentibus petiolis quam limbus triplo brevioribus hirsutis, verticillastris sepissime 6–8-floris (summis 3–5-floris) subumbellatis in spicastris bracteatis paniculatim ramosis hirsutulis ordinatis, bracteis persistentibus ovatis obtusioribus crenulatis superioribus integris sparsiim piloso-pubescentibus, pedicellis calyees excententibus gracilibus pubescentibus, calycis florecentis parvi hirsutuli tubo campanulato lobos paululum excudente lobo postico ovato-oblongo obtuse acuto lobis reliquis triangularibus breviusculatis a postico leviter superatis, calycis fructescentis bene aucti decurvi pilosulis aliquantulum decoloris tubo angustate campanulato perspicue nervoso lobo postico deltoideo obtusum acutissimum quam laterales paullo longioribus necnon longius acuminatis, corolla parvi extus puberula tubo calycem florecentem 2pio excudente paululum supra basin inflexo inde gradatim dilatato, labio postico ovato-quadrato acutissimum quam anticum obovatum apice integrum parum breviore, genitalibus breviter ex tubo emin ensibus, stylo bifido.

*Hab.* Ruwenzori E. 7000 ft. January.  
Folia solemniter 4.5–5.0 cm. long., basi 4.0–4.5 cm. lat., juniora exstant minora (e. g. 2.0–2.5 cm. long.), in bracteis spicastris transeuntia, glandulis microscopicis fuscis inspersa; petioli summum 1.5 cm. long. Spi castra usque ad 20.0 × 14.0 cm. Bractee 4.0–5.0 cm. long. Pedicelli 0.5–0.7 cm. long. Flores flav. Calyx floreens totus 0.25 cm. long.; lobus posticus 0.13 cm., reliqui circa 0.1 cm. Calyx fructe sens 0.7 cm. long.; tubus 0.5 cm. long., juxta basin 0.25 cm., ore 0.45 cm. lat.; lobus posticus 0.2 × 0.3 cm.; lobi laterales 0.15 cm., antici 0.175 cm. long. Corolla tota 0.85 cm. long.; tubus 0.5 cm. long.; labium posticum 0.3 × 0.275 cm., anticum 0.35 × 0.3 cm. Genitalia adusque 0.2 cm. corollae tubum excudentia.

Near *P. albíus*, Gürke, which it fairly well resembles in leaf; but the verticillasters have more flowers and the teeth of the calyx are more sharply pointed, while the small yellow corollas are quite different.
COLEUS (§ Solenostemonoides) GRACILENTUS, sp. nov.

C. caule erecto tetragono minute pubescente dein puberulo, foliis parvis brevipetiolatis summis subsessilibus ovatis apice obtusis basi truncato-rotundatis leviterve cordatis margine breviter crenatissimis tenuiter membranaceis supra puberulis subius praecipue in nervis minute pubescentibus, floribus parvulis in spicastris racemosis terminalibus vel ex axillis summis oriundis minute pubescentibus digestis, verticillastris stricte umbellatis circa 8-(junioribus vero paucius-)floris, bracteis parvis ovato-oblongis vel lanceolato-ovatis diusculis persistentibus, pedicellis tenuibus calycem bene excedentibus, calyces florescentes parvuli minute pubescentis tubo campanulato limbus paullulum excedente lobo postico ovato-oblongo obtuso acuto quam laterales linear-lanceolati acuti paullo longiore lobis antecis inter se libepis linear-lanceolatis acuminati antice aequilongis, calyces fructescens acuti decurvi tubo late cylindrico basi obliquo lobo postico ovato reliquis inter se subequalibus aequilongus lobis antecis paullo recurvis, corolla parva tubo calycem excedente infra medium curvato a basi gradatim ampliato labio postico late obovato inaequaliter 4-lobo quam anticum cymbiforme apice integrum paullo breviore, genitalibus labium anticum fere aequantibus.


Folia 2-0-3-5 cm. long., juxta basin 2-0-2-5 cm. lat., in sicco brunnescentia, pag. inf. glandulis sessilibus rubris cereberrime induta; petioli summum 0-5 cm. long., minute pubescentes. Inflorescentia 10-0-25-0 cm. long. Bracteae ±0-15 cm. long., haud coloratæ. Pedicelli circa 0-4 cm. long., Flores purpurei. Calyx florescens 0-225 cm. long. Calyx fructescens totus circa 0-45 cm. long.; tubus 0-25 cm., lobi 0-2 cm. long.; lobus posticus 0-2 cm. lat. Corolla tubus 0-3 cm. long., bassi 0-1 cm., faucibus 0-25 cm. lat.; labium posticum 0-25 cm. long., hujus lobi laterales admodum abbreviati, terminales rotundati; 0-1 cm. long.; labium anticum 0-35 cm. long.

On superficial examination this might pass for C. latifolius, Hochst., a species with, inter alia, more deeply and distantly crenate leaves, verticillasters not strictly umbellate and the two front lobes of the calyx connate some way up.

COLEUS (§ Solenostemonoides) LATIDENS, sp. nov.

Herbaecus, caule erecto tetragono subsimplici piloso-pubescente, foliis manifeste petiolatis ovatis apice breviter acuminatis basi late truncatis cordatisive tenuiter membranaceis margine mediocrer crenato-serratis sub apice integris pag. sup. pilosulis pag. inf. sparsim piloso-pubescentibus, floribus majusculis in spicastris terminalibus folia multoties excedentibus digestis, verticillastris pluriibus sepissime 12-16-floris subumbellatis pauciramosis inferioribus subdistantibus superioribus hand
aggregatiss, bracteis perspicuiss ovatis sursum longe acuminatis basi truncatis marginis integris vel leviter crenulatis caducissimis hand coloratis, pedicellis calyces multo excedentibus, calycis inferne pubescentis lobo postico ovato-rotundato obtuso quam laterales late oblongi apice truncati plane longiore lobis antici postico circa aequilongis angusti oblongis acutis ultra medium connatis, calyce fructescenti vix acuto decurvo, corollae tubo calyced excendente sursum gradatim amplificato juxta medium incurvo labio postico abbreviatum late oblongo brevierto 4-lobo antico elongato cymbiformi.

*Hab.* Ruwenzori E. 9000 ft. February.

Stirps minimum bispithamea. Internodia 2:0–4:0 cm. long. Foliorum limbus solemniter 5:0–7:0 × 3:5–5:5 cm., glandulis microscopiciis fuscesscentibus praeeditus ; petioli 0:6–2:5 cm. long. Spicastra 18:0–20:0 cm. long. Verticillastri inferiores intersunt 2:5–3:0 cm., superiores circa 1:0–2:0 cm. Pedicelli graciliimini, minute pubescentes, ±1:0 cm. long. Bractee 1:0–1:2 cm. long., basi 0:7 cm. lat. Flores purpurei. Calyxis tubus 0:2 cm. long.; lobi posticius 0:3 cm. long.; lobi laterales 0:1 cm. long. et lat., antici 0:325 cm. long., lobi omnes ut tubus glandulis parvis inspersi. Corollae extus puberulae tubus 0:5 cm. long., basi 0:15 cm., faucibus 0:4 cm. lat.; labium posticum 0:45 × 0:5 cm., anticum 1:25 cm. long.

Distinguished from its allies (C. Garckeanae, Vatke, &c.) by the leaves with their truncate bases and smallish serrations, the acuminate bracts, and among other features the broad truncate lateral lobes of the calyx.

**COLEUS** (§ Solenostemonoides) **CLIVICOLA**, sp. nov.

Herbae, caule erecto verisimiliter simplici tetragono bene folioso piloso-pubescente tandem puberulo, foliis sessilibus oblongo-ovatis sursum gradatim attenuatis apice obtusi basi latis et aliquantulum obliquis et breviter amplexicaulis margini subtilliter crenulato-serratis membranaceis supra fere glabris subtus in costa media costisque secundulis piloso-pubescentibus, spicastris terminalibus folia multo excedentibus fulvo-hirsutulis, verticillastri pluribus stricte umbellatis racemum referentibus circa 8-floris inferioribus subdistantibus, bracteis ovaris obtusi caducissimis hand coloratis, floribus majusculis breviter pedicellatis, calyxis pedicellis leviter superantis pubescentis statu fructiferi parum aucti necnon decurvi lobo postico ovato-oblongo acuto quam reliqui linear-lanceolati paullo longiori, lobis lateraliis acutis quam antici acuminatis inter se liberi paululum brevioribus, corollae tubo calyced excendente juxta basin curvato inde dilatato labio postico 4-lobo quam anticum magnum cymbiformi plane breviore.

*Hab.* Ruwenzori E. 10,000 ft. February.

Planta saltem bispithamea. Internodia 3:0–5:0 cm. long. Folia sepissime
4·0–6·0 x 2·0–2·5 cm., serraturis summum 0·15 cm. altis, in sicco olivaceo-castanea, pag. inf. glandulis sessilibus perspinis rubescendentibus copioso instruta. Spicastrum rite evolutum 20·0 cm. vel ultra. Verticillastri inferiores intersunt 3·0 cm., superiores 1·0–2·0 cm. Pedicelli hirsutuli, 0·3 cm. long. Flores purpurei. Calyx florescens glandulis rubescendentibus onustus; hujus tubus 0·2 cm., lobus posticus 0·3 cm., lobi laterales vix 0·2 cm., antici 0·225 cm. long. Calyces frutescentis tubus 0·25 cm. long.; lobus posticus ovatus, 0·35 cm. long., lobi laterales 0·22 cm., antici 0·3 cm. long. Corollae tubus 0·6 cm. long., ima basi 0·2 cm. faucibus 0·5 cm. lat.; labium posticum 0·5 cm., anticum 1·1 cm. long., hoc juxta apicem pubescens.

Near C. edulis, Vatke, and C. aquatius, Gürke; distinguished from both by the small leaves with nerves hairy on the underside and finely-toothed margin, the short pedicels, the small upper lip, &c.

PYCNOUSTACHYS ELLIOTTII, sp. nov.

Fruticosae, elata, ramulis validis tetragonis longitrosum striatis pubescentibus subinde glabrescentibus, foliis amplis ovatis sepe breviter cuspidatis apice obtusi basi truncato-rotundatis ipsa obtusis margine subtiliter nervatione creberrime serratis juxta basin integris tenuter membranaceis utroque sparsim pubescentibus, spica sat longe pedunculata cylindrica ipsa quoniam folia breviore, bracteis basilibus calyces subaequantibus lineari-lanceolatis acutis puberulis, calyeis tubo a lamellis interpositis omnino occusio anguste campanulato puberulo, lobis tubi plus quam duplo excedentibus lineari-subulatis apicem versus incrassatis induratisque apice acuminatis alhíde hispidulis, corollae pro rata magna recurvae extus glandulis rubescendentibus insperse tubo paullo supra basin contracto ibique inflexo superne gradatim dilatato labio postico sub-quadrate lobis inter se subaequalibus trianguliris obtusis labio antico elongato cymbiformi apice integro, genitalibus longe exsertis.—P. articefólia, Baker, in Dyer, Fl. Trop. Afr. t. 386 ex parte, non Hook.

Hab. Ruwenzori. 9000 ft. (Also Ruwenzori; Scott Elliot, 7719.)

Frutex adnusque circa 6-metralis ("15–20 ft."). Foliorum limbus profecto evolutus 9·0–10·0 x 6·0 cm.; in sicco brunnescens, utrinque glandulis microscopicis perlucentibus praeditus; serraturæ 0·15 cm. alt., 0·1–0·2 cm. lat.; petioli 2·0–3·5 cm. long., pubescentes. Pedunculus validus, 4·0–7·0 cm. long. Spica (corollis haud exemptis) 6·0–7·0 x 3·0 cm. Bracteae 0·5 cm. long. Flores albi. Calyceis florescentis tubus vix 0·2 cm. long.; hujus lobi circa 0·5 cm. long. (pars incrassata 0·2 cm.) lamellae interpositæ ovato-rotundatae, 0·1 cm. long. Corollae tubi pars basilis comparata amplificata 0·2 x 0·175 cm.; pars constricta 0·15 x 0·05 cm.; pars dilatata 0·8 cm. long., faucibus 0·5 cm. diam. Labium posticum 0·25 cm. long.; hujus lobi 0·075 cm. Labium
PLANTS COLLECTED ON MT. RUWENZORI.

anticum 0'8 cm. long. Genitalia usque ad 1'1 cm. e tubo corollae eminentia.

A very distinct plant, known by the ample petiolate broad-based leaves with numerous small serrations, the broad spikes, the calyx-lobes indurated only at the top, the long white corollas, &c.

MICROMERIA BIFLORA, Benth. in DC. Prod. xii. 220.
E. 7000 ft. February.
Distrib. Nile Land, Mozambique, Upper and Lower Guinea; also S. Africa, India.

E. 8000 and 11,000 ft. February.
The higher-level specimens are without prickles.
Distrib. Abyssinia to Cameroons.

CALAMINTHA (§ Acinos) PARVULA, sp. nov.
Herbaeae, caule gracili humili deorsum repente necnon radicante sursum ascendente piloso-hirsutulo deinde puberulo, foliis sparsis parvulis petiolatis rotundato-ovatis obtusis basi rotundatis obtusisve nequaquam cordatis margine serrato-crenatis planis utrinque pilis panis strigosis appressis albis munitis fac. sup. in sicco nigricantibus, verticillatis sapissime 4—7-floris ex foliorum superiorum axillis oriundis, bracteolis abbreviatis angustissime linearibus pilosis, pedicellis gracilibus quam calyx brevioribus piloso-hirsutis, calycis tubo piloso-hispidulo deorsum inflato quam limbus longiore intus pilorum annulo instructo labio postico rotundato lobis abbreviatis subulatis labii antici lobis triangularibus acuminatis lobis omnibus margine longe ciliatis, corolla tubo ex calyce breviter eminente sursum leviter amplificato labio postico quam anticum breviore apice truncato integro antici lobis rotundatis intermedio latiore emarginato, staminibus antici subincisis posticis imminuis cassis, styli lobis admodum inequalibus.

Hab. Ruwenzori E. 11,000 ft. February.
Folia soleniiiter 0'7 X 0'6 cm., firme membranacea, subtus in sicco griseo-viridibus; petioli 0'3—0'4 cm. long., piloso-hirsutuli. Bracteole circa 0'2 cm., pedicelli 0'3 cm. long. Calyx totus 0'6 cm.; tubus 0'4 cm., basi faucibusque 0'22 cm. lat., medio 0'18 cm.; labium anticum 0'2 cm. long., hujus lobi 0'15 cm. long., posticum 0'2 cm. long., lobi 0'06 cm.; pilorum annulus ad 0'1 cm. infra os insertus. Corolla 0'7 cm. long.; tubus extus superne pubescent, basi 0'1 cm. faucibus 0'2 cm. lat.; labium posticum 0'15 cm., anticum 0'3 cm. long. Stylus 5'5 cm. long.; stigmatibus lobus alter debilis 0'025 cm., alter incurvus 0'1 cm. long.
To be placed next C. simensis, Benth., from which it can be distinguished.
by the rather coarsely crenate-serrate leaves drying black, the longer lobes of the calyx (which organ has a ring of weak hairs inside inserted a little distance from the mouth instead of one with many coarse hairs inserted in the mouth itself), and the reduced posticous pair of stamens.

**PLANTAGINEæ.**


E. 7000 ft. January.

*Distrib.* Mountains from Cameroons to Kilimanjaro.

**APETALÆ.**

By A. B. Rendle.

The collection includes the following well-known plants:—*Pteronia abyssinica*, Moq., E. 7000 ft. (tropical and South Africa and Madagascar); *Chenopodium fieldiium*, Schrad., E. 7000 ft. (generally distributed in the tropics and warm temperate zones); *Basella alba*, Linn., E. 7000 ft. (tropical Africa and Asia); *Amaranthus caudatus*, Linn., S.E. 3500 ft. (warmer parts of the Eastern hemisphere); *Achyranthes aspera*, Linn., E. 6000 & 7000 ft. (tropics of Old World); *Celosia trigyna*, Linn., S.E. 3500 ft. (common in tropical and South Africa); *Euphorbia hypericifolia*, Linn., S.E. 3500 ft. (a common weed in the warmer parts of the earth); in addition to the following.

**AMARANTACEÆ.**

*Cyathula cylindrica*, Moq. in DC. Prodr. xiii. 2. 328.

E. 6000 ft. January.

*Distrib.* Tropical and South Africa and Madagascar.

**POLYGONACEÆ.**


E. 7000 ft. January.

*Distrib.* Highlands of East tropical Africa and Madagascar.


E. 7000 ft. January.

*Distrib.* East tropical Africa and Cameroons.
PLANTS COLLECTED ON MT. RUWENZORI.

PIPERACEÆ.

Piper capense. Linn. f. Suppl. 90.
E. 7000 ft. January.—Also collected by Scott Elliot (No. 7909) in the
Wimi valley at 7000–8000 ft.
Distrib. East tropical Africa, Cameroons, South Africa.

Peperomia ruwenzoriensis, sp. n.
Herba, caulibus junioribus et petioli pilosulis; foliis alternis lanceolatis
vel ovatis, apice acutis, siccis tenuibus, in dorso laminae sparse pilosis,
3-nervis; ametais modice pedunculatis, in axillis foliorum superiorum
et terminalibus folia valde excedentibus; bractea orbiculare; ovario
rhachi impresso, late obovato, apice obtuso, stigmatifero; baccæ minima,
late ovata, brunnea, glandulosa.
Hab. Ruwenzori E. 7000 ft. January. Climbing; flowers greenish white.—Also collected by Scott Elliot at 7000–8000 ft., on tree-trunks.
In fruit, May. No. 7862 in part.
Caulis 2 mm. crass. e nodis in arborum trunci radicans. Folia cum
petiolo vix 1 cm. long., ad 5 cm. long. et 3 cm. lat., sepissime minora.
Amenta ad 5 cm. long., 1·5 mm. crass. Baccæ 1 mm. long.
Near P. Stuhlmannii, which was collected about the same altitude on
Ruwenzori by Stuhlmann, and differs in being a glabrous plant with
leaves oblong-lanceolate and acute at base and apex. I have to thank
Dr. Engler for comparing our specimens with the type of P. Stuhlmannii
at Berlin.

URTICACEÆ.

E. 12,000 ft. February.
Distrib. Widely spread in temperate and tropical regions, and occurring
in Africa in Abyssinia and the Cameroons.

Fleurya podocarpa. Wedd. in DC. Prodr. xvi. 1. 76.
E. 5000 ft. March.
Distrib. East and West tropical Africa.

EUPHORBIACEÆ.

E. 7000 ft. January (fruit).
Distrib. East and West tropical Africa, and found on Mts. Kenia and
Kilimanjaro.

E. 7000 ft. January.
Distrib. East tropical Africa.
VEGETATION ON MOUNT RUWENZORI
Fig. 5.

Fig. 6.

VEGETATION ON MOUNT RUWENZORI.
MR. G. S. WEST ON SOME CRITICAL GREEN ALGÆ. 279

EXPLANATION OF THE PLATES.
(From Photographs taken by Dr. A. F. R. Wollaston.)

PLATE 16.
Fig. 1. Vegetation on Mt. Ruwenzori at 3500 feet, with Euphorbia, Acenon, and short grass.
2. Tree Senecios, with Lobelia Stuhlmanni in the centre, at 9500 feet.

PLATE 17.
Fig. 3. Lobelia Gibbera at 7000 feet.
4. L. Deckenni in flat swampy ground at 11,000 ft.

PLATE 18.
Fig. 5. Senecio adnivalis to the right showing branching, Lobelias to the left, Lobelia Wollastoni in front, at 12,000 ft.
6. Steep slope with tree Senecios, probably Senecio adnivalis and Lobelia Wollastoni, at 13,000 ft.

PLATE 19.
Fig. 7. Lobelia Wollastoni at 12,500 to 13,000 feet. The Kyanga Peak is seen in the background.
8. Very old tree Senecios at 12,500 feet: tree heath, Erica arborea, in the background.


(Plates 20 & 21.)

[Read 20th June, 1907.]

During the examination of numerous collections of algae, I have repeatedly brought before my notice many forms about which little or nothing is known, and a brief account of the peculiarities and affinities of some of these may prove of considerable interest. The six algae dealt with in this paper are all members of the Chlorophyceæ.

1. Polychætophora simplex, sp. n. P. cellulis subglobosis vel ovoideis, membrana tenue et homogenea; parte dorsali cellulis uniuscujusque setis longis flexuosis simplicibus non vaginatis 2–4 instructa; chromatophoris singulis parietalibus, interdum cum granulis amyloideis minutis circ. 2–3. Diam. cell. veget. 15–20 μ; long. set. usque ad 210 μ. (Pl. 20, figs. 1–6.)

Hab. Shores of Lough Gartan, Donegal, Ireland; epiphytic on the submerged portions of various aquatic phanerogams.
The discovery of this Alga adds a second species to a genus which has so far been known only by the solitary species Polyectophora lamellosa, W. & G. S. West.

The specimens were collected in 1901 on the shores of Lough Gartan, Donegal, and occurred as epiphytes on various aquatic flowering plants.

The cells are globose or ovoid in form, rather small, and destitute of any appreciable mucous envelope. They are solitary, or occur two or three together, having but a slight attachment to the plant upon which they grow. There is a distinct dorsiventrality about the cells, although there is no attempt at the formation of either a creeping filament or a flat plate. The ventral part of the cell is attached to the substratum, and the other part, which may be regarded as dorsal, is furnished with from two to four simple, but greatly elongated bristles. There is one parietal chloroplast in each cell, normally somewhat cup-shaped and occupying the ventral wall. No pyrenoids were observed, but several scattered granules of minute size, which stained blue-black with chlor-zinc-iodine, were observed in some of the cells. These were most probably small granules of starch (fig. 6). A small nucleus is present towards one side of the hollow in the cup-shaped chloroplast (fig. 6, n).

Polyectophora simplex differs from P. lamellosa in the smaller size of its cells, in the very much thinner cell-wall, which is not lamellose, and in the restricted number of bristles. From eight to twelve of the latter are present in P. lamellosa, and they are distributed all round the exterior of the cell, whereas there are only two to four bristles in P. simplex, and their dorsal attachment is a conspicuous feature of the species.

The genus Polyectophora belongs to the Chaetopeltideae, a small family distinguished from the rest of the Protococcideae by the presence of sete or bristles.

Nothing is known of the reproduction of Polyectophora, but in P. lamellosa multiplication takes place by the division of the cells in one plane and the formation of a short irregular chain. This short filament, consisting of about eight cells, subsequently breaks up, each cell being able under suitable conditions to form a new chain.

It is possible that Polyectophora simplex, or a closely allied Alga, is responsible for the confusion which has existed concerning the identity of Gloeochete Wittrockiana. The latter was described by Lagerheim from Sweden as a blue-green Alga, and I have since found it repeatedly. There is not the slightest question that it is one of the Myxophyceae of the subfamily Chroocysteae, with a cytological structure closely akin to that of Chroococcus. Yet

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Dangeard ¹, Schmidle ², and Borge ³ have all placed *Glocheta Wittrockiana* in the Chlorophyceae. It therefore seems probable that these authors really had a green Alga under observation, and not the blue-green Alga described by Lagerheim.

*Polychetocephora simplex* and *Glocheta Wittrockiana* should not be confused. The former is a member of the Chlorophyceae, and its cells, which are not enveloped in mucilage, are each furnished with two to four simple bristles. The latter is one of the Myxophyceae, with its cells enveloped in a copious mucilage, and its bristles frequently possess short spur-like branches.

2. *Brachionomos submarina*, Bohlin. (Pl. 20, figs. 7–19.) I am indebted to Mr. Thomas Bolton, of Birmingham, for kindly bringing me, in the early part of February 1907, a tube containing a motile green Alga of great interest. It was collected in brackish marshes at Sheerness by the Rev. Eustace Tozen, who sends the information that it is common there in February. Mr. Bolton was also good enough to procure me a further supply of this Alga in April.

The Alga is a member of the subfamily Chlamydomonadeae of the Volvocaceae, and belongs to *Brachionomos*, Bohlin, a genus which, so far as I am aware, has only been previously observed from the brackish marshes and harbours of Stockholm and certain of the coast districts of Norway. Two species were described by Bohlin ⁴ ten years ago, but do not appear to have been since recorded.

The plant from Sheerness does not strictly agree with either of the species described by Bohlin, but to a certain extent combines the characters of each of them. The anterior half of the cell is subhemispherical and the posterior half conical. The posterior extremity is provided with a stout attenuated horn, and four other equidistant horns are disposed in the equatorial plane. The equatorial horns are backwardly curved, but otherwise similar to the straight posterior horn.

The parietal chloroplast, which is somewhat massive, does not extend into the horn-like processes, except to form a rounded lobe at the base of each. A large pyrenoid is present ⁵, usually towards the posterior region, and a number of bright granules are scattered through the chloroplast.

At least one vacuole is present in the cell, and there may be one near the base of each process. A solitary vacuole is usually large, and often of

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¹ Dangeard in *Le Botaniste* (1889), p. 158, t. 7, f. 12 a–j (described as a new Alga under the name of *Schrammia barbata*, Dang.).
⁵ Sometimes more than one pyrenoid is present (cide fig. 11).
irregular form, being situated in the anterior region of the cell. When more than one vacuole exists, they are commonly spherical. They contain a colourless cell-sap, and in all the specimens examined granules of a brown colour were present, which exhibited a lively dancing movement (figs. 7, 9–11, 18, 19). These granules varied in number from 2 to 15 in each vacuole, and were of various sizes. They strongly reminded one of those formed in the vacuoles of most Des-mids under pathological conditions.

The nucleus is situated anteriorly, but may be displaced by the formation of a large vacuole.

The horns are colourless and very hyaline, but as the cytoplasm of each process can be stained up to its extremity, they are hollow.

A pair of long cilia are attached to the anterior extremity, and as the organism progresses in a forward direction, it rotates about its longitudinal axis. This rotation is not constant, as the organisms, when examined on a slide, frequently come to rest and then begin again their movements, when, as often as not, they rotate in the opposite direction.

The rate of movement was measured in a number of full-grown vegetative cells, and it gives an average of 0.22 mm. per second, which is considerably below the average for the Chlamydomonadaceae.

When at rest the cilia are carried backwardly directed, with the proximal part of each cilium closely pressed against the anterior margin of the cell (fig. 9).

Several cultures of this organism were started in February and examined constantly up to May. Some were in Knop's solution, and others in Knop's solution to which a small quantity of sodium chloride had been added. The tube of material as forwarded to me was a pure collection, and the most diligent search brought to light no other organism among the Brachiononas. A few drops of this fluid containing the living Brachiononas were added to about 150 c. c. of the prepared medium, so that no trace of colour could be observed in the culture. The glass culture-vessels were exposed to the outside air temperature, except during frost. All the cultures became decidedly green at the beginning of April, but there was a marked difference in the two series. Those cultures from which sodium chloride was excluded contained hardly any Brachiononas, but a species of Chlamydomonas and a multitude of rounded green cells in the palmelloid condition.

Those containing sodium chloride were pure cultures of Brachiononas, and the multiplication was carried on with moderate rapidity by the formation of zoogonidia. Four of these arose in each mother-cell, and they assumed the peculiar form of the adult before liberation.

2 I have been unable to determine with any degree of certainty the species of Alga to which these belong. Most of the Chlamydomonadaceae are known to assume a palmelloid state under certain conditions, but I hesitate to refer the above-mentioned cells to Brachiononas.
During May some of the cells formed gametes, which differed from the zoogonidia in their smaller size and greatly reduced processes (fig. 16). In fact, the latter were only discernible as very minute conical warts. These gametes, which, so far as I could ascertain, arose in a mother-cell, conjugated in pairs and formed globular zygospores with smooth walls.

As is usual in so many cultures of Algae, some of the individuals were distorted and monstrous. The commonest distortion from the original type was an inflated, swollen individual, in which the body of the cell was spherical, the processes appearing correspondingly small (fig. 18). These individuals only appeared in a three-months' culture. The most interesting monstrous form was an incomplete separation of two individuals, owing to imperfect division of the contents of the mother-cell during the formation of zoogonidia (fig. 19).

After much consideration I have referred the Sheerness organism to Brachionomus submarina.

None of the adult vegetative specimens had the processes quite so short as figured by Bohlin for B. submarina, and some of the specimens agree in form with Bohlin's fig. 1 b of B. gracilis; but the only alternative was to establish a third species intermediate in character between the two already described. This was inadvisable, because in the outward form of the cells, which alone was used in discriminating between B. submarina and B. gracilis, the Sheerness specimens exhibited much variability. The anterior region of the cell was never so flattened as in Bohlin's figs. 1 a and 1 c of B. gracilis, and the posterior horn rarely so long, whereas the subhemispherical anterior region of the cell and the form of the posterior horn were characters in agreement with B. submarina.

Length of Sheerness specimens (including horns) 15–24 μ; breadth (including horns) 13–25 μ; length of cilia 22–29 μ.

If Bohlin's figures are correct, then the Sheerness specimens differed in one respect from both his species. The chloroplast never extended beyond the broad base of the horns, the latter always remaining clear and colourless.

3. Phyllobium sphagnicola, sp. n. Ph. filis vegetativis longissimis, subcontortis et anastomosibus, inter cellulas foliorum Sphagni cretis; cellulis vegetativis elongatis et subcylindricis, membrana tenuissima; hypnosporis globosis vel subdepresso-globosis, membrana firma et crassa, nonnunquam irregulariter incrassata. Crass. fil. veget. 2.7–4 μ; diam. cell. hypnosp. 18–42 μ. (Pl. 21. figs. 31–35.)

Hab. North Uist, Outer Hebrides; on the old leaves of Sphagnum.

In August 1904 my father collected some plants of Sphagnum in the boggy areas of N. Uist, Outer Hebrides, which had attracted his attention by reason
of their peculiar appearance. The plants were old, with withered, bleached leaves, on which were dotted here and there irregular blotches of a vivid green colour.

A closer examination of the leaves showed them to be studded with the dark green cells of an epiphytic Alga. Some of the specimens were dried and others were preserved in 2 per cent. formalin, and on further investigation the epiphyte has proved to be an undescribed species of the genus *Phyllobium*.

The two previously known species of this genus, *Phyllobium dimorphum*, Klebs, and *P. inerbum*, Klebs 1, were discovered on dead leaves—the former on *Lysimachia Nummularia*, Ajuga, Chloris, &c., and the latter on the leaves of Carex. This is the first recorded instance of a *Phyllobium* occurring on the leaves of *Sphagnum*, and I have named it *Phyllobium sphagnicola*.

The bright green cells studding the exterior of the old *Sphagnum*-leaves are the resting-cells, and occur either scattered or in irregular clusters. The cell-wall is often irregularly thickened, and not infrequently produced out at some indefinite point into a curved beak-like projection (fig. 33). All the thickened parts of the cell-wall show a marked lamellation. These green cells are attached at the base to the vegetative thallus, consisting of slender branched threads, anastomosing and ramifying over the entire leaf. Each resting-cell is attached to one or sometimes two of the vegetative threads, and the wall in the region of attachment is generally much thickened and lamellate. The adult vegetative threads are destitute of protoplasts or of chlorophyll, are much branched, and distinctly but distantly septate. These threads follow a very irregular course, commonly passing through the leaf by means of the perforations in the large hyaline cells.

As the specimens were preserved, the formation of gametes and zoogonidia could not be observed.

The green resting-cells of *Phyllobium sphagnicola* are smaller and more rounded than those of *P. dimorphum*, and their attachment to the vegetative filaments is more basal than lateral. The threads composing the vegetative part of the thallus are also profusely developed, possibly owing to the ease with which they can traverse the large hyaline cells of the *Sphagnum*-leaf.

1. *Kirchneriella subsolitaria*, sp. n. *K.* cellulis minutis, obesis, arenatissimis, polis obtusis vel rarissime subacutis, sepe magnitudinis inequalis; cellulis plerumque solitariis vel in colonis parvis e cellulis 2-4 constitutis, coloniis non mucosis. Diam. max. cell. 6-7 μ; crass. cell. 2-9-3-2 μ; crass. colon. 4 cell. 10-15 μ. (Pl. 20. figs. 20-30.)

*Hab.* Studley Park, Warwickshire; in small pond.

Kirchneriella subsolitaria differs from the three previously known species of the genus in the subsolitary habit and the entire absence of mucous. In the form of its cells it greatly resembles K. obesa, but apart from its different habit it is much smaller.

The genus Kirchneriella was founded by Schmidle ¹ in 1893 to include a small protococaceeous Alga which had been regarded by Kirchner as an Ankistrodesmus (= Rhaphidium). This plant, Kirchneriella lunaris, Schmidle, and another species, K. obesa, W. & G. S. West ², have been shown to be fairly abundant in the European freshwater plankton, the latter being sparingly distributed in the summer plankton of the lakes of Western Scotland ³. A third species, K. contorta, (Schmidle) Bohlin, is known from Germany, and var. gracillima of it from South America ⁴.

The most important generic character, which is well marked in all the three species and several named varieties of them, is the somewhat irregular disposition of a number of arcuate cells within a copious structureless mucilage. As will be seen from the description of the newly discovered species, this generic character will have to be modified for the inclusion within the genus of K. subsolitaria.

This undescribed species was found in October 1906, among numerous other Algae of the Protococceae, in a collection made from a small pond in Dudley Park, Warwickshire. The cells agree almost exactly with those of K. obesa, but are much smaller. They are stout and much bent, but show a greater irregularity of form than is seen in K. obesa. Very often one limb of the cell is much thicker than the other (figs. 21–23), or both limbs may be much attenuated (fig. 20). There is a chloroplast filling up the greater part of the cell, but in some cases not extending quite to the poles. This chloroplast has a homogeneous structure, and is without pyrenoids or any trace of granulation. Most of the cells were solitary, but small colonies of 2 or 4 cells were not uncommon (figs. 26–30). The cells in each colony were enclosed in a thin, firm membrane, globular or ellipsoidal in form, which fitted closely round them. This membrane is the dilated wall of the mother-cell, which, however, does not undergo gelatinization. No colony of more than four cells was observed, and no mucilaginous envelope is present around either the solitary cells or the small colonies. It is this absence of enveloping jelly that necessitates a slight modification in the generic characters of Kirchneriella in order to include K. subsolitaria.


LINN. JOURN.—BOTANY, VOL. XXXVIII.
An Alga has recently been described by Schmidle\(^1\), under the name of *Didymogones palatina*, which bears much resemblance to *Kirchneriella subsolitaria*. Its cells, which are mostly in pairs, are not bent anything like so much, and each possesses a chloroplast with one pyrenoid. I do not see how Schmidle finds any generic characters for *Didymogones palatina*; but whatever it may be, it is not the Alga here described as *Kirchneriella subsolitaria*.

5. *Tetraëdron platyisthnum*, nob. (= *Cosmarium plathyisthmum*, Archer, 1880). *T.* mediocre, subrectangulare, compressum, circiter tam longum quam latum, lateribus late excavatis cum isthmo latu et longo in centro cellulae, apicibus convexis sed in medio leviter retusis, angulis lateribus subprodusitis et incassulatis, cum fossa inconspicua longitudinaliter disposita in centro cellulae praec tenuis apice unoquoque; membrana composita punctulata, cum serie singula punctorum majorum trans partes latiores duas cellulae. Cellula a vertice visa elliptica, polis attenuatis, excavatione minuta ad medium utrohique; a latere visa elliptica. Chromatophora cum pyrenoid centrali. Long. 24-35 \(\mu\); lat. 28-35\(\frac{5}{5}\) \(\mu\); crass. 12-14 \(\mu\). (Pl. 21, figs. 36-39.)

*Hab.* Near Rhiconich, Sutherland (West). Ireland (Archer).

Some collections of Algae from the boggy hollows in the Lewisian Gneiss of West Sutherland, which were rich in Desmids of the Western British type, such as *Docidium undulatum*, Bail., *Penium addechondrum*, Elfv., *Euastrum intermedium*, Cleve, *E. pingue*, Elfv., and *Staurastrum elongatum*, Barker, also contained a most peculiar species of the genus *Tetraëdron*. It agrees with no described species of this genus, and I have not observed it from elsewhere.

The cell is more or less quadrato when seen from the front, with a broad excavation at each side, which gives it the appearance of a species of *Cosmarium* with a very wide and elongate isthmus. The apices are faintly retuse and the lateral angles are produced and somewhat attenuated, having a slight thickening at the extremity. Seen from the side the cell is elliptical; from the apex it is elliptical with attenuated poles, and exhibits a slight indentation in the middle of each side. The cell-wall is finely punctate, and extending from angle to angle across each half of the cell is a row of rather stronger and more distant punctae disposed in the form of an arc. The greater part of the living cell is occupied by a single large chloroplast, with several irregular ridges and a central pyrenoid (fig. 36).

Several empty individuals were noticed which possessed a prominent slit down one face of the cell-wall, most probably indicating the place of escape of autospores (fig. 39).

The outward form of this Tetraedron recalled to my memory one of Archer's preliminary notes on a supposed new species of Desmid. This brief preliminary account, like many others by the same writer, was unfortunately never followed by the promised detailed description. It is copied by Cooke, and reads as follows:

"Cosmaritimplatt/irthmum, Archer. Minute. In general outline in front, or broad view, much resembling, say, a section of a double railway-rail—that is to say, the isthmus very broad and comparatively long, thus the isthmus makes up a great proportion of the whole Cosmarium; the semi-cells are elliptic, much broader than high, the whole smooth; end view elongate compressed, extremities rounded. The lateral extremities of the semi-cells somewhat taper ere becoming rounded off, and the upper margins are notably retuse in the middle. Size not given. Hab. Ireland."

A comparison of the above description with the specimens from Scotland leaves no doubt as to the identity of the Irish and Scottish plants. As a further confirmation of this view, I may add that many of Archer's new species were collected in Connemara, and that the Alga-flora of West Ireland very closely resembles that of North-West Scotland. The similarity between the species occurring in certain districts of Connemara and those found in Western Sutherland is most striking. In fact, so far as their British distribution is concerned, many of them are only known to occur in these two areas.

Archer was in error in referring the plant to the Desmidiaceae as a species of the genus Cosmarium, and he omitted to mention certain of its characteristic, although inconspicuous features.

6. Chodatella quadrirseta, Lemmermann. (Pl. 21. figs. 40-43.) This genus Chodatella belongs to the subfamily Phytochloia of the Protococaceae (or Autosporaceae), and was founded by Lemmermann to include a number of free-floating unicells, furnished with long spines.

It is very closely allied to Lagerheimia, Chodat, differing only in the absence of tubercles at the base of the spines. Lemmermann enumerates seven species known up to 1898. Three of these—C. ciliata, (Lagerh.) Lemm., C. amphitricha, (Lagerh.) Lemm., and C. radians, (West) Lemm.—should clearly be united, reducing them to five, and another species discovered in 1902 makes a total of six known species.

Although many of the Algae comprising the Phytochloia are constituents of the freshwater plankton, my recent experience is that they occur more frequently in the waters of small ponds such as are found on old pasture-land, being intermingled with other free-floating Protococaceae of the genera Ankistrodesmus, Scenedesmus, Tetraedron, &c.

3 E. Lemmermann in Hedwigia, xxxviii. (1898) p. 309.
In October 1906 a collection of Algae was made from a small pond in Studley Park, Warwickshire, which proved rather rich in some of the more minute species of the Protococccaceae. One of these minute Algae I have regarded as Chodatella quadriviseta, Lemm.

The cells were elliptic-oblung, or oblong with rounded extremities, about 1½ times longer than their diameter, and furnished towards each pole with a pair of widely divergent spines. The spines were attached not at the poles, but rather below them, and were so widely divergent as to appear almost laterally inserted. Thus the breadth of the Alga is considerably greater than the length, if the spines are reckoned in the measurements. The cell-wall was very delicate, and a large chloroplast occupied the greater part of the interior of the cell. As this chloroplast was to a great extent pressed up against the inner side of the cell-wall, it is parietal. It should be noted, however, that in many individuals two chloroplasts were present, one disposed towards each end of the cell, a condition most probably brought about by a separation of the original chloroplasts into two parts. No pyrenoids were present in any individual examined.

In his description of the genus, Lemmermann states: "Chlorophora singula, parietalia. Nucleus amylaceus singulis."

As the specimens from Studley Park often possessed two chloroplasts, and no individual was noticed with any trace of pyrenoids, this statement requires modification. It is also fitting to once more point out that the presence or absence of pyrenoids in the chloroplasts of Green Algae has no value as a generic character.

Lemmermann's description of Chodatella quadriviseta is very brief: — "Cellulae ovales vel subglobosae, 4 μ late et 5-5 μ longae, utroque polo 2 setis circ. 15 μ longis instructae." It gives one the impression that the setae are attached actually at the poles of the cells. The specimens from Studley Park had a length of 5-5-8 μ, a breadth of 3-4-5 μ, and the spines were 15-17-5 μ in length. They occurred in a habitat precisely similar to that in which Lemmermann discovered the species near Leipzig in 1898.

No reproductive stages were observed, and, owing to the relative scarcity of the species among a vast multitude of other minute green Algae, I was unable to make cultures which were not at once choked with other Protococccideae. In fact, I was never able to find any Chodatella except in the original material.

EXPLANATION OF THE PLATES.

PLATE 20.

Figs. 1-6. *Polychaetophora simplex*, sp. n. × 400.
1-5. Vegetative cells from the side showing the flexuose bristles and the single chloroplasts.
6. Cell stained to show nucleus (a); the dark granules (s) are particles of starch.

Figs. 7-19. *Brachiononas submarina*, Bohlin. × 1000.
7-9. Three vegetative cells to show variability of external form.
10, 11. Two individuals viewed from the anterior end to show the four lateral horns; 11 has three small pyrenoids (p', p'', and p''').
12. Individual stained with gentian-violet to bring out the nucleus (n), and to show the extension of the cytoplasm to the extremities of the hollow horns.
14, 15. Anterior and side views of enlarged mother-cells containing four zoogonidia. These are disposed with their posterior horns directed towards a central point.
17. Zygospore.
18. Distended individual only observed in cultures in Knop's solution after about three months.
19. Monstrous specimen due to imperfect separation of two zoogonidia during their formation within the mother-cell.

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25. Solitary individual within a delicate membrane (probably the old wall of a mother-cell).
26, 27. Colonies of two cells.
28-30. Colonies of four cells; all enclosed in firm but delicate membranes, which are the old walls of the original mother-cells, but not gelatinized.

PLATE 21.

Figs. 31-35. *Phyllobium sphagnicola*, sp. n. × 500.
31. Edge of sphagnum-leaf with nine resting-cells of the Alga attached to the ramifying vegetative threads: r.c., resting-cell; v.c., vegetative cell.
32-35. Resting-cells attached to vegetative threads, isolated from the Sphagnum-leaves.

36. Cell showing chloroplast with one pyrenoid (p).
37. Empty cell in three positions.
38. Empty cell.
39. Empty cell with longitudinal slit (x), possibly formed for the escape of autospores.

Figs. 40-43. *Chodatella quadriseta*, Lemm. × 1000.
In 41 and 42 the chloroplast has become separated into two parts.
CRITICAL GREEN ALGÆ.
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The collection of title-slips for the United Kingdom of Great Britain and Ireland as regards BOTANY

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The fifth volume, for 1905, will shortly be issued.

B. DAYDON JACKSON,
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In 41 and 42 the chloroplast has become separated into two parts.

[Read 16th January, 1908.]


*Gronovia*, Blanco, *Fl. Filip.* ed. i. 186 (1837), non Linn.


Frutices ope petiolorum scandentes. Folia alterna, 3-(vel 5)-foliolata, foliolis petiolaris. Inflorescentiae cymose, bracteolate. Flores hermafroditae; calycibus tubus ovoideis, superne constrictis, ovario adnato; limbus 5-partitus, lobis patentibus, valvis, oblatais, deciduis; petala 5, sepalis textura similibus; stamina 5 cum glandulis 5 oppositipetalis alternantia, ima basi nectariis duobus lateralibus vel dorsalis appendiculata, nectaris tubulosus extrorsis conspicuis vel solidis obscuris, antheris ovatis, lateraliiter valvatis deliscentibus; ovarium 1-loculare; ovulum unicum pendulum; stylus brevis, in stigma peltatum undulatum vel varie incisum expansus; fructus indehiscentes, siccus, 2-4-alatus; semen oblongum, cotyledonibus plano-convexibus, radicula inclusa. Genus gerontogeum tropicum species 12 asiaticas includens et unam africanam.

Blume founded the genus in 1826 (*i. e.*) on two Javan climbers with trifoliolate leaves, inferior one-celled ovaries, and a remarkable floral structure recalling that of the Lauracese. Eleven more species sharing these peculiar characteristics have now been added, some of which were at first thought to represent distinct genera. *Henschelia* was founded by Presl on a Philippine specimen collected by Haenke, and a full description with an elaborate figure was published by him (*Rel. Haenk.* ii. 81, t. 63); from a perusal of these it would appear as though his plant differed from Blume's species in many important particulars, the ovary being represented as superior with two erect basal ovules and the staminal whorl as also widely different. The
similarity in habit, foliage and inflorescence, however, led Miquel (Fl. Ind. Bat. i. i. 1094) to reduce Henschelia tentatively to Illigera; and this reduction is now confirmed by Mr. Elmer D. Merrill, who has compared side by side the types of Henschelia luzonensis, Presl, and Illigera Meyeniana, Kunth, which he finds to be conspecific.

Gronovia and Coryzadenia were proposed by their authors for species whose affinities to Illigera they did not recognize, probably on account of the inaccuracy of Blume’s original diagnosis.

At the time that Blume wrote, mature fruits of the two species before him were not known, and it was from an examination of immature material, and under the influence of the recognized affinities of his genus with the Lauraceae, that he was unfortunately led to the erroneous conclusion that the fruit of the genus was a wingless drupe and that the cotyledons of the embryo were convolute. These conjectural characters Blume indiscreetly included in the essential diagnosis of his genus, and when nearly forty years later Meissner had five species, agreeing closely in floral characters, under consideration for his revision of Illigera in DeCandolle’s ‘Prodromus’ (xv. i. 251), he very doubtfully included the only one of which ripe fruit was known (I. dubia, Span.), because it had a dry winged fruit and not a wingless drupe. In the following year (1865) Hooker fil. revised the genus for the ‘Genera Plantarum.’ He had access to specimens of several Indian species with almost identical flowers but, like the above, with winged fruit. With characteristic clearness of judgment Hooker saw for the first time that Blume’s diagnosis was wrong, no examples of mature wingless fruit had been found, and he amended this generic character accordingly. Of the 13 species now known 10 have winged fruit, while in the remainder ripe fruit is still undescribed. It is therefore in the highest degree probable that the fruit of Illigera is invariably winged.

The character of the staminal whorl and its accessory organs is so peculiar that it is desirable to describe it in detail. The stamens are opposite to the outer segments of the perianth and dehisce by two lateral valves which open from the inner side and remain fixed, at any rate for a time, by their outer or by their upper edges. Between them and the inner whorl of the perianth are two sets of organs. The outer consists of five glands opposite to the inner perianth segments; this might be looked upon as the disc, for in the young bud this whorl is an obscurely toothed ring on the inner side of which the stamens arise. The teeth alternate with the stamens and develop into the glands. When fully formed they are sessile or shortly stalked globular bodies or shallow fleshy, often lobed cups. [Or, on the other hand, the glands of the outer whorl might be regarded as staminodes, homologous with an outer whorl of stamens in Lauraceae.] The inner whorl comprises ten nectaries associated in pairs with the stamens, and either actually attached
to their base, or free, and in one case enclosed by the revolute margins of the flat filament. They apparently arise as papillae at the base of the developing stamens. When fully developed, they form shortly stalked membranous cups with open spathe-like acute or truncate entire or serrulate hoods, or else, the spathe being nearly closed, they become oblique club-shaped receptacles with longitudinal openings; in all cases, the insertion is slightly behind or outside of the filaments and the opening is always extrorse. When rudimentary, the nectaries form small hemispherical or club-shaped excrescences or stalked globular appendages at the base of the stamens.

Twelve of the species now known inhabit a well-defined geographical area, including N.E. India, Burma, the Malay Peninsula and Archipelago, the Philippine Islands, Formosa, and tropical China. The remaining species is widely distributed in tropical Africa.

The systematic position of the genus has been the subject of much discussion from the time of its discovery, and succeeding botanists have placed it in association with widely different groups according as they were more impressed by one or other of its characteristics. Blume located it near Lauracee, in consequence of the valvular dehiscence of its stamens and its solitary pendulous ovule, and in spite of its inferior ovary, which gave it, he said, the same relation to that order as Vaccinium has to Ericaceae (Ann. Sci. Nat. 2 sér. ii. (1834) 95). He recognized also its relation to Gyrocarpus, and placed them together under the name of Illigereae. Endlicher (Gen. (1836) 2069) associated the same two genera under the name of Gyrocarpeae and placed them near Daphmoideae. The close relation of Hernandia with Illigera was not seen till thirty years later, but in order to understand the systematic history of the latter it will be necessary to trace also that of the former. Endlicher (loc. cit.) placed Hernandia in Santalaceae. Nees (Syst. Laur. (1836) 703), and originally Lindley (Key to Nat. Syn. (1836) 202), followed Blume. Later, in his Vegetable Kingdom (1846, p. 718), Lindley referred Gyrocarpeae to Combretaceae, Hernandia to Thymelaeaceae. Meissner (DC. Prodr. xv. i. (1864) 251) restored Gyrocarpeae to Lauraceae, and made Hernandia the type of a natural order Hernandiaceae in the same affinity, Bentham and Hooker (Gen. Pl. i. (1865) 689), following Lindley, placed Gyrocarpeae again in Combretaceae, adding to them Martius's Sparattanthelium, while Hernandia was referred to Lauraceae. Meanwhile Baillon had pointed out (Adans. v. (1865) 186) that Hernandia might be regarded as a diminutive reduced type of Illigera. If, indeed, a hermaphrodite flower be theoretically constructed from the male and female flowers of Hernandia, the peculiar floral characters of Illigera are almost exactly reproduced. In 1885 Solereder (in Bot. Centrbl. xiii. 163) showed that the Gyrocarpeae differed from the Combretaceae and agreed with the Lauraceae in important anatomical characters, namely, the absence of internal phloem and the presence of secreting cells. Four years later (in Engl. Bot. Jahrb. x. (1889) 511), he
investigated the anatomy of the Gyrocarpese in greater detail and adduced an additional character, the presence of raphides, as confirming the relationship with Lauraceae. Almost simultaneously Pax (in Engl. u. Prantl, Pflanzenfam. III. ii. (1889) 126) added Bentham and Hooker’s Gyrocarpese to Hernandiaceae and placed the order near Lauraceae, and this arrangement is probably a fair representation of our present knowledge of these genera.

Illicera naturally falls into two distinct sections according to the character of the nectaries, six of the twelve species whose flowers are known having these organs comparatively large and tubular, while in the remainder minute solid glands take their place. Blume’s two original species, upon which he founded the genus, happen to have belonged one to each section, and one of the characters upon which he relied to distinguish them, and which he used for the name of one of them (I. appendiculata), was this sectional character. I cannot, therefore, do better than apply the name Appendixulate to the six species having large nectaries, and Parviglandulato to the remainder.

**Key to the Species of Illicera.**

| Leaves ternate | 2 |
| Leaves quinate | 1 |
| Infructescence with stiff setose hairs | 3 |
| Nectaries inflated, large | 4 |
| Nectaries obscure | 9 |
| Calyx-tube clothed with spreading red hairs (yellow in a dried state) | 5 |
| Calyx-tube glabrous or softly pubescent | 6 |
| Calyx-lobes externally tomentose | 7 |
| Calyx-lobes glabrous or puberulous | 8 |
| Calyx-tube glabrous or nearly so | 9 |
| Calyx-tube softly and densely pubescent | 10 |
| Leaves with tufts of hair in vein-axils | 11 |
| Leaves glabrous or uniformly hairy | 12 |
| Veins immersed | 13 |
| Veins prominently reticulate on the lower surface | 14 |
| Filaments cylindric | 15 |
| Filaments winged | 16 |
| Leaf-veins ascending | 17 |
| Leaf-veins patent, stamens bearded | 18 |
| Leaves glabrous, lanceolate | 19 |
| Leaves pubescent, ovate-cordate | 20 |
| Calyx-tube puberulous | 21 |
| Calyx-tube glabrous | 22 |
Sect. 1. **Appendiculatae.**


Descriptioni addenda: petala 7 mm. longa, staminibus longiora, nectariis staminalibus obovatis, basi breviter cupularibus, 2 mm. longis, membranaceis, apice truncatis, integris, glandulis disci sphaeroideis sessilibus.


True *I. appendiculata*, Blume, is a plant with ovate leaflets, hairy in the vein-axils beneath, and is at present known only from the Malayan Islands. The plant so called by Kurz and later Indian botanists is No. 4 below. *I. dubia*, Span., was distinguished by Miquel from *I. appendiculata*, Blume, by its winged fruit, under the impression that the fruit of the latter was a wingless drupe. As it has been shown above that this is almost certainly not the case, it becomes highly probable that *I. dubia*, Span., is a synonym and it is so inserted, though not with certainty, above.


Descri. addenda: petala 7 mm. longa, utrinque pubescentia, nectariis 2½ mm. longis, eis *I. rhodanthae* similibus.


Descri. addenda: petala 7–10 mm., staminibus æquilonga, nectariis staminalibus eis *I. appendiculatae* similibus.

**INS. PHILIPP.:** Luzon, common. **CHINA**: Formosa, *Henry*, n. 703, *Playfair*, n. 61.

OF THE GENUS ILLIGERA.


Var. Kurzii, King, l.c.—I. Kurzii, C. B. Clarke, l.c.


Descri. addenda: petala 7 mm. longa, staminibus longiora, nectariis staminalibus ovalibus, inflatis, sessilibus, superne poro laterali provisis, 3 mm. longis.

Kurz's mistake in referring this plant to I. appendiculata, Blume, has already been referred to under that species. It appears that Blume's plant, though really easily distinguishable, and well described from authentic specimens by Miquel, was not understood by Kurz and Clarke. This may have arisen from the fact that Teijsmann, as Miquel remarked, sent out specimens of it from the Buitenzorg Botanic Gardens under the name of I. pulchra.

5. I. Dasyphylla, Miq. Fl. Ind. Bat. i. i. (1860) 1094, Suppl. i. 333, tab. 1; Ann. Mus. Bot. Lugd.-Bat. ii. 215; Meissn. in DC. Prodr. xv. i. 251.

Malaya: W. Sumatra (ide Miq.).


Descri. addenda: petala 10 mm. longa, staminibus longiora, nectariis staminalibus breviter stipitatis, obovatis, basi breviter cupularibus, apice rotundatis, serrulatis.

Some of the above specimens, though characterized by the distinct inflorescence and floral characters of Hance's plant, vary considerably in the shape and hairiness of the leaves, which are oblong and subglabrous in Morse's Kwangsi specimens, ovate and densely pubescent in Balansa's plants from Tonkin.


Africa: Angola, Welwitsch, n. 1763.

Sect. 2. Parviglandulata.

MR. S. T. DUNN: A REVISION OF THE GENUS ILLIGERA.


Deser. addenda: petala ligulata, 6 mm. longa, staminibus æquilonga, basi barbata, nectaris staminibus globosis, sessilibus, minutis.

The redescribing of this species under the name of Illigera lucida by Teijssmann was probably another mistake due to having the name I. pulchra wrongly applied to I. appendiculata in the Buitenzorg Botanic Gardens.

9. Illigera parviflora, Dunn, sp. n. Frutex scandens, inflorescentia excepta, glaber. Folia trifoliolata, petiolo 4–5 cm. longo; foliola lanceolata, lateralvalis valde obliqua, 5–7 cm. longa, chartacea, acuminata, basi cuneata. Panicleae pedunculatae, angustae, foliis brevioribus, pedunculis 4 cm. longis. Calycis tubus dense pubescens, lobis 4 mm. longis glabris; petala interne glabra, externe pubescentia, sepalis æqualia; stamina 7 mm. longa, puberula, nectaris staminibus minutis sessilibus rotundatis, glandulis disci minutis stipitatis.

CHINA: Kwantung, N.W. River, Ford, n. 260.

10. I. cordata, Dunn, sp. n. Frutex scandens. Caulis striatus puberulus, glabrescens. Folia trifoliolata, petioli 4–12 cm. longis, foliolis suborbicularibus vel ovatis, 7–12 cm. longis, chartaceis, ubique molliter pubescens, tandem subglabres, subabrupte acuminatis, terminalibus symetricis, lateralis oblique cordatis. Flores in cymas densas, pedunculatas, pubescentes, foliis brevioribus dispositis, pedunculis communibus 4–6 cm. longis, bracteolis oblongis, ad. 3 mm. longis. Flores flavae; calycis tubus dense pubescentis; lobi 5 mm. longi, interne pubescentes; petala sepalis similis; stamina 3 mm. longa, puberula, nectaris staminibus oblongis, minutis, glandulis disci trilobis 1½ mm. latis; stylus hirsutus. Fructus secus, tetrapterus, 3–5 cm. latus, 25–35 mm. longus, subglaber, alis lateralis aliorum dimidia excedentibus vel eis æqualibus.

CHINA: Yunnan, Hancock, n. 538, Henry, nn. 9902, 9902 A. 10649.


MALAYA: Celebes (side Miq).

12. I. platyandra, Dunn, sp. n. Frutex scandens, floribus exceptis glaber. Folia superiora trifoliolata, petiolis 5–7 cm. longis; foliola ovata vel ovato-oblonga, basi rotundata vel subcordata, venis secundariis utroque latero 4–5 erecto-patentibus, curvatis. Flores in cymas compactas, petiolis brevioribus, vel in paniculas foliosas dispositis, bracteolis minutis paucis. Calycis tubus glaber; lobi oblongi 5 cm. longi, extus acuminis, intus omnino pubescentes, 5 mm. longi, acuti; petala angustiora. æquilonga, ubique pubescentia; stamina petalis duplo longiora, filamentis alatis superne angustatis, anguste revolutis, 10 mm. longis, basi 2½ mm. latis, minute
puberulis, nectariis rudimentariis alis filamenti obsectis, glandulis disci obsolentis. Stylus pubescentis. Fructus tetrapetalus, alis coriaceis striatis, lateralibus 2–3 cm. longis, exeteris duplo brevioribus, ovatis, glabris.


Flowers unknown.

India: Naga Hills, Clarke, n. 41843.

Species exclusenda.

I. obtusa, Meisn. DC. Prodr. xv. i. 251.

From the characters there given the plant is clearly to be rejected from the genus.

On some new Species of Coniferae from the Island of Formosa. By Bunzo Hayata (Tokyo). (Communicated by W. Botting Hemsley, F.R.S., F.L.S.)

(Plates 22 & 23.)

[Read 16th January, 1908.]

The following pages were in type, and the Plates ready for printing, when the new species contained in it were published in 'The Gardeners' Chronicle,' 28th March, 1908, p. 194. The Council were unaware that this paper had been sent to the late Dr. M. T. Masters for publication, but his unexpected death induced the author to forward another manuscript and to ask that it might be presented to the Linnean Society, in the belief that the original paper would not be published.—Sec. L. S.

The following Pinus was first collected by Mr. C. Owatari in the mountainous districts of the Island. I was not able to investigate it with any satisfaction until Mr. G. Nakahara brought me some mature cones of this plant. The following description is drawn from both materials.

Pinus formosana, Hayata, sp. n. (Pl. 22.)

Ramuli teretes, perularum rudimentis notati, novelli pubescentes. Gemmae ovate, perulate, perulis acutis membranaceis margine lacerratis. Folia in quovis fasciculo quinque, fasciulis approximatis, acerosa, rigidula, 6–8 cm. longa, arcuata sed non torta, apice acuta, dorso plana, facie acuta carinata, triangularia in sectione, margine et in carina remote serrulata. Strobili erecti, ovato-elliptici, obtusi, e squamis circ. 40 compositi, 7–9 cm.
MR. B. HAYATA ON NEW SPECIES OF

longi, 4–6 cm. lati, squamis ellipticis basi cuneatis sursum rotundatis leviter reflexis, 3 cm. longis, 1½ cm. latis, coriaceo-crassis et sublignescentibus concavis radio-fuscis, dispersis sed aborti monospermis. Bracteae brevissimae. Semina ovata, apice obtusa, 10 mm. longa, 6 mm. lata. Testa coriacea, pallide ferruginea glabra. Ala membranaceae, tenuis, cultriformis, 2 cm. longa, 8 mm. lata.


This Pinus is very near P. parvijlora Sieb. et Zucc., but differs from that by the shape of the cones, which in the new species are usually reflexed and especially so in the lower scales. The wings of the seeds are much larger than those of P. parvijlora.

According to the information from Mr. G. Nakahara, the plant grows in the mountainous districts of the Taichū prefecture, at an altitude of 1500 m. Forming a forest along a valley, parallel to the Camphor forests, this pine gives the most remarkable feature to the vegetation of this district. Attaining a height of about 15 m., and a diameter of a little less than 1 m., it has an outline of a conical form, its branches spreading quite loosely upwards from the middle of the trunk, and downwards to about the reach of one's arms. The trunk is greyish white, very straight like a fir and the texture of the bark is very similar. The distribution of this Pinus is rather local, being limited to the western slope of the central mountain-ranges in the middle part of the island. It grows mostly on clay slates.

The following Juniperus was found on the top of Mt. Morrison at an altitude of about 4000 m., and was first collected by Mr. Shimoyama. Although the same mountain has since been botanized by several collectors, the specimens brought to me were but fragments of a barren branch. I could get no more information about this species than that it is something like Juniperus chinensis, Linn., until Mr. T. Kawakami gave me a perfect specimen. Examining this material, I find that it is very different from J. chinensis, Linn. The following description is mostly based upon Mr. T. Kawakami's specimens.

Juniperus morrisonicola, Hayata, sp. n.

Rami teretes; ramuli novelli virides, trigoni. Folia omnia lanceolata, apice acerosa patentiusscula, 3–4 mm. longa, 1 mm. lata, supra concava, glaucescentia, subtus leviter carinata. Flores masculi ad ramulos brevissimos terminales ovoidei, 4 mm. longi, 2 mm. lati; stamina 8, filamenti in squamum peltatis, squamis suborbicularibus, 1½ mm. diametro aquantibus, loculis anthera 3. Flores feminei ad ramulos brevissimos terminales, basi foliis squamiformibus bracteisque 6–9 oppositis sufituli, squamis intimis 3, ovatis acutis verticillatis patentibus. Ovulum terminale, solitarium, a squamis
intus circumdatum, oblongum, apice attenuatum. Galbulus globosus vel oblongus, 6 mm. longus, extus bractearum apicibus notatus. Semina solitaria, globoso-ovoidea, 5 mm. longa, 4 mm. lata; testa ossea sulcata; embryo normalis; cotyledones 2.

_Hab._ ad verticem montis Morrison, 13200 ped. alt., leg. Shimoyama, anno 1899; leg. R. Torii, anno 1900; leg. S. Nagasawa, anno 1905 (no. 585); leg. T. Kawakami, mense Octobro, anno 1906 (no. 2142, fr.).

This new plant resembles _J. chinensis_ in habit, but is easily distinguished by its solitary ovule on a short branchlet and by the shape of its cone. The leaves have a large single resin-canal near the phloem. So far, the plant does not seem to have dimorphic leaves, all the specimens we have at present having but one kind of leaf.

_Cunninghamia_ was hitherto a monotypic genus, having only _C. sinensis_, R. Br. It is therefore most remarkable that we have here an addition of another species to this interesting genus. The new _Cunninghamia_ here described was kindly sent to me by Mr. T. Kawakami, Government Expert of Formosa. It was obtained by Mr. Konishi on Mt. Rantaizan at an altitude of about 2000 m. It is very rare in the coniferous forests and attains a considerable height; it affords a good timber, which bears much resemblance to that of _Chamecyparis_.

_Cunninghamia Konishi_, Hayata, sp. n. (Pl. 23.)

_Arbor_; rami omnes teretes, glabri, foliorum spiraliter confertorum cicatricibus notati. Gemmæ floriferae nude, depresso-globose, bracteis depresso-ovatis brevissimae aristato-acutis. Folia ramorum veteriorum spiraliter conferta, adnato-decurrentia, anguste linearis-falcata, incurvo-erecta, acuta, dorso leviter carinata, ramulorum juvenilium spiraliter conferta, adnato-decurrentia, anguste lineari-falcata, incurvo-erecta, acuta, dorso leviter carinatae, lamina 15 mm. longa, 2.5 mm. lata, ad basin oblique torta, apice obtusiuscula, margine sub lento serrulata, rigida, coriacea, utrinque pagina glaucescensia et striis duabus stomaticis multi-seriatis cincta, octovum in annum virentia, demum exarida sensim soluta. Strobili maturi ovato-globosi, 20 mm. longi, 15 mm. lati; squamae rotundatae, mucronatae, basi distincte unguiculatae, ungue brevo, lamina dilatata cordata late depresso-ovata, margine integra, lignescentes, sursum coriacea et marginem versus subundulata, dorso apice leviter carinatae, glabrae; bracteis obsoletis; squamule 3 in medio laminae, distinctae, fimbriate, crenulatae. Semina 3, ad squamulorum basin affixa reversa libera, ovato-elliptica, testa coriacea durissima, ala angusta cineta; embryo ignotus.

_Hab._ in monte Rantaizan, Nanto, ad 7000 ped. alt., leg. N. Konishi, mense Julio, anno 1907.

Mr. T. Kawakami informs me that this new plant is intermediate in habit between _Cunninghamia_ and _Taiwania_. On examining the specimen carefully, I find the cone of the plant has a secondary squama, and should
therefore be undoubtedly referred to *Cunninghamia*. The leaf has stomata on both surfaces, while that of *C. sinensis* has none on the upper surface, or a very few. In the case of *Taiwania*, the stomata are found on both surfaces of the leaf. The new *Cunninghamia* differs essentially from *C. sinensis* by the arrangement and the shape of the leaves, smaller cones and broader squamae. The timber is like that of other Conifers, the bark is reddish brown and in all respects is very like that of *Chamaecyparis*; but it has a peculiar odour unlike other Conifers. The leaf of *C. Konishii* is more durable than that of *C. sinensis*; the former lasts for eight, the latter for five years only.

In conclusion, I must express my hearty thanks to Prof. J. Matsumura under whose special permission this work has been carried out.

EXPLANATION OF THE PLATES.

**PLATE 22.**

*

**Pinus formosana**, Hayata.

Fig. 1. A cone after dispersing the seeds.
2. A young cone.
3. A scale of the same, seen from within.
4. The same, seen from without; *br*=bract.
5. A scale, taken from a little below the middle portion of a mature cone.
6. A scale, taken from the middle portion of the same cone, seen from without.
7. The same, seen from within.
8. A scale, taken from a little above the middle portion of the same cone.
9. A scale.
10. The section of a leaf. *f*=fibro-vascular bundles; *r*=resin-canal.

Figs. 1 and 2, natural size; the rest are all more or less magnified.

**PLATE 23.**

*

**Cunninghamia Konishii**, Hayata.

Fig. 1. A branch, bearing a cone.
2. A leaf (outer or under surface); those portions which bear stomata are shown by dots.
3. A leaf (inner or upper surface).
4. Diagrammatic section of a leaf. *re*=resin-canal; *Trf*=transfusion tissue; *fvb*=fibro-vascular bundles.
5. A scale of the cone (taken from the upper part of the cone; dorsal view).
6. The same (ventral view); traces of seeds are clearly seen.
7. A scale of the cone (taken from middle part of the cone; ventral view); two lateral seeds are clearly seen, the middle one taken off.
8. Seed.
9. The same, seen from the other side.

Fig. 1, natural size; the rest are all more or less magnified.
intimis circumdatum, oblongum, apice attenuatum. Galbulus globosus vel oblongus, 6 mm. longus, extus bractearum apicibus notatus. Semina
solitaria, globoso-ovoidea, 5 mm. longa, 4 mm. lata; testa ossea sulcata;
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to that of Chamaecyparis.

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cibus notati. Gemmæ florifere nuda, depresso-globosae, bracteis depresso-
avatis brevissime aristato-acutis. Folia ramorum veteriorum spiraliter con-
fera, adnato-decurrentia, anguste lineari-falcata, incurvo-erecta, acuta, dorso
leviter carinata, ramulorum juvenilium longiora, ascendento-patentia, lineari-
lanceolata, 15 mm. longa, 2½ mm. lata; ad basin oblique torta, apice obtusi-
uscula, margine sub lentse serrulata, rigida, coriacea, utrinque pagina glae-
cescentia et striis duabus stomatibus multi-seriatis cincta, octovæm in annum
virentia, demum exarida sensim soluta. Strobili maturi ovato-globosi, 20 mm.
longi, 15 mm. lati; squamae rotundate, mucronate, basi distincte unguiculæ,
unge brevo, lamina dilatata cordata late depresso-ovata, marginc integra,
lignecentes, sursum coriaceæ et marginem versus subundulata, dorso apice
leviter carinate, glabrae; bracteis obsoletis; squamulae 3 in medio lamine,
distincte, fimbriate, crenulate. Semina 3, ad squamulorum basin affixa
reversa libera, ovato-elliptica, testa coriacea duriuscula, ala angusta cincta;
embryo ignotus.

Hab. in monte Rantaizan, Nanto, ad 7000 ped. alt., leg. N. Konishi,
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habit between Cunninghamia and Taiwania. On examining the specimen
carefully, I find the cone of the plant has a secondary squama, and should
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In conclusion, I must express my hearty thanks to Prof. J. Matsumura under whose special permission this work has been carried out.

EXPLANATION OF THE PLATES.

**PLATE 22.**

*Pinus formosana*, Hayata.

Fig. 1. A branch of the plant bearing both young and mature cones. *y*=young cone; *m*=mature cone.
2. A young cone (*y* of fig. 1).
3. A scale of the same, seen from within.
4. The same, seen from without.
5. A cone after dispersing the seeds.
6. A scale, taken from a little below the middle portion of a mature cone (*m* of fig. 1).
7. A scale, taken from the middle portion of the same cone, seen from without.
8. The same, seen from within.
9. A scale, taken from a little above the middle portion of the same cone.
10. A scale.
11. The section of a leaf. *f*=fibro-vascular bundles; *r*=resin-canal.

Figs. 1, 2, and 5, natural size; the rest are all more or less magnified.

**PLATE 23.**

*Cunninghamia Konishii*, Hayata.

Fig. 1. A branch, bearing a cone.
2. A leaf (outer or under surface); those portions which bear stomata are shown by dots.
3. A leaf (inner or upper surface).
4. Diagrammatic section of a leaf. *rc*=resin-canal; *TfTf*=transfusion tissue; *fBf*=fibro-vascular bundles; *s*=portions of surface with stomata.
5. A scale of the cone (taken from the upper part of the cone; dorsal view).
6. The same (ventral view); traces of seeds are clearly seen.
7. A scale of the cone (taken from middle part of the cone; ventral view); two lateral seeds are clearly seen, the middle one taken off.
8. Seed.
9. The same, seen from the other side.

Fig. 1, natural size; the rest are all more or less magnified.
CUNNINGHAMIA KONISHII, Hayata.

[Read 5th December, 1907.]

[In 1905 the Trustees of the British Museum made a grant towards the expenses of Mr. H. C. Robinson's expedition to Gunong Tahan in the Malay Peninsula, on condition that the whole collection made by the expedition should be sent to the Natural History Museum and that the first set should become the property of the Trustees. An account of the expedition will shortly be published in the Journal of the Federated Malay States Museum.

The plants, numbering about 250 specimens, were collected from May to July, 1905, by Mr. Robinson and Mr. L. Wray, Director of Museums, Federated Malay States. As Mr. H. N. Ridley, who is specially interested in the botany of the Peninsula, was home on leave during last year, I asked him to prepare an account of the collection. He agreed, but having to return to Singapore early in January, left his paper in an unfinished state; with Mr. E. G. Baker's assistance I have compared it with the specimens in the study set at the British Museum, annotated, and prepared it for the press. The account of the Ferns and Mosses is largely the work of Mr. A. Gepp, and that of the Fungi and Lichens has been prepared by Miss A. Lorrain Smith.

(A. B. Rendle.)]

The mountain Gunong Tahan lies in the north of Pahang, on the east coast of the Malay Peninsula, and was formerly believed to be by far the highest mountain in the Peninsula. It proves, however, to be by no means so lofty as was at first supposed, being only 7100 feet in altitude.

Several attempts were made to explore this mountain on previous occasions. The first of these was undertaken by the author of this paper, accompanied by Mr. W. Davison, Curator of the Raffles Museum, Singapore, and Lieut. Kelsall, R.E., in 1891. The position of the mountain was then unknown, and owing to the limited time allowed, the failure of the commissariat, the extremely unhealthy character of the Tahan Valley, and the unsettled state of Pahang, then on the eve of the rebellion which broke out the following year, the expedition failed to reach its goal. A good collection of plants, however, was made, an account of which was published in the Transactions of this Society, ser. 2, iii. p. 267, and an itinerary of the trip in the Journal of the Royal Asiatic Society, Straits Branch, vol. xxv. p. 33. This expedition attempted to reach the mountain by travelling up the Pahang river, then up the Tembeling and Tahan rivers, which latter stream is reported to spring from the base of the mountain.
In 1893 Mr. H. M. Becher again attempted to reach the mountain by the same route, but perished in a spate of the Tahan river about five miles above the point at which the first expedition stopped. A few plants were added to the collections at Singapore Botanic Gardens by the Gardens' plant-collector, who accompanied Mr. Becher's ill-fated expedition.

In 1899 Mr. W. W. Skeat went with the Cambridge expedition to explore the north of the Peninsula, made a hasty trip to the mountain from the north, and after much difficulty and risk reached it.

In 1901 Mr. John Waterstradt reached the mountain in a trip made chiefly for the purpose of collecting birds. An account of his expedition was published in the Journal of the Royal Asiatic Society, Straits Branch, vol. xxxvii. (1902) pp. 1-27.

The collection of plants made by Messrs. Robinson and Wray is one of considerable interest, and contains a number of remarkable additions to the knowledge of the flora of the Malay Peninsula. It has long been known that the floras of the east and west coasts are very different, the eastern side showing a number of Australian and eastern Asiatic types not met with on the western side, the flora of which is more accessible and has been more thoroughly studied.

The greatest interest centres round the plants, the geographical distribution of which is further extended. Two of these are specially noteworthy, viz. Pentaphylax malayana, n. sp., and Gentiana malayana: the former is the second representative of a Chinese monotypic genus of Ternstroemiae previously known only from Hongkong; the latter is closely allied to a Bornean species occurring on Mt. Kinabalu and to a Javan species.

A curious new genus of Melastomaceae allied to Dissoeharta, which I have called Oritrephes, is also an important addition. The genus Xyris is represented in the Peninsula by several sea-shore species, but is seldom met with inland or at any altitude; it is absent, so far as is known, from the Perak Hills and Mount Ophir, but one species, X. Ridleyi, was found by me on Kedah Peak at about 3000 feet elevation. Two species occur on Gunong Tahan, one identical with that from Kedah Peak, the other, X. grandis, n. sp., perhaps the largest species of the genus, conspicuous from its stiff sword-like leaves resembling those of Cladium Maiangayi, C. B. Clarke, of Mount Ophir.

There are, as usual in such collections, several species of Didymocarpus, including two new to science, and a number of Orchids, a good proportion of which are also new.

Among the previously described plants it is interesting to find several of those known only from Father Scortechini's collections and distributed without any specific locality. It is probable that as they have not been met with on the western slopes of the Perak Hills, Scortechini must have collected them on the eastern watershed of the main range. Such are Gordonia imbricata, King, Polysoma coriacea, King, and Calophyllum venustum, King.
PLANTS FROM GUNONG TAHAN, PAHANG.
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SPERMATOPHYTA.

DICOTYLEDONES.

POLYPOETALAE.

DILLENIACEÆ.

ACRITERMA COSTATUM, Jack, in Mal. Misc. i.(1820) No. v. 36.

Kuala Teku, 500-1000 ft. (5536.)

Distrib. Common in most hill regions of the Straits Settlements at that altitude and occasionally at lower elevations.

POLYGALACEÆ.

POLYGALA MONTICOLA, n. sp.

Frutex circa bipedalis, basi nuda lignosa, superne haud ramosa. Folia 3-4 poll. longa, 1½ poll. lata, lanceolata utriusque acuminata, petiolata, glabra aut raro pilis translucentibus parce munita, nervis primariis ad 8 paria, petiolo ½ poll. longo. Racemus subterminalis strictus erectus densus. Flores albi, carinis roseis, ¼ poll. longis; pedicellis brevissimis. Sepala externa ovata rotundata pubescentia. Petala oblonga, carina cristata. Capsula immatura reniformis biloba ferme ¼ poll. in diametro.

Gunong Tahan, 5000-6000 ft. A small shrub; flowers white; column edged with yellow, pinkish above; sepals edged with purple. (5456.) At 4000-5000 ft.; about 2 feet high. Flower white when first opened, afterwards turning pink; leaf-stalks tinted pink. (5384.)

Forma major, foliis 6 poll. longis, 2 poll. latis, glabris, petiolis pollicaribus; racemo 9 poll. longo.

Flowers tipped rose-red, calyx and flower-stalks white; mid-ribs of leaves tinted with red. At 5000 ft. (5333.)

Though this has been several times collected in the mountains of the Malay Peninsula by different collectors, it seems to have been confused with P. tenenosa, Juss. Its smaller flowers on very short pedicels, as well as its dwarf stem and dense erect raceme, make it very distinct from the great spreading half-shrub which is common in the lower damp forests; and it is difficult to see how it could be considered a variety of P. tenenosa, which is really much less variable than would appear from the number of varieties of it recorded.

PITTOSPORACEÆ.

Pittosporum sp. A small tree 10 to 15 feet high, with light-coloured boughs and opposite subcoriaceous lanceolate leaves glabrous with impressed nerves above, strongly reticulate above and beneath, petioles pubescent. Fruit solitary, oval, ½ inch long, on a slender peduncle 1½ inch long.
Gunong Tahan, 5000–6000 ft. (5444.)
Too incomplete to describe, but I cannot identify it with any Asiatic species.
The only species hitherto recorded from the Peninsula is *Pittosporum ferrugineum*, Dryand.

**GUTTIFERÆ.**

In fruit, Gunong Tahan, 3300 ft. A medium-sized tree 50–60 feet high.

*Distrib.* A common and widely dispersed species, occurring from the Andamans eastward to the Society Islands.

Gunong Tahan, 4000–5000 ft. A small tree with white flowers. (5340, 5395.)

*Distrib.* Perak. Only once previously collected.

**TERNSTREMIAEÆ.**

Gunong Tahan, 3300 ft. A small tree; calyx bright red. (5322.)

*Distrib.* Found also on Mt. Ophir, and Gunong Batu Putih and other mountains of Perak; also Philippine Is.

**ADINANDRA VILLOSA,** *Choisy, l.c. 112.*
Gunong Tahan, 5000–5500 ft. Tree 30–40 ft. high; flowers white. (5517.)

*Distrib.* Tavoy and Perak at high elevations.

**A. ANGULATA,** n. sp.
Gunong Tahan, 5000–5500 ft. (5518.) A very remarkable species, with the foliage of one of the large Garcinias, and quadrate stems with a narrow wing running along each edge. The very large fruits are in pairs.

**TERNSTREMIA JAPONICA,** *Thunb. in Trans. Linn. Soc. ii. (1794) 335.*
Gunong Tahan, 3300 ft. Bush; flowers white; leaves pale green beneath. (5328.)—5000–6000 ft. Shrub 2–3 feet high; flowers greenish white; anthers brown. (5501.)
Distrib. An addition to the flora of the Malay Peninsula. *Ternstroemia japonica* taken in a large sense is a widely spread species in Eastern Asia, and as *T. aneura*, Miq. (the type of which these specimens closely resemble), occurs in Banka.


Gunong Tahan, 6000 ft. A small tree; the flower cream-colour, ⅔ inch across. (5436 and 5406.)

**Distrib.** A rare plant, only collected once in Perak by Scortechini.

**Schima noronhii**, *Reinw. ex Blume, Bijdr.*, 130.

Gunong Tahan, 5000–5500 ft. A small tree 20 to 25 feet high, or a shrub 4–6 feet high; flower white, stamens yellow. (5508, 5525.)

**Distrib.** Common and variable at high altitudes, occurring also in Burma and the Malay Archipelago.

**Pentaphylax malayana**, n. sp.


Gunong Tahan, 3300–5000 ft. Bush with white flowers. (5325, 5339, 5405.)

A very fine addition to the flora of the Malay Peninsula, the only other known species, *P. euryoides*, Gardn. & Champ., being a native of Hongkong. Specimens of obviously the same species were some years ago brought by Mr. Barnes from K’luang Terbang in Pahang (Journ. Roy. As. Soc., Straits Branch, xxxix. (1903) 1–18). These specimens were in fruit, and the description of the fruit is taken from them. *P. malayana* differs from *P. euryoides* in its smaller, more thickly coriaceous, blunt leaves, and its shorter and thicker flower-spikes.

**Tiliaceae.**

**Elæocarpus monticola**, n. sp.


Linn. *Journ.—Botany, Vol. XXXVIII.*
Ovarium globosum, stylo brevius. Torus crassus undulatus. Drupa globosa, plus quam \( \frac{1}{2} \) poll. longa, rugosa.

Gunong Tahan, 5000–5500 ft. Shrub 10–12 feet high. Sepals pinkish brown; petals greenish white. (5523.)

Near Elaeocarpus punctatus, King, in Journ. As. Soc. Beng. lx. ii. (1891) 139 (Malay Peninsula, Java, and Sumatra), but differs in the more fimbriate petals, longer style, and entire leaves. The fruit is very different from that of E. punctatus and resembles that of E. parvifolia, Wall.

RUTACEÆ.

**Evodia simplicifolia**, n. sp.

Frutex 7-pedalis ramosus. Folia opposita elliptica obtusa, basi subcuneata vel rotundata, coriacea integra, nervis primariis sepe 16, nervulis reticulatatis, 3–3\( \frac{1}{2} \) poll. longa, 1\( \frac{1}{2} \) poll. lata, siccate pallida, petiolis \( \frac{1}{2} \) poll. longis. Panicula petiolo vix longiores in axillis foliorum summorum disposita. Flores non visi. Capsule 4-lobate \( \frac{1}{2} \) poll. late rugose glabra.

Gunong Tahan, 5000–6000 ft. A shrub 7 feet high. In fruit. (5492.) Much resembles E. pachyphylla, King, a native of Perak, but is very distinct in its simple unifoliolate leaves and glabrous capsules.

CELASTRACEÆ.


Gunong Tahan, 5000 ft. A small tree; flowers dull red. (5332.) I have seen no authentic specimen.

Distrib. Originally collected in Perak by Scortechini, who gave no exact locality.

ROSACEÆ.

**Photinia dubia**, Lindl. in Trans. Linn. Soc. xiii. (1821) 104, t. 10.

Gunong Tahan, 5000–6000 ft. Small shrub 8–15 feet high; fruit brownish red. (5486.) Not recorded in the 'Flora of the Malayan Peninsula'; it was collected by Griffith at Bukit China, a low hill close to Malacca, and by myself on rocks by the river in the Dindings, where it is a low straggling bush.

Distrib. North India.


Gunong Tahan, 5000–5500 ft. Tree 15 to 25 feet. (5520.)

Distrib. Khasia, Burma, and Sumatra.

SAXIFRAGACEÆ.


Gunong Tahan. Tree; flowers red; leaves green, stalks red. (5319.)

Distrib. Higher mountains of the Peninsula.
PLANTS FROM GUNONG TAHAN, PAHANG.

POLYOSMA CORIACEA, King, in Journ. As. Soc. Beng. lxvi. ii. (1897) 300.
Gunong Tahan, 4000-5000 ft. Bush; flowers white. (5388.) A small tree 20-30 feet high; flowers yellowish-white. (5493.)
Distrib. Perak and Kedah Peak.

P. LETE-VIRENS, Griff. ex King, l. c. 303.
Small tree at 5000-6000 ft. (5462.)
Distrib. Malay Peninsula.

HAMAMELIDÆ.

Gunong Tahan, 5000-6000 ft. Large shrub 10 feet high, or tree 18 inches in diameter; flower rosy pink. (5482, 5506.)
Distrib. Hill-ranges of Malay Peninsula and in Sumatra.

RHIZOPHOREÆ.

Gunong Tahan, 3300 ft. Small tree.
Distrib. Perak. Hitherto only known from Scortechini's collection.

MYRTACEÆ.

BÉCKEA FRUTESCENS, Linn. Sp. Pl. 358.
Gunong Tahan, 3300 ft. (5311.)
Distrib. Common on all hills at this elevation; also Malay Archipelago.

LEPTOSPERMUM FLAVESCENS, Sm., var. COMMUNE, Benth. Fl. Austral. iii. 104.
Gunong Tahan, 4000-5000 ft., on ridges. Trunk up to 2 feet in diameter, but short and twisted. (5409.)
Distrib. Common on the hills at this elevation in the Malay Peninsula, and throughout the Archipelago to Australia.

RHODAMNIA TRINERVIA, Blume, Mus. Bot. Lugd.-Bat. i. 79.
Gunong Tahan, 5000-6000 ft. (5500.) A mountain form with coriaceous ovate acuminate leaves, densely white woolly beneath, less so above, but with silky white pubescence on the upper face and pubescent fruit.
Distrib. Malayan Archipelago and Philippines to Australia; Burma.

EUGENIA PAHANGENSIS, h. sp.
Arbor 20-pedalis cortice albescente. Folia coriacea crassa elliptica petiolata obtusa, costa superne depressa subtus elevata, nervis plurimis gracilibus subparallelis, 3-4 poll. longa, 2 poll. lata. Panicula brevis terminalis densiflora, 2 poll. longa, ramis paucis crassis angulatis. Flores flavescentes parvi congesti sessiles vix ¼ poll. longi. Sepala brevissima crassa,

Gunong Tahan, 5000-6000 ft. Small tree 20 feet high; flowers pale yellowish. (5454.)

Belongs to the same group as Eugenia subdecussata, Duth., but is very distinct in its foliage.

Eugenia viridescens, n. sp.

Gunong Tahan, 5000 ft. A bush; flowers pale green, leaves and young wood tinged with purple. (5338.)

Allied to E. subdecussata, Duth., but differs in the form of the leaves, which narrow towards the base and end in a truncate retuse manner. They are less stiff than those of subdecussata, drying of a yellowish colour, and the margins curling back. The nervation is very fine and close and hardly distinguishable.

MELASTOMACEÆ.


Gunong Tahan, 5000–5500 ft. Flower pinkish. (5514.)

A very large-flowered form of this variable species, the petals being nearly as large as those of M. decemfidium, Roxb., but otherwise there is very little difference between this and typical M. malabaricum of the plains. Distrib. India to China and North Australia.

Sonerila heterostemona, Naud. in Ann. Sci. Nat. sér. 3, xv. (1851) 326.

Kuala Teka, 800–1000 ft. (5538.)
Distrib. Common in the woods of the plains. Malay Peninsula, Sumatra to Borneo.


Gunong Tahan, 3300 ft. Flowers white or tinted with pink; leaves dull green with white hairs, beneath crimson with white hairs. (5315, 5347.)
Distrib. Perak, Gunong Bubu (previously collected by Wray).

S. paradoxa, Naud. l. c. 321.

Gunong Tahan, 3300 ft. Leaves bright green with metallic blue lights, beneath crimson, hairs on both sides crimson; flowers pale pink. (5362.)
The very hairy form common at higher elevations.
Distrib. Penang.
PLANTS FROM GUNONG TAHAN, PAHANG.

ANERINCLEISTUS FRUTICOSUS, n. sp.

Gunong Tahan, 5000-6000 ft. Small shrub; flower pale pink; anthers pale yellow. (5453.)
Allied to A. macranthus, King, but more glabrous with smaller leaves and more woody.

ORITREPHES, n. gen.

Frutex; foliis oppositis ellipticis acuminatis, basi cuneatis, trinerviis. Pani
cula terminalis paniciflora, floribus majusculis. Calyx leprosus obconicus, apice constricto, lobis 4 brevibus connatis, dentiformibus. Petala 4 obovata unguiculata alba. Stamina 8, aequalia, similia, antheris elongatis versus apices attenuatis, poro terminali, basibus breviter hastatis, appendicibus et setis nullis, dorso processu parvo circulari onustis. Stylus longus, stigmatum punctiformi. Ovarium 4-loculatum ellipticum, ferme ad basin tubi calycis liberum, vertice depresso-concavum. Fructus baccatus. Semina plura, placentis axillaris suffulta; adhuc imma
tura.

O. PULCHRA, n. sp.

Frutex ramosus; foliis superne glabris inferne rufescenti-lepidotis, nervis
tomento rufo tectis, primariis tribus subitus elevatis, secundariis horizon

Gunong Tahan, 5000-5500 ft. Petals white tipped with pink. (5509.)
Closely allied to Dissocheta and Anplectrum. Remarkable for its 8 similar stamens without hairs or appendages.

MEDINILLA CLARKEI, King, in Journ. As. Soc. Beng. lxix. ii. (1900) 63.

Gunong Tahan, 3300 ft. Small-sized tree. (5312.)
Distrib. Malay Peninsula.
Medinilla pahangensis, n.sp.
Frutex epiphyticus, cortice albo verrucoso. Folia verticillata lanceolata subobtusa vel oblanccolata, basi angustata, coriacea enervia, 2 poll. longa \( \frac{3}{4} \) poll. lata, petiolo \( \frac{1}{4} \) poll. Flores in cymis 1 poll. longis, pentameri, albi, \( \frac{1}{2} \) poll. longi. Calyx cupuliformis, granulatus, obscure 5-dentatus. Petala obovata rotundata. Stamina 10, filamentos sinuatis glabris, antheris æquilongis curvis, processibus 2 anticis ad basin corniformibus, unoque dorsali.
Gunong Tahan, 4000-5000 ft. Growing on trees; flowers white. (5396.)
In general appearance resembles M. Hasseltii, Blume, but is pentamerous.

Gunong Tahan, on trees at 3300 ft. Flowers white, each petal tinted rose-red at the base; flower-stalks, fruit, and mid-ribs of leaves beneath coral-red. (5237.)
Distrib. Malay Peninsula, Burma, Borneo. Common at all altitudes.

Memecylon garcinioides, Blume, Mus. Bot. Lugd.-Bat. i. 358.
Gunong Tahan, 3300 ft. Flowers white; anthers violet. (5352.)
Distrib. Borneo and Sumatra.

Gunong Tahan, 5000-6000 ft. Creeper; fruit chrome-yellow. (5457.)
Distrib. Malay Peninsula.

Begoniaceæ.

Begonia sinuata, Wall. List, n. 3680.
Kwala Teku, 500-1000 ft. Flowers pale pink; stamens chrome-yellow; stalks purplish pink, leaves beneath reddish purple. (5539.)
Distrib. Burma, Malay Peninsula.

Kwala Teku, 500-1000 ft. (5546.)
Distrib. Malacca.

Gampetaleæ.

Rubiaceæ.

Argostemma muscicola, n.sp.
Herba parva erecta vel suberecta, hispidula, 2 poll. alta. Folia æqualia angustae lanceolata acute basi cuneata herbacea, glabra, nervis tribus et marginali pilis albescentibus munitis exceptis, 1-1\( \frac{1}{2} \) poll. longa, \( \frac{1}{2} \) poll. lata; petiolo brevi. Flores 1-2 terminales pedunculati, albi, inter majores generis, \( \frac{1}{2} \) poll. lati. Bracteae lanceolate, et eum pedicellis hirsute. Sepala lanceolata acuta. Petala lanceolata acuta.
Gunong Tahan, 5000–6000 ft. Small herb on mossy rocks by streams. (5461.)

The number of Argostemmas in the Peninsula is large and increases with every mountain explored, as in the case of Sonerila. This little erect species belongs to the set with equal leaves, but has somewhat the habit of A. involucratum, Hemsl.

**Argostemma albociliatum, n. sp.**

*Herba reptans, gracilis, hispida, 3–7 poll. longa. Folia aequalia ovata apicibus subacutis vel rotundatis, breviter petiolata, dense hispida, ½ ad poll. longa, ¼–½ poll. lata. Stipulae breves ovae. Flores 1–4 in pedunculo gracili hispido, 2 poll. longo. Bractee minute lanceolate lineares. Calyx hispidus, lobis brevibus hispidis. Petala lanceolata acuminata, hispidula, ½ poll. longa.*

Gunong Tahan, 3300 ft. Flowers white; leaves pale green, covered with white hairs. (5229.)

A curious creeping species with ovate hairy leaves.


Gunong Tahan, 5000–6000 ft. Flowers white; anthers yellow. (5491.)

*Distrib.* Perak.

A. **Hookeri**, King, l. c. 45.

Gunong Tahan, 3300 ft. Leaves dark green, with broad irregular stripe of light silvery green in centre. (5376.)

*Distrib.* Malay Peninsula. Frequent on the hills.


Kwala Teku, 500–1000 ft. Flowers white. (5543.)

*Distrib.* Malay Peninsula. Common in hill-forests.


Kwala Teku, 500–1000 ft. (5534.)

*Distrib.* India, Malay. A variable species common all over the Peninsula.

**Hedyotis Patens, n. sp.**

Gunong Tahan, 4000-5000 ft. Bush; flowers pale green. (5393.) At 5000-6000 ft. Shrub somewhat creeping in habit; flowers greenish. (5475.)

Allied to Hedyotis Maingayi, Hook. fil., of Mount Ophir, and H. peduncularis, King, of Kedah Peak, but much more branched than either. This group of Hedyotis is very characteristic of our high elevations, and the species are usually confined to one mountain-top.

Timonium montanum, n. sp.


Gunong Tahan, 5000–6000 ft. Shrub 8 feet high; petals pale yellow; anthers rich chrome-yellow; corolla-tube reddish externally. (5499.)

Resembling in habit some forms of T. jambosella, Thw., but distinguished by its long glabrous corolla and short peduncle.


Gunong Tahan, 5000–5500 ft. Shrub 10–11 ft.; fruit brownish. (5524.)

Distrib. Perak, Hongkong, Formosa.

L. coronatus, King & Gamble, in Journ. As. Soc. Beng. lxxiii. ii. (1904) 120.

Gunong Tahan, 5000–6000 ft. Shrub; flowers white. (5503, 5438.)

Distrib. Perak.

CAMPANULACEAE.

Pentaphragma grandis, n. sp.


Gunong Tahan, 4000–5000 ft. 1–2 feet high; flowers dirty white; leaves bright green fleshy, pale beneath. (5408.)

A large plant for the genus, remarkable for its tall fistular stem and large flowers.
PLANTS FROM GUNONG TAHAN, PAHANG.

VACCINIACEÆ.

Vaccinium pubicarpum, n. sp.
Gunong Tahan, 5000–6000 ft. Shrub 4 feet high, in shady ravines. (5443.)
Resembles V. malaccensis, Wight, which is common in the lowlands of the Peninsula, but differs in the long acuminate leaves and pubescent fruit.

V. Longibracteatum, n. sp.
Gunong Tahan, 3300 ft. (5326.)
Remarkable for its pubescence and the large lanceolate bracts. The leaves are close-set and very coriaceous, hairy beneath with conspicuous ascending nerves.

V. Teysmanni, Mix. Fl. Ind. Bat. ii. 1062.
Gunong Tahan. 3300 ft. Flowers crimson; leaves rusty beneath. (5053.)
Distrib. Perak ; Java.

ERICACEÆ.

Gunong Tahan, 5000–6000 ft. Small tree 15–20 feet; flowers whitish. (5476.)
Distrib. Himalayas to Japan.

Gunong Tahan, 3300 ft. Small tree. (5323.)
Distrib. Common on hills in Malay Peninsula ; Malaya.
Rhododendron Wrayi, King & Gamble, in Journ. As. Soc. Beng. lxxiv. ii. (1906) 75.
Gunong Tahan, 4000-5000 ft. (5387.)
Distrib. Occurs also in the Kedah, Selangor, and Perak hills.

Gunong Tahan, 4000-5000 ft. Growing on trees; flowers salmon-pink. (5382.)
Distrib. Perak, Borneo, and Sumatra.

R. elegans, n. sp.
Epiphytica, ramis tenuibus undulatis. Folia opposita vel 5-verticillata elliptica-lanceolata obtusa basi cuneata parva, coriacea, glabra, $\frac{1}{2}$-1 poll. longa, $\frac{1}{2}$ poll. lata, nervis inconspicuis, subtus crebre punctata superne nitida, petiolis brevissimis $\frac{1}{2}$ poll. longis. Flores rubri singuli terminalis, $\frac{1}{2}$ poll. longi, $\frac{3}{4}$ poll. lati, pedicelis equinolongis pubescentibus gracilibus. Calyx cupularis parvus, lobis brevissimis ovatis. Corolla parva recta crassa cylindrica rubra pubescens, lobis rotundatis brevibus. Stamina 8, filamentis pubescentibus. Ovarium hirtum. Stylus cylindricus crassiusculus baud exsertus; stigma clavatum.
Gunong Tahan, 5000 ft. Flowers bright red; leaves dark shining green; growing on trees. (5429.)
A very elegant little slender-branched plant with small flowers. I know nothing exactly like it.

Epacrideæ.

Leucopteron Malayanus, Jack, in Mal. Misc. i. (1820) no. v. 20.
Gunong Tahan. Small tree. (5316.)
Distrib. Common on all the hills and on sandy coasts of the Peninsula. Occurs also in Borneo and Banka, with a variety in Tenasserim.

Myrsineæ.

Gunong Tahan, 5000-6000 ft. Small tree; flowers white, stalks purplish. (5467.) Shrub; flowers white, flower-stalks red; leaves and young wood tinged with red. (5334.)
Distrib. Perak, on most hill-ranges at high elevations.

A. biniflora, n. sp.
Frutex validus, ramis pallidis densis. Folia coriacea lanceolata obtusa basibus cuneatis, glabra, $\frac{1}{2}$ poll. longa, 1 poll. lata, carina subtus crassiuscula, nervis copiosis, petiolo $\frac{1}{2}$ poll. longo. Flores axillares bini vel terni in pedunculo 1 poll. gracili, foliis breviores. Bractee ad basin pedunculi et pedicellorum foliaceæ parvae ovatæ. Sepala rotundata brevia
hand imbricata marginibus glandulosso-dentatis. Petala lanceolata acuta, glandulosa, glandulis magnis, \( \frac{1}{2} \) poll. longa. Antherae lanceolate apiculatae. Gunong Tahan, in ravines, 5000-6000 ft. Shrub 10-15 feet high; flower reddish pink; anthers brownish. (5460.)

A shrub with the habit of *Ardisia littoralis*, Andr., but with very stiff, closely-veined, entire, obscurely gland-dotted leaves, and flowers in pairs on axillary peduncles.

**Ardisia retinervia**, n. sp.

Frutex 10-12 ped. alt., ramis validis brunneis, omnino glaber. Folia coriacea elliptica, apice rotundata, basi cuneata, 4-4\( \frac{1}{2} \) poll. longa, 2 poll. lata, crebre glandulosso-punctata in utraque pagina, costa superne depressa subtus elevata crassiuscula; nervis superne inconspicuis, subtus elevatis horizontalibus numerosis valde reticulatis usque ad margines; margines integri, glandulis marginalibus nullis; petiolo valido brevi, \( \frac{1}{2}-1 \) poll. longo. Cymae paniculatae on illares breves. Flores desunt; pedicellis fructiferis subangulatis, \( \frac{1}{4} \) poll. longi. Sepala 5 ovata obtusa glandulifera glabra brevia. Drupa globosa multi-sulcata, \( \frac{1}{4} \) poll. longa; stylo brevi.

Gunong Tahan, 5000-6000 ft. Shrub 10-15 feet high. (5502.)

Remarkable chiefly for its stiffly coriaceous, strongly reticulated leaves. The drupe, which is large for the genus, is marked with narrow ridges and grooves.

**STYRACEÆ.**

**Symlocos adenophylla**, Wall. ex G. Don, Gen. Syst. iv 3

Gunong Tahan, 3300 ft. (5320.)

*Distrib.* Malay Peninsula and Archipelago.


Gunong Tahan, 4000-5000 ft. Tree; flowers white, tinged near the ends of the petals with pink, veins of flowers red. (5392.)

*Distrib.* Perak. I have seen no authentic specimen of this plant, which has only once been collected, by Scortechini.

**ASCLEPIADACEÆ.**

**Pentasacme caudatum**, Wall. in Wight, *Contribution* 60.

Kuala Teku, 500-1000 ft. (5533.)

*Distrib.* Common in streams at high altitudes in the eastern side of the Peninsula; North India, Burma.


Gunong Tahan, 3300 ft. On trees; flowers red; leaves dull crimson. (5410.)

*Distrib.* Malay Peninsula; common at high altitudes.

Gunong Tahan. On trees; flowers pale yellow. (5399.)

*Distrib.* Malay Peninsula.

GENTIANACEÆ.

**GENTIANA MALAYANA**, n. sp.

Herba pusilla 1-3 poll. alt. Folia carnosa congesta acuta lanceolata sessilia integra glabra, $\frac{1}{2}$-2 poll. longa. Flos terminalis $\frac{1}{2}$ poll. longus. Calyx tubulosus, lobis acuminatis tubum corollæ superantibus. Corolla azurea tubulosa, lobis brevibus subspathulatis apicibus rotundatis, plicis integris. Stamina antheris longius hastatis prædata. Ovarium stipitatum; stylo brevi, stigmatibus brevibus.

Gunong Tahan, 5000-6000 ft. Flowers deep sky-blue. Growing among moss in damp places (5473); on wet rocks (5479).

The addition of the genus *Gentiana* to the Flora of the Malay Peninsula is an interesting one. The species is closely allied to *G. borneensis*, Hook. fil., from Kinabalu, differing chiefly in the quite entire leaves, rounded tips of the petals and entire, not lobed, folds between them. The anthers are narrower and more acute.

The plants collected under the two numbers seem specifically identical, but the specimens of no. 5473 are very much smaller than those of 5479.

**CASSCORA TRINERVIA**, n. sp.

Herba 3-5 poll. alta, caulisibus pluribus. Folia glabra ovata vel ovato-lanceolata herbacea utrinque acuminata trinervia, $\frac{1}{2}$-1 poll. longa, $\frac{1}{2}$-2 poll. lata. Flores in axillis superioribus, albis. Calyx tubulosus superne angustatus $\frac{1}{2}$ poll. longus, costis 8 elevatis, alterne bifurcatis, lobis acuminatis. Corolla irregularis alba, tubo quam sepala paullo longiore, lobis 4 oblongis rotundatis marginibus crispis, uno multo latiore, $\frac{1}{4}$ poll. longis. Stamina fertilia 3, antheris oblongis, uno sterili filiformi. Stylus sat longus; stigmatibus 2 linearibus elongatis.

Gunong Tahan, 5000-5500 ft. Herb by stream; flowers white. (5507.)

There are two species of this genus recorded by C. B. Clarke in his description of the family in the “Materials for a Flora of the Malayan Peninsula,” one of which, *C. diffusa*, a common Indian species, is recorded as belonging to this region only on the authority of a specimen collected by Lobb in Singapore and undoubtedly wrongly localised. The other, *C. pentanthera*, C. B. Clarke, an endemic species, occurs usually at high elevations; it has five complete stamens and a regular corolla, while *C. trinervia* has three complete stamens only and a staminode and an irregular corolla.
macula flaVA in ore tubi notata, \( \frac{2}{3} \) poll. longa. Capsula gracilis cylindrica acuminata, 2\( \frac{1}{2} \) poll. longa.

Gunong Tahan, 5000-6000 ft. Flowers purplish streaked with white, with yellow at top of tube. (5470.)

This species is allied to _D. hispida_, Ridl. It is unusually branched and woody for its group.

LOXOCARPUS INCANA, _R. Br. in Benn. Pl. Jav. Rav._ 120.

Gunong Tahan, 5000 ft. Flowers pale violet, darker in the throat. (5430.)

_Distrib._ Malay Peninsula.

L. ANGUSTIFOLIA, _n. sp._

Herba acaulis, foliis lanceolatis acutis subfalcatis plurimis, basibus in petioliis attenuatis sericeis, \( \frac{3}{4} \)-2 poll. longis, \( \frac{1}{4} \)-\( \frac{3}{4} \) poll. latis. Pedunculus tenuis erectus sericeus, 2 poll. longus. Flores 2-3. Sepala lanceolata hispido-sericea, \( \frac{1}{2} \) poll. longa. Corolle \( \frac{1}{2} \) poll. longe, tubus erassus brevis, lobi rotundati, labium inferioris longius, pallide purpureum.

Capsula cornuta curva acuminata, pilis viscidis tecta.

Gunong Tahan, 5000-6000 ft. (5504.)

A very distinct plant with narrow lanceolate oblique leaves.


Kwala Teku, 300-1000 ft. (5545.)

_Distrib._ Originally found in the Tahan valley.

P. RUBIGINOSA, _n. sp._

Radix crassa lignosa, 6 poll. longa; caudex brevis, 1 poll. longus, lignosus, tomento multo rufo tectus vel nullus. Folia rosulata vel opposita ob-lanceolata obtusa basin versus angustata rotundata, margine dentato, nervis 10 paribus, superfite atroviridia hispida, praesertim in marginibus, subtus crebre punctata glabra, nervis et costa rubiginoso-tomentosis exceptis. Pedunculi 3 vel plures, gracies, 6-8 poll. longi, rubro-pubescentes. Bractee minute lineares pubescentes. Sepala linearia brevia, vix \( \frac{1}{4} \) poll. longa. Corolla alba colore roseo tincta campanulata, \( \frac{1}{4} \) poll. longa, lobis rotundatis. Stamina brevia 2, antheris subglobosis. Capsula lanceolata acuminata, \( \frac{2}{3} \) poll. longa.

Gunong Tahan, 4000-5000 ft.; on rocks. Leaves dark velvety green; flowers white tinged with pink. (5398.)

Flowers resembling those of _P. pyroliflora_, Ridl., but the style is much shorter. The foliage is very different and more resembles that of _Didymocarpus heterophylla_, Ridl.


Kwala Teku, 500-1000 ft. (5540.)

_Distrib._ Malay Peninsula.
Eschynanthus sp.
Gunong Tahan, 5000–6000 ft. Creeper very fleshy, reddish. (5483.)
A rather woody plant with pale bark and oval fleshy leaves a quarter inch long.
There are no flowers (only pods already dehisced) and no seed. Doubtless an undescribed species, but the material is insufficient.

APETALÆ.

Nepenthaceæ.

Gunong Tahan, 5000 ft. Flowers dull red-brown; cups white tinted pale green at base and spotted with pink. (5411.)
The original plant was obtained on Merapi mountain in Sumatra. The Tahan plant seems to resemble it very closely, but the fruit is much larger than it is in Korthals’s figure. The male flowers are small, with 4 oblong obtuse pubescent petals a quarter inch long, the pedicels of the flowers a quarter inch. The raceme is lax and about 6 inches long. The lid of the pitcher is densely glandular. The capsules are three-quarters of an inch long.

N. gracillima, n. sp.
Caulis gracillimus a quarter poll. in diametro. Folia remota sessilia angustae lanceolata acuminata, lamina 2–3 poll. longa a quarter poll. lata glabra coriacea; petiolulo 5-polllicari; amphiura subcilindrica angusta, 4 poll. longa, a quarter poll. in diametro, superne glandulosa paullo constricta, annulo angusto, obscure costato. Operculum orbiculare a quarter–a quarter poll. longum, cervix et lamina pubescentibus, cornibus ad basin operculi dubus a quarter poll. longis, glandulae nullae. Racemos masculus gracilis plus quam 6 poll. longus. Flores parvi dissiti, pedicellis a quarter poll. longis. Bracteae lineares graciles. Petala 4 oblonga obtusa glabra. Racemos fructiferus circa 6 poll. longus; capsule a quarter poll. longae glabres, pedicellis a quarter poll. longis, valvae utrinque angustate.
Gunong Tahan, 3300 ft. Pitchers pale green, tinted in places with dull crimson, and mottled with dull purple; lid of cup brighter green lined with dull crimson. (5309.)
Allied to N. gracilis, Korth., but is a much slenderer plant; the stem is rounded and not angular, the leaves are not decurrent, the peristome is faintly ribbed on the lower surface, the cup is differently coloured, and the lid is not glandular.

Lauraceæ.

Dehaasia lancifolia, n. sp.
Arbor 25-pedalis. Folia coriacea lanceolata obtusa (siccitate rufa),
breviter petiolata glabra, nervorum 9–11 paribus praedita; nervis ascendentibus in margine arcuati, costa crassiuscula, 4 1/2–7 1/2 poll. longa, 1 1/2–2 lata. Panicule elongatae patentes 7–8 poll. longae, ramulis paucis brevibus pubescentibus. Flores 6–7 perparvi in cymulas in apicibus ramulorum virescentes dispositi, pedicellis brevibus pubescentibus. Sepala 3 minuta ovata obtusa. Petala alterna ovata cucullata pubescentia, quam sepala multo majora. Stamina 9 filamentis brevissimis, antheris ovatis. Stylus quam stamina longior crassus; stigma magnum rotundatum crassum atrum. Drupa elliptica 1 1/2 poll. longa, pedunculo haud multum incrassato.

Gunong Tahan, 5000–6000 ft. Tree 11 inches in diameter, 25 feet high, flowers greenish (5468). Shrub 8–10 feet, in fruit (5526).

This fine plant is represented by two specimens, one in flower and one in fruit, which evidently belong to the same species. The leaves are bright brown when dry. The main nerves ascend and curving upwards at the margin connect with each other by a loop, and the intermediate nervules are conspicuously reticulated. The long lax panicle of short branches is not like that of any other species known to me. The flowers are quite those of a Dehaasia, some unisexual and some bisexual. The stigma is remarkably thick and rounded for the genus.


Gunong Tahan, 5000–6000 ft. Small shrub. (5455.)

Distrib. Philippines to Borneo.

Loranthaceae.

Loranthus Pulcher, DC. Prod. iv. 295.

Gunong Tahan, 5500 ft. Shrub; flowers Carmine; calyx and flower-stalks dull red; leaves very thick and fleshy. (5337.) The leaves are more oval in outline and more fleshy than usual. Not rare in the hill-region.

Distrib. Penang.


Gunong Tahan. (5185.) Common in the hill-regions.

Distrib. Penang.

L. Globosus, Roxb. Fl. Ind. i. 550.

Gunong Tahan, 4000–5000 ft.; on trees. Flowers bright orange-red, leave red above and dull green beneath. (5404.)

Distrib. North India, Malay Peninsula, Java.

Linn. Journ.—Botany, Vol. XXXVII.
SANTALACEÆ.

Henslowia variaans, Blume, Mus. Bot. Lugd.-Bat. i. 244.
Gunong Tahan, 3300 ft. Climber; fruit green, tinted dull red. (5349.)
Distrib. Tenasserim, Malacca, Borneo.

Gunong Tahan, 5000–6000 ft. Creeper; berries reddish. (5484.)
Distrib. Malay Peninsula.

EUPHORBIACEÆ.

Choriophyllum montanum, n. sp.
Frutex ramosus, foliis oppositis coriaceis, ellipticis, basibus angustatis,
apicibus retredis, superfice nitidis, subito pallidioribus 2 poll. longis, \( \frac{2}{3} \) poll. latis, breviter petiolatis, petiole \( \frac{1}{10} \) poll. longo. Flores non visi. Capsula tricocca globosa, coccis bivalvis \( \frac{1}{2} \) poll. longis. Semina \( \frac{1}{4} \) poll. longa rufo-castanea polita elliptica subobliqua, arillo bilobo, semen semitegente, lobis subaeutis triangularibus.
Gunong Tahan, 3300 ft. (5434.) Flowers yellow.
Very distinct from Ch. malayanum, Benth., in its much smaller, elliptic, very coriaceous leaves.

MYRICACEÆ.

Myrica Farquhariana, Wall. Tent. 61.
Gunong Tahan, 5000–5500 ft. Shrub 10–12 feet high; flowers reddish-brown. (5519.)
Distrib. India, Malaya.
Common in the low country near the sea. This is referred to M. Nagi, Thunb., in the ‘Flora of British India,’ v. 597, but I cannot think it is identical with that Japanese plant.

CUPULIFERÆ.

Gunong Tahan, 6000 ft. (5440.) One of the very few oaks which are to be met with at an elevation of over 3000 ft.
Distrib. Malay Peninsula and Archipelago.

MONOCOTYLEDONES.

ORCHIDÆ.

Oberonia (§ Caulescentes) condensata, n. sp.
Caules congesti, 1–2 poll. longi, radicibus densis tenuibus ad bases praediti.
Folia carnosa decidua linearia acuta, \( \frac{2}{3} \) poll. longa, \( \frac{1}{2} \) poll. lata. Racemus foliicaris ad basin florifer. Bractæ lanceolatae longe acuminatae, ad
PLANTS FROM GUNONG TAHAN, PAHANG.

racemi basin longiores, superne minores. Flores citrini, \( \frac{1}{2} \) poll. in diametro. Sepala ovata obtusa. Petala lanceolata multo angustiora; labellum aquilongum, integrum elongato-triangulare, basi lato. Columna stelidiis brevibus instructa, anthera ovata alba.

Gunong Tahan, 5000–6000 ft.; on rocks. (5487.)
A very curious little plant, remarkable for its stiff short stem, its short, erect raceme, and its quite simple lip.


Gunong Tahan, 5000–6000 ft. Flowers pale greenish, with two broad stripes on the lip not reaching to the tip. (5498.) A form with a very long rhizome and stout distant bulbs.

Distrib. Perak.

P. KINGII, Hook. fil. l. c.
Gunong Tahan; on rocks at 6000 ft. Flowers yellow. (5434.)
Distrib. Perak and Borneo.

DENDROBIUM LONGIPES, Hook. fil. l. c. 713.
Summit of Gunong Tahan, 7100 ft. Flowers yellow faintly lined with brown, lip and lobes mottled with crimson. (5529.)
Distrib. Hill-ranges of the centre of the Peninsula.

Gunong Tahan, 3000–6000 ft.; on trees. (5496.)
Distrib. All the hills of the central range.

D. sp., with rather long bulbs, slender stems and terete acuminate leaves.
“Flower pale yellow, lip spotted and veined with reddish-brown and with reddish hairs.”
Gunong Tahan, 5000–6000 ft. (5481.)
This appears to be allied to D. gracile, Lindl., but there are no flowers on the specimens.

D. UNIFLORUM, Griff. Notulae, iii. 305.
Gunong Tahan, 5000–6000 ft. (5497.) At 3300 ft. (5342, 5306.) On trees; creamy white, lip tinted with green and three brown lines down the centre.
In no. 5306 the leaves are over 2 inches long and half an inch wide, of thinner texture than those of the other two specimens. The leaves of no. 5497 are those of the Mount Ophir form, short, thick and oblong.
The Dendrobiums of the section Distichophyllae, of the D. uniflorum and D. revolutum series, require critical study both in the Malay Peninsula and in Borneo, where they are also abundant on the upper parts of

2 A 2
the hill-ranges. There is considerable variation in the form and texture of the leaf and also in the height and habit of the plant, though the flowers seem to be much less variable.

**Dendrobium bifarium, Lindl. Gen. & Sp. Orch. 81.**

Gunong Tahan, 5000-5500 ft. Lip creamy white with orange blotches; petals and sepals pale coffee-brown, much darker at the base. (5505.)

I cannot distinguish this from the well-known lowland plant, on which Lindley based his species, though Mr. Robinson's note as to the colour of the flower (which is usually creamy with a green lip) shows some variation from the normal. The species occurs both in the lowlands and the hill-region of the Malay Peninsula and Borneo.


Gunong Tahan, 5000 ft.; on trees. Flowers bright magenta, stalks and bracts the same colour; a yellow spot on the lip. (5431.)

*Distrib.* Perak.

This species is closely allied both to *D. Kuhlii*, Lindl., and *D. Hasseltii*, Lindl., of Java and Sumatra. It differs but little from the latter, chiefly in the narrower acute sepals.

D. (§ Pedilonum) subflavidum, n. sp.

Caules plures graciles teretes, 18 poll. longi, 1/8 poll. crassi, internodiis bipollicaribus. Folia anguste lanceolata acuminata acuta, 3 poll. longa 1/2 poll. lata, consipicue 5-nervia, apicibus inaequalibus. Pedunculi e caulibus defoliatis 1/2 poll. longi biflori. Bractee ovata. Pedicelli cum ovaris gracilibus 1/2 poll. longi. Flos 1 1/2 poll. longus ab apice sepali usque ad apicem menti. Sepalum posticum lanceolatum 1/2 poll. longum; sepala lateralia subtriangularia multo latiora, mentum cornutum 1 poll. longum, apice curvo. Labellum lanceolatum, ungue longo et anguste, limbo integro obtuso, 1 poll. longum 1/8 poll. latum. Columnae parte libera brevi lata, alis alte elevatis.

Gunong Tahan, 3300 ft. Flowers yellow. (5317.) At roots of trees; flowers pale greenish-yellow, lip yellow, spotted with crimson near the base on either side; leaves tinged with dull crimson on the under face. (5300.)

Evidently allied to *D. megaceras*, Hook. fil., a little known plant collected by Maingay in Malacca and not since found. It differs chiefly in the lip being quite entire and the limb lanceolate. *D. Anthrene*, Ridl., of Borneo is also allied.

**Bulbophyllum galbinum, Ridl. in Journ. Linn. Soc., Bot. xxxii. (1896) 267.**

Gunong Tahan, 3300 ft.; on trees. (5305.)

*Distrib.* Perak.
BULBOPHYLLUM (§ Sestochilus) MICROGLOSSUM, n. sp.
Caulis longe repens \( \frac{1}{2} \) poll. crassus, internodiis \( \frac{1}{4} \) poll. longis; pseudobulbis conicis ascendentibus \( \frac{1}{2} \) poll. longis \( \frac{1}{4} \) poll. latis ad bases. Folia elliptica obtusa, breviter petiolarata coriacea \( \frac{1}{4} \) poll. longa \( \frac{1}{2} \) poll. lata. Pedunculus gracilis \( \frac{3}{4} \) poll. longus. Sepalum posticum ellipticum eucullatum, sep. lateralia ovata-lanceolata falcata obtusa \( \frac{1}{4} \) poll. longa. Petala lata oblongo-lanceolata obtusa fere subsequalia. Labellum minimum, basi late emarginato, apice decurvato, carnosum lateraleiter compressum vix \( \frac{1}{4} \) poll. longum. Columna cum pede longo sursum curvo libero, alis in margine pedis elongatis, stelidia obscura.
Gunong Tahan, 4000-5000 ft.; on trees. Flowers dull yellow, lined and spotted with red, movable lip pink. (5327.)

Rather small-flowered for the section and with a very small lip which is flattened sideways and narrow, the base dilated and deeply emarginate. In the column, the side wings are well developed along the edge of the foot, forming rather large flanges running from the top of the column nearly to the point at which the foot becomes free from the sepals.

B. (§ Monanthaparva) TITANIA, n. sp.
Rhizoma longe repens, pseudobulbis arcte appressis tectum. Pseudobulbi oblongi apicibus ascendentibus ut in B. catenarium, ferme \( \frac{1}{2} \) poll. longis. Folia lanceolata \( \frac{1}{2} \) poll. longa \( \frac{1}{4} \) poll. lata, basi angustato. Pedunculus gracilis capillaris \( \frac{1}{4} \) poll. longus. Bractee infundibuliformes, \( \frac{1}{4} \) poll. longae. Sepala lanceolata \( \frac{3}{4} \) poll. longa, 6-nervia, lateralia latiora. Petala minuta \( \frac{1}{4} \) longitudinis sepali sequae, lanceolata un nervia. Labellum linguiforme, in medio flexum \( \frac{3}{4} \) longitudinis sepali sequae, carnosum flavum. Columna validula, stelidiis setiformibus longis.
Gunong Tahan, 5000-6000 ft.; growing among moss in gullies. Flowers and stalks orange, deeper on lip and column. (5471.)

Very near B. catenarium, but with larger flowers and pseudobulbs. The lip is yellow and not purple, and the stelidia are as long as the body of the column.

B. (§ Racemosse) VIRIDESCENS, n. sp.
Rhizoma longum tenue, pseudobulbis nullis. Folia breviter petiolarata, petiolo crasso, lamina elliptica 1 poll. longa \( \frac{3}{4} \) poll. lata crassa carnosa obtusa. Scapi filiformes 2 poll. longi, floribus paucis remotis. Bractee lanceolata acuminata ovaria sequantes \( \frac{1}{4} \) poll. longae. Flores pallide virides, \( \frac{1}{4} \) poll. longi, carnosi. Sepalum posticum lanceolatum obtusum, sep. lateralia ad bases gibbosa sublanceolata subobtusa. Petala linearia falcata obtusa. Labellum sepaloe sequale carnosum crassum linguiforme obtusum profunde canaliculatum brunneum papillosum. Columna minima, stelidiis obscursa.
Gunong Tahan, 3300 ft.; on trees. Flowers pale green, lip brown. (5313.)

Remarkable for the absence of pseudobulbs and the thick fleshy leaves, unusual in this section.


Gunong Tahan, 6000 ft. Flowers white, lip and two inner petals tipped with yellow; sepals tinged with pink; bracts pale dull red. (5439.)

*Distrib.* A common plant all over the Peninsula.

**E. (§ Hymenaria) CARUNCULATA, n. sp.**


Gunong Tahan, 5000–6000 ft.; on rocks. Flower pallid brownish-white, lip edged with flesh-colour. (5445.)

Allied to *E. Maingayi*, Hook. fil. The lip is rather curious in form, the side-lobes meet by their inner faces over the claw of the mid-lobe, and being very fleshy almost form a callus-like mass.

**E. LONGIFOLIA, Hook. fil. Fl. Brit. Ind. v. 790.**

Gunong Tahan, 5000–5500 ft.; on trees. Flowers white, lip purple, edge of petals spotted with purple. (5515.)

*Distrib.* Not rare on the central hill-ranges.

**E. TERETIFOLIA, Griff. Notulce, iii. 298.**

Gunong Tahan, 5000–5500 ft.; on trees. Flowers creamy white, base of lip pink; sweet-scented. (5527.)

*Distrib.* Common on trees at from 2000 feet upwards in the Peninsula and Borneo.

**E. FEROS, Bl. Mus. Bot. Lugd.-Bat. i. 184.**

Gunong Tahan, 5000–5500 ft.; on the ground. Flowers creamy white, lip mottled with purple. (5516.)

*Distrib.* Malay Peninsula, Java, Borneo.
**PLANTS FROM GUNONG TAHAN, PAHANG.**

**ERIA (§ Dilochiopsis) SCORTECHINI, Hook. fl. Fl. Brit. Ind. v. 809.**

Gunong Tahan, 5000 ft. Stalks up to 8 feet high; bracts white, flowers white, tinted with pink. (5433.)

*Distrib.* Hill-ranges of the Peninsula.

**E. (§ Acridostachya) REPTANS, n. sp.**


Gunong Tahan, 5000-6000 ft.; on rocks. Flowers pale yellow. (5446.)

Rather a striking plant for its section with its long creeping rhizomes, distant bulbs, and long wiry roots.

**E. (§ Acridostachya) CRASSIPES, n. sp.**


Gunong Tahan, 5000 ft. (5336.) Allied to *E. brunnea*, Ridl., but with a different lip. The specimens are nearly out of flower.

**CERATOSTYLIS GRACILIS, Blume, Bijdr. 306.**

Gunong Tahan, 5000-5500 ft. (5528.)

*Distrib.* Common all over the Peninsula and Java.

**PHREATIA LISTROPHORA, Ridl. in Journ. Linn. Soc., Bot. xxxii. (1896) 307.**

Gunong Tahan, 5000-6000 ft. Flowers white, strongly scented. (5469.)

*Distrib.* Malay Peninsula.
Nepelaphyllum pulchrum, Blume, Bijdr. 373.
Gunong Tahan, 3300 ft.; on ground among dead leaves. Lip white, lined in the centre with green and outside with dull crimson; petals dull crimson-red; leaves resembling a dead leaf. (5302.)
Distrib. Java.

Tainia speciosa, Blume, Bijdr. 354.
Gunong Tahan, 3300 ft.; on the ground. Flowers dull pale green lined with crimson, point of lip yellow; stalks and pseudobulbs dull purple. (5308.)
Distrib. Not rare at high elevations all over the Peninsula, also Java.

T. Vegetissima, n. sp.
Gunong Tahan, 3300 ft.; on the ground. Flowers pale yellow closely lined with crimson, lip edged with yellow, centre crimson; leaves shining purplish-brown, stalks crimson. (5314.)
A very distinct and pretty plant allied to no species very distinctly, but in some points approaching T. grandiflora, Ridl. Like that plant its stem and leaves suggest an affinity with Nepelaphyllum and there is also some similarity in the column, but the absence of the spur prevents its being referred to that genus.

Spathoglottis aurea, Lindl. Part. Fl. Gard. i. (1850) 16.
Gunong Tahan, 5000 ft. (5441.)

Arundina speciosa, Blume, Bijdr. 401.
Gunong Tahan, 5000–6000 ft.; among brushwood in ravines. Petals pale pink, lip magenta ribbed with yellow. (5448.) Common in all our hill-ranges.
Distrib. From India to Java.
PLANTS FROM GUNONG TAHAN, PAHANG.

Calanthe Cecille, Reichenb. f. in Gard. Chron. ser. ii. xix. (1883) 432.
Kwai Jelai, 500–1000 ft. Flowers pure white; bracts pale green; column and lip tinged with sulphur-yellow. (5542.)
Distrib. Common in the Peninsula in some localities.

Gunong Tahan, 500–6000 ft.; on low stems in shady thickets. Flowers white, lip and column streaked with yellow. (5451.)
Distrib. Perak.

Gunong Tahan, 5000 ft.; on trees. Flowers pale red-brown veined with brown on the sides of the lip. (5432.)
Distrib. Perak.

C. cymbidioides, n. sp.
Gunong Tahan, 5000–6000 ft. Flowers whitish, stalks pale brown, lip striped with brown, white, and yellow. (5465.)
A handsome species, allied to C. Dayana, Reichenb. f., but differing in the narrower pseudobulb, laxer spike, and long narrow petals and sepals.

Summit of Gunong Tahan, 7100 ft. Leaves glaucous green; flower-stalks greenish, flowers white. (5531.)

Gunong Tahan, 7100 ft. (5530.)
So different in habit from the typical form as to appear at first sight a very distinct species. As, however, the flowers are similar, I conclude that it is merely a condensed form due to its habitat.
Gunong Tahan, 3300 ft. Flowers creamy white. (5428.) Common at high and low altitudes on trees.
Distrib. Selangor, Singapore.

Gunong Tahan, 5000-5500 ft.; on trees. (5512.)
Distrib. Malay Peninsula.

Kwala Tahan, 500-1000 ft. Flowers yellowish-white; top of column pink. (5537.) From the type-locality.

Acriopsis javanica, Blume, Bijdr. 337.
Gunong Tahan, 4000-5000 ft. (5412.) Fruiting specimen only.
Distrib. Malay Peninsula, Tenasserim, Sumatra, Java.

Heteria elegans, n. sp.
Caulis 3 poll. longus. Folia ovata acuminata acuta trinervia, 3 poll. longa 1 poll. lata, glabra, petiolo vaginante l\(\frac{1}{2}\) poll. longo. Pedunculus cum racemo 18-polllicari, basi (12 poll.) nudo. Racemus multiflorus, laxiusculus; rachis albopubescent. Flores vix plus quam l\(\frac{1}{2}\) poll. longi, pedicello cum ovario l\(\frac{1}{2}\) poll. longo. Bracteae lanceolate acuminate. Sepala ovata obtusa glabra. Petala anguste linearia apicibus dilatatis. Labellum quam sepala brevius oblongum ovatum saccatum, cum processibus carnosis clavatis pluribus in sacco; carunculo carnosum in apice labelli. Columna basi angusta, superne dilatata. Rostellum late excisum, lobis latis obtusis.
Gunong Tahan, 5000-6000 ft. Flowers greenish. (5466.)
Near H. elata, Hook. fil., of Batang Padang, but differs in having a laxer spike, narrower petals, and a different lip.

Gunong Tahan, 5000-6000 ft. Flowers greenish. (5480.)
Distrib. Also occurs on Mt. Ophir and other hills in the Peninsula.

Gunong Tahan, 5000-6000 ft. Leaves chequered pale green and white; lateral petals spotted with black-purple terminally. (5442.) Specimen in fruit only; determination doubtful.
Distrib. Malay Peninsula, Siam.

Apostasiaceae.

Apostasia nuda, R. Br. in Wall. Pl. As. Rar. i. 76.
Gunong Tahan, 3300 ft. Flowers white. (5318.)
Distrib. Common in the Peninsula; also North-East India; Sumatra, Java.
ZINGIBERACEÆ.

HEDYCHIUM COLLINUM, Ridl. in Journ. Roy. As. Soc. Straits Br. xxxii. (1899) 103.
Gunong Tahan, 5000–5600 ft. Flowers white, stamens brownish; strongly scented. (5513.) Apparently the same species as I obtained on Kedah Peak, but a bigger and taller plant about 5 feet high. I had only one rather stunted plant from a somewhat exposed precipice. The calyx and corolla-tube are pubescent in this plant.

ZINGIBER GRACILE, Jack, in Mal. Misc. i. (1820) no. 1. 1.
Gunong Tahan, 3300 ft. (5365.) Exactly the ordinary form as far as the specimen goes, but the field-note says: “Flowers pale yellow, bracts yellow, lower ones streaked with green; flower-stalk dull red.” The bracts of this species are normally dull red.

CAMPANDRA PARVULA, Ridl. l. c. 104.
Kwala Teku, 500–1000 ft. Flowers white, throat yellow. (5532.)
Distrib. Malay Peninsula.

CONAMOMUM UTRICULOSUM, Ridl. l. c. 122.
Gunong Tahan, 3300 ft. Flowers yellow. (5424.)
Distrib. Perak Hills.

GEOSTACHYS ELEGANS, Ridl. l. c. 160.
Gunong Tahan, 5000–5500 ft. Flowers yellow, the sides of the lip mottled with red, the lower surface of the leaves purple. (5511.)
Distrib. Mount Ophir.
This is quite like the Mount Ophir plant, but the stamen in the one perfect flower I was able to examine has a distinct little lacerate crest.

LILIACEÆ.

Gunong Tahan, 3300 ft. Flowers white, leaves green; about 3 feet high (5371.)
Distrib. Common all over the Peninsula; Singapore, Siam.

BURMANNIAEÆ.

BURMANNIA DIISTICA, Linn. Sp. Pl. 287.
Distrib. India, Sumatra, China, Australia.

B. LONGIFOLIA, Becc. Malesia, i. 244.
Gunong Tahan, 3300 ft. Flowers and bracts white, petals tinted on edges pale blue. (5230.) Usually with the last.
Distrib. Malay Peninsula, Borneo.
XYRIDACEÆ.

**XYRIS.GRANDIS**, n. sp.


Gunong Tahan, 3300 ft. Flowers yellow, leaves green tinted with red, brown at the base. (5341.)

This is the finest *Xyris* I know; the great sword-like leaves recall those of *Cladium Maingayi*, C. B. Clarke, of Mt. Ophir, and are quite unlike those of any other species.


Gunong Tahan, 5000–6000 ft., in damp places on rocks. Flowers bright cadmium-yellow, turning white. (5450.)

*Distrib.* Kedah Peak.

The original specimen from Kedah Peak is somewhat taller with slightly larger heads, but the plants from the two localities are evidently conspecific (A. B. R.).

ARACEÆ.


Gunong Tahan, 3300 ft., climbing on trees. Whole flower pale yellow. (5307.)

*Distrib.* Common in all the hill districts in the Peninsula.

ERIOCAULONACEÆ.


Gunong Tahan, 5000–5000 ft. Flower-heads greyish-white. (5510.)

I take this to be a form of the Javan plant described by Ruhland, but have seen no type. Plants collected by Horsfield at Rawa Diyang seem to be the same thing.

GYMNOSPERMÆ.

**CONIFERÆ.**


Gunong Tahan, 5000–6000 ft. Tree from 35–40 feet high, in sheltered gullies. (5488.)

*Distrib.* Malay Peninsula and Archipelago.
Gunong Tahan, 3300 ft. Tree 60–80 feet tall. (5380.)
*Distrib.* Common at high altitudes in the Peninsula and Archipelago.

Podocarpus cupressina, R. Br. ex Mirb. in Mém. Mus. Par. xiii. (1825) 75.
Gunong Tahan, 3300 ft. Tree 50–60 feet high. (5354.)
*Distrib.* Common at such altitudes in the Peninsula and Islands.

P. bracteata, Blume, Enum. i. 88.
Gunong Tahan, 5000–6000 ft. Tree 20 feet high, branches at right angles to the stem. (5452.)
*Distrib.* Not previously recorded from the Malay Peninsula; Java.

**PTERIDOPHYTA.**
(With A. Gepp, M.A., F.L.S.)

Gunong Tahan, 4000–5000 ft. (5407.)

G. Norrisii, Mett. ex Kuhn, in Linn. xlii. (1869–70) 165.
Gunong Tahan, 3300 ft.; climbing fern. Leaves bluish-white beneath. (5358.)

Cyathea brunonis, Wall. ex Hook. Sp. Fil. i. 15.
Gunong Tahan. (5379.)

Gunong Tahan, 3300 ft. Tree-fern, stem about 4 feet high. (5425.)

Matonia pectinata, R. Br. in Wall. Pl. Asiat. Rar. i. t. 16.
Gunong Tahan, 3300 ft. (5351.)

Lecanopteris carnosa, Blume, Enum. Pl. Jav. 120.
Gunong Tahan, 4000–5000 ft.; growing on trees on ridges. (5389.)

Gunong Tahan, 3300 ft.; growing in damp places on trees. (5422.)

Gunong Tahan, 5000–6000 ft.; on damp shady rocks. (5474.)

Gunong Tahan, 4000–5000 ft.; growing on rocks. Pale olive-green. (5401.)

Gunong Tahan, 3300–5000 ft. (5359, 5385.)
TRICHOMANES APHIFOLIUM, Presl, Hymenoph. 16, 44.
Gunong Tahan, 3300 ft.; growing in damp places. (5421.)

Gunong Tahan, 3300 ft.; growing in damp places. (5419.) Specimen in very shrivelled condition, but apparently this species.

Gunong Tahan, 5000-6000 ft.; growing on trees. (5437, 5472.)

DAVALLIA PINNATA var. GRACILIS, Hook. & Bak. Syn. Fil. 98.
Gunong Tahan, 3300 ft. (5377.)

LINDSAYA RIGIDA, J. Smith, l. c. 415.
Gunong Tahan, 5000 ft. (5547.)

Gunong Tahan, 5000-5500 ft.; on rocks. (5521.)

L. SCANDENS, Hook. Spec. Fil. i. 205.
Gunong Tahan, 3300 ft.; climbing fern on trees. (5368, 5418.)

L. FLABELLULATA, Dryand. in Trans. Linn. Soc. iii. (1797) 41.
Gunong Tahan, 3300 ft. (5372.)

Gunong Tahan, 3300 ft. (5373.)

OLEANDRA NERIFORMIS, Cav. in Anal. Hist. Nat. i. (1799) 115.
Gunong Tahan, 3300 ft.; climbing fern. (5357.)

Dipteris HORSFIELDII, Bedd. Ferns Brit. Ind. t. 321.
Gunong Tahan, 3300 ft. (5350.)

Gunong Tahan, 5000-6000 ft.; growing on trees. (5478.)

Gunong Tahan, 4000-5000 ft.; growing on rocks. (5394.)

P. CUCULLATUM, Nees & Blume, in Nova Acta, xi. (1823) 121.
Gunong Tahan, 5000-5500 ft.; on rocks. (5522.)

Gunong Tahan, 5000-6000 ft.; growing on trees. (5463.)

Gunong Tahan, 4000-5000 ft.; growing on trees. (5386.)
Gunong Tahan; growing on rocks at 5000–6000 ft.  (5494.)

Gunong Tahan, 5000–6000 ft.; growing on damp rocks.  (5459.)

Gunong Tahan, 3300 ft.; growing on trees.  (5301.)

Gunong Tahan, 3300 ft.; growing on the ground.  (5345.)

Gunong Tahan, 5000–6000 ft.; growing on trees.  (5464.)

SCHIZEA MALACCANA, Baker, Syn. Fil. 428.
Gunong Tahan, 4000–5000 ft.; growing on the ground and on trees.  (5403.)

LYCOPODIUM CASUARINOIDES, Spring, Monogr. Lycop. i. 94.
Gunong Tahan, 4000–5000 ft.; climbing among high bushes, &c.  (5398.)

Kwala Teku, 500–1000 ft.  (5541.)

Gunong Tahan, 3300 ft.; growing on the earth in jungle.  (5361.)

S. WALlichii, Spring, Monogr. Lycop. ii. 143.
Gunong Tahan, 3300 ft.  Stalks dull red.  (5414.)

S. ATROVIRIDIS, Spring, l. c. 124.
Gunong Tahan, 3300 ft.  Green, stalks dull red.  (5366.)

BRYOPHYTA.
(By A. Gepp, M.A., F.L.S.)

SPHAGNUM JUNGHUHNIANUM, Doz. & Molk. Bryol. Jav. i. 27.
Gunong Tahan, 6000 ft.  Pale green, the tops pale reddish-brown.  (5435.)

EUCAOPTODON MACROCALYX, C. Mall. Syn. Muse. i. 346.
Gunong Tahan, 5000–5500 ft.; growing on 5527 (Eria teretifolia).

Gunong Tahan, 3300 ft.; growing on trees.  (5420.)

Gunong Tahan, 3300 ft.; growing on small tree.  (5417.)
ON PLANTS FROM GUNONG TAHAN, PAHANG.

Gunong Tahan, 5000–6000 ft. Fruit yellowish. (5490.)

MASTIGOBRYUM sp.
Gunong Tahan, 3300 ft. (5374.)

LEPIDOZIA WALLICHIANA, Göttsche, Syn. Hepat. 204.
Gunong Tahan, 3300 ft.; on dead tree. Delicate pale green. (5360.)

LICHENES.
(By Miss A. Lorrain Smith, F.L.S.)

STEREOCAULON CORALLOIDES, Fries, Sched. Crit. iv. 21, var.
Gunong Tahan, 3300 ft.; growing amongst moss. Colour very pale sea-green. (5348.)

Gunong Tahan, 3300 ft.; growing on branches of trees. Dull; very pale green. (5353.)

CLADONIA MACILENTA, Hoffm. Deutschl. Fl. 126.
Gunong Tahan, 4000–5000 ft.; on trees. Pale dull green; fruiting tops bright red. (5402.)

C. RANGIFERINA, Hoffm. l. c. 114.
Gunong Tahan, 5000 ft.; growing on the ground. White, slightly tinged with green. (5331.)

FUNGI.
(By Miss A. Lorrain Smith, F.L.S.)

HEXAGONIA TENUIS, Fries, Epier. 498.
Gunong Tahan, 3300 ft.; on dead wood. Shaded with warm brown above, brown powdered with white beneath. (5423.)

Gunong Tahan, 3300 ft.; on dead wood. Very pale brown. (5416.)

PANUS sp.
Gunong Tahan, 3300 ft.; on dead wood. White shaded with warm brown above, pure white beneath. (5310.)

Gunong Tahan, 3300 ft.; growing among moss, &c. Whole plant ochre-yellow. (5346.)
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SCIENTIFIC LITERATURE.

The Royal Society has been engaged for some years past in arranging for the publication of an International Catalogue of Scientific Literature, beginning from the 1st January, 1901. Each science is represented in an annual volume containing lists arranged under authors and subjects, of all books and papers published during the year; these are contributed through official channels of information—abroad, by direct control of the respective governments—at home, by means of the various Societies which devote themselves to particular sciences; those Societies whose domains overlap having arranged for mutual cooperation.

The collection of title-slips for the United Kingdom of Great Britain and Ireland as regards

BOTANY

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THE JOURNAL
OF
THE LINNEAN SOCIETY.

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which is cancelled.]

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In 1899 I was attracted to the study of crosses among species and varieties of Brassicas by a statement in one of the leading agricultural journals that certain types mentioned by the writer do not hybridize naturally, and therefore can be grown in close proximity to each other without fear of destroying the highly selected forms which the seedsman is at so much pains to keep true.

As experience gained during many years' association with practical seed-growing convinced me that the statement was incorrect, I decided to put the matter to a practical test in order to place on record the results obtained, and to show which species and varieties of Brassica would intercross and which would not.

In the first experiments, begun in 1900, the varieties of Brassica oleracea, L., shown in figs. 1 to 9 (Pl. 24), were planted side by side so that cross-fertilization might take place wherever such was possible. (For names of these varieties see list on page 347.)

The seed saved from these plants gave rise to an extremely heterogeneous collection of nondescript forms, few or none of which were true to the female parental type. Various types, however, were noticed which there was every reason to believe would, if it were possible to perpetuate them, become valuable additions to the economic plants of the farm or garden. From these the forms represented in figs. 10, 11, 12, & 13 (Pl. 25) have been fixed, and come fairly true from seed.

In a later season the experiment was repeated with the addition of varieties of Turnips (Brassica Rapa, L.), Swedes (Brassica campestris, L. var. Napobrassica, DC.), and non-bulbing oil-yielding Rape (Brassica campestris, var. oleifera, DC.).

Instead, however, of all being planted in one large patch, they were arranged in small isolated groups of seven plants each. Two of the plants were of one variety, and round them were placed five of another kind. In this manner about twenty such double combinations were arranged and the seed saved and grown.

A large collection of mongrel plants was obtained; the results were entirely in accordance with my previous experience, and proved that while no variety derived from Brassica oleracea was affected by the pollen of Rape, Swede or Turnip, and vice versa, yet all the types of B. oleracea would freely intercross between themselves, and this was equally true of many varieties of Turnip, Swede, and Rape.

Hitherto I had been content to note such species of Brassica as would...
intercross when planted in close association, but looking over the plants raised in the last experiment with Professor Percival of University College, Reading, we concluded that the experiment would be far more complete if a series of carefully controlled artificial crosses were undertaken in order to ascertain whether some of the species or varieties which had not naturally intercrossed in the previous experiment, might do so when the flowers were artificially pollinated.

The Brassicas selected for this experiment are shown on Plate 26, and consist of:

Fig. 16. Colza Rape (Brassica campestris, L., var. oleifera, DC.). Resembles the Swede in its glaucous leaves, which when young are hispid, but its flowers are bright canary-yellow.

17. Ragged Jack Kale. A plant resembling in general character the Colza Rape and Asparagus Kale, but with laciniate leaves.

18. Asparagus Kale closely allied to Colza Rape.


Swede Turnips, viz.:


Flowers bright canary-colour.

23. Purple-top Round Yellow-fleshed Brassica campestris, L., var. Napo-brassica Rucabaya, DC.

Flowers pale buff-colour.

Turnips, viz.:

24. " Tankard "

Flowers pale buff-colour.

25. { Green-top Yellow-fleshed } Brussica Rapa, L.

Flowers pale buff-colour.

26. Purple-top White-fleshed Brussica Rapa, L.

27. Green-top White-fleshed Brussica Rapa, L.

Flowers bright canary-colour.

From this point I had the advantage of the able assistance of Professor Percival, who personally emasculated the blooms and applied the desired pollen.
The chief objects we had in view were:

1. To determine which varieties of *Brassica* would cross with each other, and whether the plants of the first filial generation (F1) were fertile or sterile.

2. To draw such conclusions as might be possible from results thus obtained concerning the origin of the principal distinct types of Swedes and Turnips, and more especially to ascertain whether the White-fleshed and Yellow-fleshed Swedes had a common origin, as also the White-fleshed and Yellow-fleshed Turnips.

3. To ascertain whether a Yellow-fleshed Turnip similar to those termed "Hybrid Turnips" by some seedsmen and farmers could be produced by crossing the Swede (*Brassica campestris*, L., var. *Napo-brassica*, Rapa, DC.) with the White-fleshed Turnip (*Brassica Rapa*, L.).

4. Incidentally we wished to obtain light upon the relationship of the different cultivated forms of *Brassica*.

Arising out of these experiments it became evident that the results had a definite bearing on Mendelian phenomena.

The plants used for crossing were grown in the open trial grounds, but flowers selected for fertilization were very carefully emasculated before the stamens were ripe, and enclosed in small paper envelopes. The pollen was obtained only from flowers which were allowed to open inside close-fitting paper bags to prevent the possibility of stray pollen becoming mixed with that which was to be used in the experiments.

Many apparently unopened flowers were found to be useless for our purpose on account of the attack of minute larvae of species of *Meligethes* and *Cecidomyia*, which had fed on the immature pollen in the anther lobes and scattered some of it in the inside of the flowers.

In addition to the greatest care in emasculation and in the exclusion of insects large and small, each stigma was examined with a Coddington lens to make certain of its clean state before the application of the pollen.

Over 80 distinct crosses were attempted.

Taking into consideration the results obtained from them, they may be arranged in three groups, viz.:

Group I. Crosses from which no seed was obtained.

II. Those plants from which seeds were produced but the plants raised from them proved self-sterile.

III. Those plants from which seeds were obtained and the plants from which were quite fertile among themselves.
**Group I.**—No seed resulted from the pollination of

\[
\text{Cabbage} \quad \text{Thousand-headed Kale} \quad \text{Kohl Rabi} \quad \text{with} \quad \begin{cases} \text{Swedes,} \\ \text{Turnips,} \end{cases} \quad \begin{cases} \text{Colza Rape,} \\ \text{Asparagus Kale,} \\ \text{Ragged Jack Kale,} \end{cases}
\]

or the reverse pollinations.

In some instances the pollen appeared to act as a stimulus to the growth of the pericarp of the fruit, the pods growing to the normal size or even larger, but the ovules were abortive.

**Group II.**—To this group belongs the cross

\[
\text{White-fleshed Turnip} \quad \text{on Swede, and its reciprocal Swede on White-fleshed Turnip,}
\]

which proved remarkable in many ways.

When the Swede is fertilized by the Turnip, that is, when the Swede is made the seed-bearer, the seeds obtained are abundant. They are large black-coated like those of the typical Swede, and contain embryos which grow vigorously into fine healthy plants.

In the reciprocal cross, that is, where the Turnip is fertilized by Swede pollen, the Turnip being the seed-bearer, the seeds produced are rather paler in coat colour than those of the normal Turnip and always smaller and shrivelled. Moreover, it is difficult to germinate and rear seedlings from them in open ground, though there is little difficulty in doing this with the seeds of the reverse cross.

These points have been tested many times during two seasons, always with the same results.

At first the seeds of the crosses were sown in carefully prepared beds in the open ground; and from the fact that no plants were obtained from the seeds of the Swede \(\varphi\) on Turnip \(\varphi\) cross, we were inclined to conclude that the embryos in the seeds were abortive and incapable of growth.

However, in 1906 seeds, from reciprocal crossings, were again obtained, the same striking differences in size, colour, and shape as were seen in the seeds before, but instead of sowing them at once in the open ground they were germinated on blotting-paper and the seedlings planted out. Those of the Swede \(\varphi\) on Turnip \(\varphi\) were weak, but after careful management ultimately grew into plants as large as those from the Turnip \(\varphi\) on Swede \(\varphi\) cross. Moreover the characters of the full-grown plants proved to be the same whichever way the cross was made.

The general facies of the plants was intermediate between the two parents. The leaves were glaucous like Swede leaves, but more hispid and more like those of the Turnip in shape. The "bulb" resembled the Swede in form.
and neck perhaps more than the Turnip, but the flesh was white like the latter. The flowers were almost as large as those of the Swede, but canary-yellow in colour like those of the White-fleshed Turnip or White-fleshed Swede. They were abundant and apparently normal, but produced no seed although many were pollinated by hand. It was discovered later that the pollen was abnormal in form and structure, many of the pollen mother-cells having undergone peculiar changes which we hope to investigate further in the coming season.

The very marked sterility and the intermediate character of the plants obtained when the Swede (Brassica campestris, L., var. Napo-brassica Ratabaga, DC.) and White-fleshed Turnip (Brassica Rapa, L.) are crossed, seem to point strongly to the conclusion that they are true hybrids and that the parents are specifically distinct.

Apart from the fact that the plants are sterile, they are so different in character from the so-called "hybrid" yellow-fleshed Turnip, that it does not appear likely that the latter has originated by crossing the Swede and Turnip.

In addition to the Turnip × Swede cross just described, many others were made, including the following, which should probably be placed in this group:

<table>
<thead>
<tr>
<th>Plant Breed</th>
<th>On Plant Breed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colza Rape</td>
<td>Yellow-fleshed Tankard Swede.</td>
</tr>
<tr>
<td>Colza Rape</td>
<td>White-fleshed Round Swede.</td>
</tr>
<tr>
<td>Colza Rape</td>
<td>Yellow-fleshed Turnip.</td>
</tr>
<tr>
<td>White-fleshed Turnip</td>
<td>on Colza Rape.</td>
</tr>
<tr>
<td>White-fleshed Turnip</td>
<td>on White-fleshed Round Swede.</td>
</tr>
<tr>
<td>White-fleshed Turnip</td>
<td>on Asparagus Kale.</td>
</tr>
<tr>
<td>White-fleshed Turnip</td>
<td>on White-fleshed Swede.</td>
</tr>
<tr>
<td>White-fleshed Turnip</td>
<td>on Yellow-fleshed Turnip.</td>
</tr>
<tr>
<td>White-fleshed Turnip</td>
<td>on Yellow-fleshed Swede.</td>
</tr>
<tr>
<td>Yellow-fleshed Turnip</td>
<td>on Colza Rape.</td>
</tr>
<tr>
<td>Yellow-fleshed Turnip</td>
<td>on Ragged Jack Kale.</td>
</tr>
<tr>
<td>Yellow-fleshed Turnip</td>
<td>on Yellow-fleshed Swede.</td>
</tr>
<tr>
<td>Yellow-fleshed Turnip</td>
<td>on Ragged Jack Kale.</td>
</tr>
<tr>
<td>Yellow-fleshed Turnip</td>
<td>on White-fleshed Swede.</td>
</tr>
<tr>
<td>Yellow-fleshed Turnip</td>
<td>on White-fleshed Turnip.</td>
</tr>
<tr>
<td>Asparagus Kale</td>
<td>on Yellow-fleshed Tankard Swede.</td>
</tr>
<tr>
<td>Ragged Jack Kale</td>
<td>on Yellow-fleshed Tankard Swede.</td>
</tr>
<tr>
<td>Yellow-fleshed Round Swede</td>
<td>on Ragged Jack Kale.</td>
</tr>
</tbody>
</table>

From all these crosses hybrid plants were obtained, many of which proved sterile, while others unfortunately died off in the winter before the question of their fertility or sterility could be ascertained.

The most interesting of these are shown in figs. 28 to 57 (Pls. 27 to 29).
Group III.—In this series of crosses abundant seed was produced, and plants of the F1 and F2 generation were easily raised.

The seeds from the F1 generation were sown and about 200 plants from them were grown for observation. In the second filial generation (F2) segregation occurred in all cases.

In order to obtain an impartial estimate of the numbers and characters of the plants, neither Professor Percival nor myself had anything to do with the classification of the segregated plants, this being left to the judgment of one of our assistants who had no inclination to look for Mendelian numbers. Many of the results, as will be seen below, are confirmatory of Mendel’s laws. Where the figures appear to disagree with the well-known ratios among segregated plants of the F2 generation, it is possible that the discrepancy may be due to the great difficulty in deciding into which group individual plants should be placed.

\[
\begin{array}{c|c}
\text{♂} & \text{♀} \\
\text{Ragged Jack Kale} & \text{White Swede} \\
\end{array}
\]

Ragged Jack Kale (Pl. 30, fig. 58) is a form of Brassica which in general habit and flower resembles a Colza Rape but the leaves are laciniate. The Swede used for the female parent was a white-fleshed variety with purple top (fig. 50).

The plants of F1 had strong Swede-like leaves; they were however slightly more incised at the margins than the normal Swede parent, indicating the influence of the Ragged Jack parent. The rootstock was thick with little tendency to “bulbing” (fig. 60).

The plants of the F2 generation, of which 198 were grown, were of several forms. There were bulbing and non-bulbing plants, some having leaves like the Swede, others the laciniate form of the Ragged Jack Kale.

The following were the classes into which the plants of this generation were divided together with numbers belonging to each class.

As regards foliage there were found—

<table>
<thead>
<tr>
<th>Foliage Type</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swede</td>
<td>142</td>
</tr>
<tr>
<td>Ragged Jack</td>
<td>38</td>
</tr>
<tr>
<td>Intermediate</td>
<td>18</td>
</tr>
</tbody>
</table>

From the Mendelian ratio of 3 to 1, where Swede is dominant, we should expect from 196 plants—

<table>
<thead>
<tr>
<th>Foliage Type</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swede</td>
<td>147</td>
</tr>
<tr>
<td>Ragged Jack</td>
<td>49</td>
</tr>
</tbody>
</table>

As regards the bulbing character there were—

<table>
<thead>
<tr>
<th>Character</th>
<th>Found (198 plants)</th>
<th>Expected (from 196 plants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbed</td>
<td>160</td>
<td>147</td>
</tr>
<tr>
<td>Bulbless</td>
<td>38</td>
<td>49</td>
</tr>
</tbody>
</table>
Probably some of the 160 plants with bulbs should have been placed in the bulbless group, since it is difficult to distinguish slight bulb from a merely thickened stem due to increased vigour.

Classifying the plants obtained into groups with two pairs of characters in each, and an intermediate group, there were—

<table>
<thead>
<tr>
<th>Character</th>
<th>Bulbed</th>
<th>Bulbless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swede</td>
<td>117</td>
<td>112</td>
</tr>
<tr>
<td>Ragged Jack</td>
<td>30</td>
<td>43</td>
</tr>
<tr>
<td>Intermediate</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Swede</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Ragged Jack</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Intermediate</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

The intermediate plants showed evidence of Ragged Jack laciniation, and should no doubt be placed with the Ragged Jack plants as indicated.

\[\text{Expected, according to the Mendelian ratio of } 9.3 \times 3.1, \text{ from } 199 \text{ plants.}\]

\[
\begin{array}{ccc}
\text{Found (198 plants).} & \text{Expected, } 3 : 1 \text{ (from 192 plants).} \\
156 \text{ with Swede foliage} & 147 & 49 \\
33 ,, \text{ Ragged Jack foliage} & 5 & 36 \\
5 ,, \text{ Intermediate foliage} & 58 & 49 \\
\end{array}
\]

As regards bulbing character there were—

\[
\begin{array}{ccc}
\text{Found (194 plants).} & \text{Expected (from 192 plants).} \\
136 \text{ Bulbed} & 147 & 127 \\
58 \text{ Bulbless} & 49 & 36 \\
\end{array}
\]

As regards foliage there were—

\[
\begin{array}{ccc}
\text{Found (194 plants).} & \text{Expected, } 9.3 \times 3.1 \text{ ratio (from 192 plants).} \\
109 \text{ Bulbed with Swede foliage} & 108 & 108 \\
23 ,, \text{ Ragged Jack foliage} & 36 & 36 \\
4 ,, \text{ Intermediate foliage} & 36 & 36 \\
47 ,, \text{ Swede foliage} & 36 & 36 \\
10 ,, \text{ Ragged Jack foliage} & 12 & 12 \\
1 ,, \text{ Intermediate foliage} & 12 & 12 \\
\end{array}
\]

This was the reciprocal of the preceding cross (see figs. 58 & 59).

The plants of F 1 were bulbless and very similar to those of F 1 in the previous cross, but weaker in growth and slightly divided; the foliage was like that of the Swede with slight indication of Ragged Jack parent (see Pl. 31, fig. 67).

The plants of F 2 are shown at figs. 68 to 73 and tabulated below.

As regards bulbing character there were—

\[
\begin{array}{ccc}
\text{Found (194 plants).} & \text{Expected (from 192 plants).} \\
136 \text{ Bulbed} & 147 & 127 \\
58 \text{ Bulbless} & 49 & 36 \\
\end{array}
\]

As regards foliage there were—

\[
\begin{array}{ccc}
\text{Found (194 plants).} & \text{Expected, } 9.3 \times 3.1 \text{ ratio (from 192 plants).} \\
109 \text{ Bulbed with Swede foliage} & 108 & 108 \\
23 ,, \text{ Ragged Jack foliage} & 36 & 36 \\
4 ,, \text{ Intermediate foliage} & 36 & 36 \\
47 ,, \text{ Swede foliage} & 36 & 36 \\
10 ,, \text{ Ragged Jack foliage} & 12 & 12 \\
1 ,, \text{ Intermediate foliage} & 12 & 12 \\
\end{array}
\]

White Swede on Ragged Jack Kale.
Kohl Rabi on Thousand-headed Kale.

There is little need to describe the parent plants minutely. The Kohl Rabi has a thickened bulbous stem with broad thinnish leaves, the Thousand-headed Kale having an elongated and very much branched stem bearing large numbers of leaves (figs. 74 & 75).

The plants of F1 were somewhat intermediate in character between the parents (fig. 76).

Segregation took place in the F2 generation, the results being as follows.

As regards the bulbing character there were:

<table>
<thead>
<tr>
<th></th>
<th>Found (207 plants)</th>
<th>Expected (from 200 plants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbed</td>
<td>154</td>
<td>156</td>
</tr>
<tr>
<td>Bulbless</td>
<td>53</td>
<td>52</td>
</tr>
</tbody>
</table>

Pl. 32. fig. 77. 60 of the bulbed plants very closely resembled the Kohl Rabi grandparent in bulb, but had strong Thousand-headed Kale foliage.

,, 78. 94 had similar Thousand-headed Kale foliage, but the bulbing character was not so pronounced.

,, 79. 53 had elongated thickened stems shorter than the typical Thousand-headed Kale; the foliage was like that of the latter plant.

This is the reciprocal of the preceding cross (see figs. 74 & 75).

The plants of F1 were intermediate in character between the parents as before described, having Thousand-headed Kale foliage and slight bulbing tendency (fig. 80).

In F2 the following results were obtained (figs. 81, 82, 83, & 84):

As regards the bulbing character there were:

<table>
<thead>
<tr>
<th></th>
<th>Found (201 plants)</th>
<th>Expected (from 200 plants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbed</td>
<td>135</td>
<td>150</td>
</tr>
<tr>
<td>Bulbless</td>
<td>66</td>
<td>50</td>
</tr>
</tbody>
</table>

The bulbed plants included 44 well-developed Kohl Rabi against 60 in the reverse cross, and 66 slightly bulbed against 94 in the reverse cross. But amongst the bulbless plants none were seen resembling the Thousand-headed Kale as in the reverse cross, though there were 38 with broad leaves like a Cabbage, quite unlike either parent.

Fig. 81. 44 were almost pure Kohl Rabi with coarse foliage.

,, 82. 91 like the 94 in the reverse, i.e. Thousand-headed Kale foliage and slight bulb.
BRASSICA CROSSES.
BRASSICA CROSSES.
BRASSICA CROSSES.
BRASSICA CROSSES.
BRASSICA CROSSES.
BRASSICA CROSSES.
BRASSICA CROSSES.
Fig. 83. 28 were bulbless with Kohl Rabi foliage.

Fig. 84. 38 had broad Cabbage-like leaves with a bulbless elongated stem.

From the $9:3 \times 3:1$ Mendelian ratio, we should expect—

<table>
<thead>
<tr>
<th></th>
<th>From 208 plants.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbed, Thousand-headed Kale foliage</td>
<td>... 117</td>
</tr>
<tr>
<td>&quot; Kohl Rabi foliage</td>
<td>... 39</td>
</tr>
<tr>
<td>Bulbless, Thousand-headed Kale foliage</td>
<td>... 39</td>
</tr>
<tr>
<td>&quot; Kohl Rabi foliage</td>
<td>... 13</td>
</tr>
</tbody>
</table>

Kohl Rabi on Drumhead Cabbage (Pl. 33. figs. 85 & 86).

The plants of F1 in this cross had slight indication of the bulbing character with foliage resembling that of the Cabbage. There was, however, no sign of the "hearting" tendency of the Cabbage (fig. 87).

215 plants were raised of the F2 generation (see figs. 88, 89, & 90). Of these:

Fig. 88. 45 had distinct Kohl Rabi bulbs and foliage.

Fig. 89. 154 had rather enlarged stems, as if influenced by Kohl Rabi, the foliage being variable and undeterminate.

Fig. 90. Only 16 plants had leaves closely resembling those of the Cabbage.

As regards typical Kohl Rabi plants there were—

<table>
<thead>
<tr>
<th></th>
<th>Found (215 plants).</th>
<th>Expected (from 216 plants).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kohl Rabi</td>
<td>45</td>
<td>54</td>
</tr>
<tr>
<td>Not Kohl Rabi</td>
<td>170</td>
<td>162</td>
</tr>
</tbody>
</table>

In the reciprocal cross:

Drumhead Cabbage on Kohl Rabi (see figs. 85 & 86),

the plants of F1 were similar to those of F1 in the reverse cross, having Cabbage-like leaves and a slight bulb (fig. 91).

195 plants were grown of the F2 generation (see figs. 92, 93, 94, & 95, Pl. 34). Of these—

Fig. 92. 46 were like Kohl Rabi (2 of these purple-leaved).

Fig. 93. 8 had leaves like Cabbage (6 of these purple).

Fig. 94. 140 had enlarged stems with foliage of variable character.

Fig. 95. 1 resembled a Kale with a "curled" or "fringed" leaf.

As regards typical Kohl Rabi plants there were—

<table>
<thead>
<tr>
<th></th>
<th>Found (195 plants).</th>
<th>Expected (from 196 plants).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kohl Rabi</td>
<td>46</td>
<td>49</td>
</tr>
<tr>
<td>Not Kohl Rabi</td>
<td>149</td>
<td>147</td>
</tr>
</tbody>
</table>
Thousand-headed Kale on Drumhead Cabbage (figs. 96 & 97).

The plants of F1 resembled a coarse-leaved Thousand-headed Kale with little or no trace of the Cabbage parent. (No photo.)

In F2, 204 plants were raised (figs. 98, 99, & 100). Of these:

Fig. 98. 176 resembled a dwarf type of Thousand-headed Kale with leaves broader than usual and fewer branches.

,, 99. 26 resembled the Cabbage.

,, 100. 2 plants were much like Brussels Sprouts.

A few plants in F2 had purple leaves.

Swede (purple top, yellow-fleshed, Pl. 35, fig. 101) on Asparagus Kale (fig. 102).

The plants of F1 had foliage like Asparagus Kale and somewhat thickened stems (fig. 103).

208 plants of the F2 generation were raised (figs. 104, 105, 106, & 107). Of these—

178 were more or less “bulbed,” 112 having Swede foliage. (Fig. 104)

30 were bulbbless, 66 ,, Asparagus Kale foliage. (,, 105)

14 ,, Swede foliage. (,, 106)

16 ,, Asparagus Kale foliage. (,, 107)

Assuming that “bulbing” and “Swede foliage” were the dominant characters, the expected results would be—

156 bulbed ........ 117 bulbed with Swede foliage.

39 ,, Asparagus Kale foliage.

52 bulbbless ........ 39 bulbbless with Swede foliage.

13 ,, Asparagus Kale foliage.

N.B. The foliage of Asparagus Kale always dies off in the winter (see figs. 105 & 107).

Conclusions.

1. The races and varieties of Brassica oleracea, L., such as Cabbages, Kohl Rabi, and Thousand-headed Kale, cross readily, the resulting plants being of nondescript mongrel character, unlike the parents. It would appear that the special forms as at present met with in gardens are more the result of continued selection rather than the direct product of crossing.

2. Forms of Brassica oleracea, L. (all of which have smooth glaucous leaves in all stages of their growth), did not cross with those of Turnip
(Brassica Rapa, L.), Swede Turnips (Brassica campestris, L., var. Napobrassica, D.C.), or various kinds of oil-yielding Rapes, all of which have hispid leaves when young.

3. No form of Rape was met with which had smooth leaves.

4. Rapes, Turnips, and Swedes cross readily with each other.

The plants obtained by crossing the (hispid green-leaved) Turnip with the (hispid glaucous-leaved) Swede proved sterile.

The Turnip and Swede-Turnip are no doubt specifically distinct.

Ragged Jack Kale and Asparagus Kale produce fertile crosses with Swede. All have hispid glaucous leaves when young.

5. The so-called "Hybrid" yellow-fleshed Turnip cannot have been obtained by crossing the Swede with the Turnip.

6. The relationship between the white- and the yellow-fleshed forms, both of Turnips and Swedes, is still unsettled.

7. Several of the crosses and their progeny exhibit simple Mendelian phenomena, but there are many points connected with the occurrences of new features, such as novel colour and altered form of leaf, in the segregates of F 2, which are not clearly understood.

The peculiar and apparently distinct character of "fleshiness" possessed by the seedsmen's specially selected forms of "roots" is very much reduced in the F 1 plants, and its occurrence in these may be readily confused with increased vigour of stem. It returns, however, in the F 2 generation in increased intensity, but none of these plants seem to possess it in the same degree as the original parents of the cross.

In the crosses where the green Drumhead Cabbage was one of the parents, a few plants having purple foliage were met with in the F 2 generation.

In preparing this paper for publication in the Society's Journal, I have had the valued help of Professor Percival.

EXPLANATION OF THE PLATES.

PLATE 24.

Fig. 1. Green Kale.
2. Variegated Kale.
4. Savoy.
5. Brussels Sprouts.

Fig. 6. Drumhead Field Cabbage.
7. Garden Cabbage.
8. Red Cabbage.

PLATE 25.

Fig. 10. A Brussels Sprouts plant with Cabbage head.
12. A plant of the habit of Thousand-headed Kale, but having very white and tender leaf-stalks of the nature of Couve Tronchuda.
13. A heading or hearting form of Couve Tronchuda.
15. True Couve Tronchuda (for comparison).
Types of roots and plants used in the experiments (see page 338):—

**Plate 26.**

Fig. 16. Colza Rape.
17. Ragged Jack Kale.

Fig. 20. Thousand-headed Kale.
Figs. 22-24. Swede Turnips.

**Plate 27.**

Fig. 28. Asparagus Kale
on
29. Yellow-fleshed Swede.

30. Type of plant produced in F1.

Fig. 31. White Turnip
on
32. Asparagus Kale.

33. Type of plant produced in F1.

Fig. 34. Ragged Jack Kale
on
35. Yellow-fleshed Swede.

36. Type of plant produced in F1.

**Plate 28.**

Fig. 37. Yellow-fleshed Swede
on
38. Ragged Jack Kale.

39. Type of plant produced in F1.

Fig. 40. Colza Rape
on
41. Yellow-fleshed Swede.

42. Type of plant produced in F1.

Fig. 43. Colza Rape
on
44. White-fleshed Swede.

45. Type of plant produced in F1.

**Plate 29.**

Fig. 46. White-fleshed Turnip
on
47. Colza Rape.

48. Type of plant produced in F1.

Fig. 52. Yellow-fleshed Turnip
on
53. Ragged Jack Kale.

54. Type of plant produced in F1.

49. Yellow-fleshed Turnip
on
50. Colza Rape.

51. Type of plant produced in F1.

55. White-fleshed Turnip
on
56. White Swede.

57. Type of plant produced in F1.
BRASSICA CROSSES.
BRASSICA CROSSES.
BRASSICA CROSSES.
Fig. 58. Ragged Jack Kale. ♂.
50. White-fleshed Swede. ♀.
60. Plant of F1 generation of Ragged Jack Kale (♂) on White Swede (♀).
Figs. 61–66. Plants of F2 generation.

PLATE 31.

Fig. 67. Plant of F1 generation of White Swede (♂) on Ragged Jack Kale (♀).
Figs. 68–73. Plants of F2 generation.
Fig. 74. Kohl Rabi (♂).
75. Thousand-headed Kale (♀).
76. Plant of F1 generation of Kohl Rabi (♂) on Thousand-headed Kale (♀).

PLATE 32.

Figs. 77–79. Plants of F2 generation of Kohl Rabi (♂) on Thousand-headed Kale (♀).
Fig. 80. Plant of F1 generation of Thousand-headed Kale (♂) on Kohl Rabi (♀).
Figs. 81–84. Plants of F2 generation.

PLATE 33.

Fig. 85. Kohl Rabi (♂).
86. Drumhead Cabbage (♀).
87. Plant of F1 generation of Kohl Rabi (♂) on Drumhead Cabbage (♀).
Figs. 88–90. Plants of F2 generation.
Fig. 91. Plant of F1 generation of Drumhead Cabbage (♂) on Kohl Rabi (♀).

PLATE 34.

Figs. 92–95. Plants of F2 generation of Drumhead Cabbage (♂) on Kohl Rabi (♀).
Fig. 96. Thousand-headed Kale (♂).
97. Drumhead Cabbage (♀).
Figs. 98–100. Plants of F2 generation of Thousand-headed Kale (♂) on Drumhead Cabbage (♀).

PLATE 35.

Fig. 101. Purple-top Swede (♂).
102. Asparagus Kale (♀).
103. Plant of F1 generation of Purple-top Swede (♂) on Asparagus Kale (♀).
Figs. 104–107. Plants of F2 generation.

[Read 6th February, 1908.]

The little explored and romantic Province of Fokien lies on the coast of China just to the north of the tropics half way between Hongkong and Shanghai. In area it is about equal to England and Wales combined. A large portion of its surface is traversed by ranges of mountains fairly covered in some parts with old forest and intersected by the deep river gorges which characterize the south-east regions of China and give to that part of the country the wild and picturesque scenery for which it is famous.

Up to the time of the expedition of which this paper gives a short account, there is no record that the interior of this district had ever been visited by a botanist. It had several times been crossed by travellers; Marco Polo himself undoubtedly descended the Kiennaing River and the Min River in the 13th century, thus traversing the centre of the province, and in recent times Mr. De La Touche, the ornithologist, ascended the same rivers in search of birds, and incidentally made a small but very interesting collection of plants, which he sent to Franchet at Paris, where they were described (Bull. Soc. Bot. France, xlvi. 204). Numerous small collections have been made from time to time in the more accessible country round the treaty ports of Foochow and Amoy; and the following three expeditions towards the interior are also on record. In 1849 Fortune attempted to ascend the Min River from Foochow, but at Shui Kau, 80 miles from that city, turned back from want of funds; later in the same year he traversed the north corner of the province. In 1873 David penetrated into the high border mountains southwest of the Bohea Hills; his collections in that country proved of great interest and many novelties were published by Franchet. Whether Fortune collected plants on his two Fokien expeditions it is difficult to say with certainty, as few of his specimens are precisely located, but several of those in the Kew Herbarium agree so closely with others from Central Fokien that I am inclined to think that he did so.

In 1905, being impressed with the importance of attempting to visit and explore this large area, the flora of which was almost totally unknown and very poorly represented in herbaria, and was supposed moreover to comprise numerous plants of first-rate commercial importance, I proposed to the Government of Hongkong that I should be given two months' leave of absence and the services of three native collectors, with the object of exploring the central portion of Fokien.

This being arranged, we accordingly started from Hongkong in the middle of April 1905 for Foochow by sea. My object was to make an
exhaustive collection of all the species of flowering plants and cryptogams recognizable in late spring and early summer, and to preserve all but the commonest species in quadruplicate for purposes of distribution. With this object in view, I determined to take as much drying paper as could possibly be wanted for making a large collection, to take an extra man from the colonial herbarium expressly for managing the drying presses, and to keep throughout within touch of rivers, the only routes on which this heavy outfit could be easily transported. Foochow was reached on April 25th, and eleven days were spent in collecting on the plains and lower hills round the city. The banks of the Yuen Fu River were also explored up to about 30 miles from its junction with the Min. At this point lies the large island of Nantai, on which Foochow is partly built. The narrow rocky gorges which run up from the Yuen Fu, and the extensive bamboo groves which clothe the lower hills along its course proved most interesting collecting grounds, and yielded several new or otherwise interesting species.

On the evening of May 4th we started up the main stream of the Min, and in two days reached the lower end of the rapids at Shui Kau (mouth of the waters). From this point the Min is barred by an almost unbroken succession of more or less dangerous rapids as far as Yenping, a distance of 50 miles in the direct line, or about double that distance by river.

The passage of the rapids in either direction is expensive and difficult, and this, in an almost roadless country, has doubtless contributed to the scarcity of the information, both botanical and otherwise, which has reached us from the interior.

Up to this time the weather had been fine and most favourable for our purpose, and, although a few wet spells were encountered during our stay in the interior, they were never long enough seriously to hamper our work.

A day was spent in exploring the valleys near Shui Kau, along Tap Ling Ho, and several interesting plants were found among the extensive Tea-oil plantations which here cover nearly all the low-lying hills; the little known Actinidia lanata was as common as the blackberry is in England, and groves of the rare Machilus Grijsii, just then in full fruit, made fine pieces of colour owing to the vivid scarlet of their peduncles. As the rapids were ascended the country, which had at first been open and cultivated, became enclosed by high mountains. 200 more species from the banks of the Min were added to our presses, which now contained about 700 species or some 2000 specimens. Yenping was reached on the 13th of May; here we were fortunate enough to meet Dr. Skinner of the American Mission, who lent us a room in which to store our belongings, and I determined to make this the base for future work. As we could see from the river that high mountains, densely covered in some parts with forests, stood within reach of the city, this neighbourhood seemed a suitable one in which to occupy the 3 or 4 weeks which still
remained, particularly as it lay near the centre of the province and far from any previously explored parts.

Before moving from the town the previous collections were carefully sorted and a rough key drawn up for each genus represented. This work was greatly facilitated by a method which had been adopted of laying each plant in the presses on a sheet of paper provided with a projecting tag bearing the proper ordinal and the generic numbers, so that any desired genus could be easily found without opening all the presses.

Although this occupied several days they were well spent, and the key proved of the greatest value in distinguishing new forms from those already collected, especially in such critical genera as Eurya, Actinidia or Carex, where it is difficult to carry in the memory while in the field, specific differences which may be obvious enough when the plants are laid side by side in the herbarium. This key was kept up to date by the addition of new species as they were subsequently found.

I then sent two collectors up to Shao Wu in the west of the province and left one man in charge of our base, while I, with my wife, who accompanied me throughout, and one collector, took up our quarters in a new Chinese cottage (any one who has travelled in China will understand the necessity of finding a house, previously uninhabited by Chinese peasants) in the small hamlet of Buong Kang, about half a day's march from Yenping, and in the centre of one of the largest patches of virgin forest on the Yenping mountains.

The forest is traversed by the high road from Yenping to Yenkan, which here runs up a valley by a flight of several thousand rough stone steps leading high above the village to a pass known as Sang Chien Bah Beh Kang or pass of 3800 steps. The valley in its lower part is clothed with dense woods with occasional clearings for bamboo and other cultivation, but, half way up, the rocks close in on both sides and make a narrow mouth through which the stream pours in a series of cascades far below the road, while the cliffs tower up several hundred feet above it. It is just above this romantic spot that Buong Kang is situated. Above the hamlet the road is bordered nearly to the top with huge trees of Liquidambar, Chestnut, Camphor, and Photinia.

During the three weeks spent here I succeeded in penetrating to all parts of the lower and middle forest, though in some places the almost impenetrable undergrowth and in others frequent precipices rendered the work slow; in some of the thickest portions torrent beds afforded the only means of progress, and it was along the banks of these, under the shade of overarching trees, that some of the most interesting species were found. A few days sufficed for the exploration of the grassy downs above the level of the woods. Each day's collections were sent down in the evening to be dried at Yenping and the species added to the key. In this way the number of distinguishable species
was brought up to 1443, including such of those gathered by the collectors from Shao Wu as were additional to my own collections.

The opportunity was taken of making careful notes on some of the local industries, such as paper-making, wood-oil manufacture, and the utilization of the different kinds of bamboos. An interesting day was spent in visiting the garden of Lei Kam, Literary Mandarin of Yenping, with whom Dr. Skinner is on friendly terms. The garden contained a great variety of trees and shrubs, as well as the usual plants in pots, which form the chief feature of all Chinese gardens. Two of the trees, both Michelias, which were unfamiliar to me, and of which I took specimens, prove to be new to science.

On the 23rd of June the collections were packed and brought back to Hong-kong after a most successful expedition of nearly two months.

The specimens contain types of at least 40 new species, and numerous other interesting plants are among them, additional to the flora of the province, and even, in some cases, to that of China.

I wish to acknowledge my indebtedness to the great resources of the Kew Herbarium and Library for the details required in compiling this paper, and to the courtesy of the Director for allowing me free use of them.

In the following list all the novelties so far identified are described, with the exception of the Hamamelidaceae. These by Mr. Hemsley’s request have been handed to him for description in Hooker’s ‘Icones Plantarum.’ Besides the new species and varieties, only such records are included below as are thought to be of special interest.

**ENUMERATION AND DESCRIPTIONS OF NEW SPECIES.**

**MAGNOLIACEÆ.**

*MICHÉLIA MAUDIE, Dunn, sp. n.*

Arbor parva, pulchra. Ramulorum cortex lacte brunneus, cum tota planta glaberrimus. Folia oblonga vel ovato-oblonga, 10–17 cm. longa, 4–7 cm. lata, coriacea, subtus glaucescentia, obtuse acuminata, basi acuta, venis lateraliis 8–12 paribus, venulis utrinque conspiciue reticulatis, petiolis 25–30 mm. longis. Flores fragrantiores, solitarii, in axillis foliorum summorum evoluti; sepala decidua non visa; petala alba, ovata, 5–6 cm. longa, obtusa; stamina petalis 5–6-plo breviora, antheris filamento crasso 5-plo longioribus; gynoeccium, petalis nuper lapis, 20 mm. longum, gynophorum 10 mm. longum includens. Gynophorum et pars fertilis fructus maturitate incipiente fortiter elongate.

**LINN. JOURN.—BOTANY, VOL. XXXVIII.**

The species is named after my wife, who has been my constant companion during my explorations in Fokien and in other parts of China.

\* MICHELIA SKINNERIANA, Dunn, sp. n. 

Arbor magna. Ramuli cupreo-sericei, mox glabri. Folia subsessilia, lanceolata, 6–10 cm. longa, 25–30 mm. lata, chartacea, matura superne glabra, nitentia, subtus tenuiter sericea, caudata, basi acuta, costa superne impressa, venis lateralibus 8–10 paribus, venulis obscure reticulatis. Flores flavi, axillares, solitarii, pedunculis rubro-sericeis 6–8 mm. longis; sepala ovata, dense sericea; petala ovata 18–20 mm. longa, cera, glabra, apice rotundata; stamina 5–6 mm. longa, antheris filamento 3-plio longioribus; ovaria dense pubescentia.

Yenping, cultivated in the gardens of the Chinese Literary Mandarin, Hongkong Herb. 2448.

The tree is closely allied to M. fusca, though readily distinguished, even at a distance, by its leaves. The specific name commemorates the chief of the American mission in Yenping, to whose kindness I was indebted for the opportunity of visiting this interesting garden in the city, as well as for numerous other hospitable actions.

\* SCHIZANDRA ELONGATA, Hook. f., var. LONGISSIMA, Dunn, var. n. Pedunculi statu fructifero 7–9 cm. longi; flores 15–20 mm. diam.

Glaides in the woods and along the sides of streams near Buong Kang at 2000 ft. Hongkong Herb. 2441, 2442. Yunnan, Henry, 9193 a, 9193 b.

CRUCIFERÆ.

\* NASTURTIIUM RIVULORUM, Dunn, sp. n.

Herba annua, laxe procumbens, omnino glabra. Folia trifoliolata, radicalium petiolis 5–6 cm. longis, superiorum gradatim brevioribus; inferiorum foliola ovata, 3–5 cm. longa, papyracea, sinuata, venis excurrentibus, obtusa, bari cordata; superiorum foliola similia sed magis sinuata, brevis et petiolulata. Racemi axillares, folia sepe excedentes; pedunculi bracteis 1–2 ovatis cordatis stipitatis prope apicem instructi, 4–6 cm. longi. Flores parvi, albi, approximati; sepala, petala et stamina 1½–2 mm. longa; ovarium ovatum, complanatum, stylo simplice, ovario 3-plio breviore, stigmatate globose; ovula circiter 12, dispemimento obsolete biseriali. Fructus ignotus.
Along the mossy banks of rivulets in shady woods at Fong Kong Tze near Foochow. Hongkong Herb. 2354.

Cochlearia fumarioïdes, Dunn, sp. n.

Herba annua, gracillima, humifusa, glabra. Folia trifoliolata, 1–2 cm. longa, petiolis 5–10 mm. longis; foliola ovata, sinuata, sepe triloba, membranacea, obtusa, petiolulis 5 mm. longis. Racemi axillares terminales-que, fructu elongati, ad 6 cm. longi, sessiles. Flores minutis, ½–1 mm. longi; ovarium 1-loculare; ovula 1–2, apicata. Silicula orbicularis, compressa, dense pustulata, 2 mm. longa, valvis deciduis; semen unicum; radicula incumbens.

On wet vertical rocks in the forest near Buong Kang. Hongkong Herb. 2360.

This interesting little species differs widely from most Cochlearias in habit and from all in its blistered fruit, but the divergence does not appear sufficient foundation for a new genus.

TERNSTREMIACEÆ.

Eurya loquaiana, Dunn, sp. n.

Frutex 3 m. altus, præter alabastra omnino glaber. Ramuli cylindrici. Folia lanceolata, præter basin scite serrata, 4–6 cm. longa, 15–20 mm. lata, chartacea, obtusa acuminata, basi cuneata, costa superne impressa, subtus prominente, venis secundariis ascendentibus frequentibus obscureis, petiolis 3 mm. longis. Flores in foliorum vetustiorum et delapsorum axillis 1–3-natim fasciculati; sepala ovata, obtusa, 1–1½ mm. longa; petala staminaque ignota; capsula ovalis, 3 mm. longa, 3-locularis; stylo capsulam æquans, tripartitus, ramis basi duplo longioribus.

In woods on the mountain-sides near Yenping at 2300 ft. Hongkong Herb. 2395. Collected by Lo Quai. This shrub has a resemblance to E. japonica, var. nitida, Hook. f. & Thoms., but can be distinguished by its small fruit and long branched styles.

Actinidia lanata, Hemsl.

Among the tea-oil plantations and on open rocky hillsides near the Min at Shui Kau. Hongkong Herb. 2397.

This species was previously known to science only from a single fruiting specimen from the N.W. River in Kwantung. It is a striking shrub forming large straggling bushes similar to those of Rubus rusticanus. The flowers are 2–3 cm. across with round salmon-pink petals, longer than the numerous stamens (in the male flowers).

Actinidia hemsleyana, Dunn, sp. n.

Frutex vagans, caulibus dimorphis. Alteri longi, cito evoluti, primo dense

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rufo-hispidi, tandem exigue setosi, alteri laterales, breves, tenuiter strigulosi vel hispiduli. Alabastra supra callos annulares foliorum delapsorum longe aureo-barbata. Folia oblongo-ovata, adpresso serrata, 10–20 cm. longa, 4–6 cm. lata, chartacea, præter petiolum sparse hispidum 2–3 cm. longum glabra. Cymæ axillares, sub-3-flone, petiolis breviores. Flores viriduli; masculorum sepala 5, ovata, subacuta, 5 mm. longa, dense rufo-tomentosa; petala 5, glabra, obovata, apice rotundata, 10 mm. longa, staminibus fuscis sesquilongiora; ovarii rudimentum 2 mm. latum, tomentosum, pedunculis gracilibus tomentosis; foeminei similis sed sepala basi coała, lobis ovatis obtusis, 8 mm. longa; stamina rudimentaria; ovarium depresso-globosum, 6 mm. latum. Fructus immaturus cylindricus, 10 mm. longus, 5 mm. latus, apice rotundatus, stylis plurimis coronatus; stili 4 mm. longi. 

Yenping Mountains, in the upper valleys. Hongkong Herb. 2400.

This beautiful and interesting plant is dedicated to Mr. W. Botting Hemsley, F.R.S., the distinguished keeper of the Kew Herbarium, whose instruction and kindness I gratefully acknowledge. The habit of this plant and all the other Actinidias that I have seen recalls that of Rubus, that is to say, they form large straggling bushes among rocks and undergrowth, in woods or in hedges. When occasion permits they may form real climbers, but I have not seen them in this condition. The present case gives a good example of the usual method of growth, and an account of it will elucidate some of the apparent anomalies of the specimens which have hitherto been received in herbaria. Each new extension of the shrub begins in this case with a long, arching, densely strigose tawny shoot bearing abnormal narrow leaves. In the autumn these leaves fall, leaving large thickened leaf-scaris and a bud above each, protected by a tuft of stiff yellow hairs. These buds develop in the spring into short flower- and leaf-bearing shoots, the leaves and the indumentum being quite different to those of the primary shoots. The plant thus has, and so have also many other members of the genus, dimorphic stems, leaves, and flowers. The male and female bushes are, so far as I have seen, similar in their vegetative portions.

**Actinidia lanceolata, Dunn, sp. n.**

Frutex magnus, vagans, semi-scandens. Caules vetusti nigri, glabri, lenticellati; ramuli florigeri dense cinnamomeo-puberuli. Folia lanceolata, macronato-serrata, 5–7 cm. longa, 2–3 cm. lata, papyracea, supra sparse et minute puberula, subtus sparse albo-tomentosa, acuminata, basi cuneata, venis utrinque 4–5 arcuato-ascendentibus, petiolis 1–1½ cm. longis cum venis majoribus cinnamomeo-pubescentibus. Flores 3–6-ni, in cymas sepius umbelliformes axillares pedunculatas dispositi, pedunculis 3–6 mm. longis cum pedicellis calycibusque tenuiter cinnamomeo-puberulis, bracteis linearibus, minutis; sepala 5, rotundata, 3–4 mm. longa; petala viridula, oblonga, acuta, vel rotundata, sepalis paullo longiora; masculorum stamina lutea,
indefinita, sepaliæ æquilonga; ovarii rudimentum oblongum, 1 mm. longum, tomentosum; feemineorum ovarium ad petalorum delapsum 1½ mm. longum, ovale, acuminatum, rufo-tomentosum, stylis circiter 10 ovario longioribus. Fructus ignotus.

Hedges along the river banks at Yenping and at Wong Ka Chi, W. Fokien. Hongkong Herb. 2399.

**Actinidia sablefolia, Dunn, sp. n.**

Frutex scandens vel vagans, præter flores omnino glaber. Caules rubri, ad exitum ramorum fortiter callosi. Folia ovata, obscure crenata, sinibus mucronulato notatis, 5–6 cm. longa, papyracea, infra pallida, venulis rubris reticulata, acuta vel obtusa, basi rotundata, venis secundariis utrinque 5 immersis arcuato-ascendentibus, petiolis 2 cm. longis. Cymæ axillares, sub-3-flore, petiolos æquantes, bracteis minutis. Flores masculi sepala rotundata 2–3 mm. longa, utrinque tenuiter pilosa; petala alba, obovata, apice rotundata, 5–6 mm. longa, staminibus luteis duplo longiora; ovarii rudimentum globulare, rubrotomentosum.

Wood-borders and glades on the mountain slopes near Yenping. Hongkong Herb. 2402. Resembling A. melanandra, Franch., but distinguished by the shape of its leaves and by its yellow anthers.

**Camellia Edithæ, Hance.** This rare shrub is now for the third time recorded from this single province. Hongkong Herb. 2455.

**Polygalaceæ.**

**Polygala Latouchei, Finet et Franch.** This plant was found several times about springs on the summits of the Yenping Mountains at perhaps 4500 ft. (Hongkong Herb. 2372.) It shares with the Yunnanese P. saxicola, Dunn, alone in the genus the character of having fleshy stems and peduncles.

**Celastraceæ.**

**Microtropis fokienensis, Dunn, sp. n.**

Frutex 3 m. altus, omnino glaber. Ramuli angulati. Folia opposita, oblanceolata, integra, 5–6 cm. longa, acuta, basi longe cuneata, petiolo 4 mm. longo. Cymæ axillares, 1–2-flore, paniculato, decurre, 1 cm. longe, bracteis multis triangularibus imbricatis vestite. Flores inter bracteas sessiles; sepala 4, rotundata, 1½ mm. longa, late imbricata; stamina 4, in disco disposita, sepaliæ breviora. Fructus juvenis 2–3 mm. longus, ovatus acuminatus, stylo ½–1 mm. longo; stigma quadrilobum.

Yenping heights at 5000 ft. Hongkong Herb. 2394.
Acer Wilsoni, Rehder, var. serrulata, Dunn, var. n. Folia serrulata.
A small tree on the sides of the tributary gorges of the Yuen Fu River near Foochow. Hongkong Herb. 2545.

Sabia discolor, Dunn, sp. n.
Frutex scandens vel vagans, glaber. Ramuli fusci. Folia late ovata, integra, anguste revoluta, 4–6 cm. longa, papyracea, supra in siccitate nigrescentia, subtus glauca, obtusa, acute vel leviter acuminata, basi rotundata, venis secondariis utrinque 3–4 duobus utrinque basi approximatis supra et infra leviter prominulis, petiolis 7–10 mm. longis. Cymae pseudo-umbellatae, 2–5-flora, pedicellatae, axillares, ebracteae, pedunculis 10–12 mm. longis. Flores virides, praeoces; sepala lanceolata, ½–1 mm. longa; petala ovata, 2 mm. longa, staminibus duplo longiora, stylum sequantia. Drupae in siccitate compressae, corrugatae, 6 mm. latæ; pedunculis 3 cm. longis.

Bushy mountain-sides near Yenning at 2300 ft. Hongkong Herb. 2537. Kuliang, Foochow. Hongkong Herb. 2536. This species differs from S. japonica, Max., its nearest ally, in its revolute leaves which are glaucous beneath.

Meliosma myriacanthum, Sieb. & Zucc., var. discolor, Dunn, var. n. Folia subitus breviter tomentosa.
W. Fokien at Shao Wu. Hongkong Herb. 2536, 2537.

Meliosma rigida, Sieb. & Zucc. Hongkong Herb. 2532. This record forms one more link in the distribution of the species between India and Japan; it was previously known from Formosa and the Liu Chiu Islands, as well as from these extreme points.

Anacardiaceae.

Rhus sylvestris, Sieb. & Zucc. Hongkong Herb. 2528. A southern extension of the known specific area.

Leguminosae.

Millettia pachycarpa, Benth. Hongkong Herb. 2564. Only previously from Yunnan.

Sophora Franchetiana, Dunn, sp. n.
Frutex 1 m. altus. Ramuli, foliorum rachides, petioli, calyces pedunculique breviter fulvo-tomentosi. Folia pinnata, 10–14 cm. longa; foliola sepe 11, elliptica, 3–4 cm. longa, papyracea, supra glabra, costa impressa, subitus
molliter fulvo-pubescentia, acuta, basi rotundata vel obtuse cuneata, venis obscuris, petiolis 2–3 mm. longis. Racemi terminales, 6–7 cm. longi, bracteis minutis. Flores albi, pedicellis 4–5 mm. longis; calyceis tubus brevis, basi concava, 4 mm. latus, 3 mm. longus, lobis obscuris late triangularibus; vexillum erectum, obovatum, apice retusum, 7 mm. longum; alae carinaque vexillo equilongae; stamina libera, basi puberula; ovarium pubescens; ovula 4 in medio ovarii linearis disposita. Legumen (unum tantum visum) 3 cm. longum, in medio seminiferum; utrinque angustatum, glabrum, opacum, bruneum; semen unicum, magnum, ovale, luteum, nitens, 8 mm. longum.

Bamboo groves on the banks of the Yuen Fu River near Foochow. Hongkong Herb. 2582. Distinguished among the soft-leaved Sophoras by its broad calyx.

The trivial name commemorates the great French botanist who, among his numerous other works on the flora of China, has added to our knowledge of Fokien plants in a paper upon a collection made in that province by Mr. De La Touche of the C.I.M. C.

ROSACEÆ.

Rubus trifidus, Thumb. Hongkong Herb. No. 2626. Previously known only from the Corean Archipelago.

Rubus pectinellus, Maxim. Hongkong Herb. 2631. A Japanese bramble, now recorded for the first time from China.

Spiraea Blumei, G. Don, var. Maximowiczii, Dunn. S. Maximowiczii, Schneider, Laubholtz, i. 461. With the abundant material before me I find it impossible to separate this form specifically from the type. It seems to be rather a geographical variety at the south of the total area. Min Bank, Fokien, Hongkong Herb. 2674; Kwantung, Ford, 66; Ichang, Hupeh, Henry, 3506, 4115.

Spiraea prunifolia, Sieb. & Zucc., var. integrifolia, Dunn, var. n. Folia integra.

Banks of the Yuen Fu River near Foochow. Hongkong Herb. 2658; also De Grijse, Hance, 1218.

HAMAMELIDACEÆ.

Distylium myricoides, Hemsl. in Hook. Ic. sub t. 2835, p. 2. Fokien, Dunn, 2684, 2685.

Distylium strictum, Hemsl. l. e. p. 3. Fokien, Dunn, 2681.

Sycopsis Dunnii, Hemsl. l. e. t. 2836. Min banks below Yenping. Hongkong Herb. 533, 2635.
MR. S. T. DUNN: A BOTANICAL

ALTINGIA GRACILIPES, Hems. in Hook. f. t. 2837. Yenping Mountains, western portion. Hongkong Herb. 119, 2682.

MELASTOMACEÆ.

MELASTOMA INTERMEDIA, Dunn, sp. n.
Frutex parvus. Ramuli angulati, sparse adpressae hispidei. Folia opposita, elliptica, integra, marginem revolutum, 3–5 cm. longa, chartacea, supra in marginibus crebre in cetera superficie tenuiter adpressae hispida vel glabra, subtus pallidiora, in venis setosa, apice obtusa, basi rotundata vel obtusa cuneata, venis 5 ad basi radiantiibus, lateraliibus marginalibus, petiolis 5–10 mm. longis. Flores solitarii, axillares vel terminales, ad ramulorum apices approximati, vel paniculam paucifloram terminalem formantes, pendunculis 1 cm. longis, bracteis 2 lanceolatis 6 mm. longis, setosis prope apicem instructis; calyces tubus sphaericus, 6 mm. longus, cum lobis pedunculoque setid ascendentiibus vestitus; lobi 5, lanceolati, acuti, tubo æquali, lobulis setaceis 3 mm. longis alternantibus; petala 5, rosea, obovata, 2 cm. longa; stamina generis. Fructus immaturus globosus, annulo coronatus. Yenping Mountains at 4500 ft. Hongkong Herb. 2706.
The species is intermediate between M. repens, Desr., and M. sanguinea, Sims.

PHYLLAGATHIS CHINENSIS, Dunn, sp. n.
Herba annua, 10–15 cm. alta. Caulis erectus, glaber. Folia opposita, lanceolata, crebre mucronato-serrata, membranacea, pilis crispis tenuiter conspersa, apice gradatim, basi subito acuminata, venis 3 ad basi divergentibus, petiolis 1–2 cm. longis. Flores saepe 2, terminales; calyces tubus subcompressus, urceolatus, 8-costatus, 4 mm. longus, 3 mm. latus; lobi 4, distantes, parvi, lanceolati; petala 4, rosea, orbicularia, breviter unguiculata, 3–4 mm. lata; stamina 8, fertilia petalis æquali; corona ovarii apice laceram; stylos individus, staminibus brevior. Fructus membranaceus, subcompressus, 5 mm. latus, imperfecte 4-locularis; placenta a medio columna centralis in loculos divergentes, fimbriatae. Semina minuta, ½–1 mm. longa, angulata.

On the margins of rivulets in the lower woods about Yenping. Hongkong Herb. 2711.

ARALIACEÆ.

HETEROPANX FRAGRANS, Seem., var. CHINENSIS, Dunn, var. n. Foliola parva, lanceolata, fructu compresso.
Lower woods near Buong Kang, Yenping. Hongkong Herb. 2754. Yunnan, Henry, 12,865. Kienning Fu Mountains, Rickett, 846. Tonkin,
Balansa, 3457. This seems to be the usual wild form in China. It is usually a small tree with the leaves and panicles collected into a compact bunch at the end of the thin straight trunk, and thus very different from the graceful umbrageous trees of India.

Rubiaceae.

Galium asprellum, Michx. Hongkong Herb. 2799. A southern extension from its previously known area, which comprised N.E. Asia to Hupeh and Szechuen.

Compositae.

Aster auriculatus, Franch. Hongkong Herb. 2826. Known previously only from Yunnan.

Vaccinaceae.

Vaccinium Carlesii, Dunn, sp. n.
Frutex omnino glaber. Ramuli striati, cinnamomei, vetustiores grisei. Folia lanceolata, leviter serrata, 3-4 cm. longa, chartacea, gradatim acuminata, basi obtuse cuneata, venis obscuris, pedicellis 3-4 mm. longis. Racemi in ramulis florigeris paniculas densas ad 10 cm. longas bracteatas formantes, bracteis folia parva simulantibus. Flores parvi, pedicellis 1-2 mm. longis, bracteolis linearibus pedicello superante caducis; calycis tubus hemisphericus, 1½ mm. longus, 5-lobatus, lobis triangularibus brevibus acutis; corolla alba, campanulata, 3 mm. longa, 5-lobata, lobis ovatis acuminatis, apice reflexo; staminum incolorum antherae in tubulis laxos attenuate, basi obtuse breviter calcareae; filaments puberula; stylus breviter exsertus.


This species might be taken for a small state of V. Donianum, Wight, to which it bears a general resemblance.

Gentianaceae.

Gentiana Thunbergii, Griseb. Ch’a Ch’un, near Shui Kau on the Min, at 1500 ft. Hongkong Herb. 3359.

An interesting addition to the flora of China as Carles’s Kiukiang plant proves to be G. Zollingeri, Fawcett (Kusnezow in Act. Hort. Petrop. xv. 375).
GESNERACEE.

Oreocharis Benthami, C. B. Clarke, var. reticulata, Dunn. Folia subtus reticulata.

Pakwan, Kwantung, Hance, 7561 of 1867, not 7561 of 1864, which is the type of the species; White Cloud Hills, Kwantung, Sampson, 447; Fokien, Hongkong Herb. 3364.

Clarke included under this specific name plants with reticulate and plain leaves and made no varietal distinction between them, because he believed, from the material at his disposal, that the reticulation was merely due to the development of the lamina with age. I have now, however, before me specimens which will not allow of this explanation, i.e., young leaves fully reticulate in plants of the above new variety and also typical examples showing no reticulation even in old leaves.

Oreocharis amabilis, Dunn, sp. n.

Herba perennis, scaposa, alabastris petiolis foliorum venis in latere inferiore pedunculis bracteis calcibusque lana brunnea vestitis. Folia radicalia, ovata vel oblonga, irregulariter crenata, 4-12 cm. longa, papyracea, supra pilis crisps adpressis vestita, obtusa, basi rotundata, majororum venis subtus reticulatis, petiolo 4-6 cm. longo. Scapa 10-18 cm. longa, lanata, glabrescentes, apice 1-2-plo umbellatim ramosae, umbellis bracteis lanceolatis, 8-12 mm. longis, involucratis. Calyx ad basin 5-lobus, lobis 4-8 mm. longis anguste lanceolatis; corolla alba (an semper?), glabra, cylindrica, subobliqua, 20-22 mm. longa, lobis erectis ovatis acutis 6-7 mm. longis; stamina prope basin corollae affixa, sinus loborum breviter superantia; stylus compressus, apice in stigma bilobum expansus.

Fokien, Foochow, Carles, 558; Shao Wu, clothing the faces of damp shady rocks, Hongkong Herb. 3363; Yunnan, Mi-lêh, on cliffs, Henry, 13,758.

SCROPHULARIACEE.


Apparently local in China, being confined to the S.E. temperate region, where it is in some parts a common and characteristic feature of the barren slopes of the mountains. The dehiscence of the capsules is remarkable. The horny endocarp seems invariably to split longitudinally down the middle of the loculus, rolling back elastically, bursting the calyx and thus expelling the seeds.
VERBENACEÆ.

Callicarpa longipes, Dunn, sp. n.

Frutex 1 m. altus, omnino floribus exceptis molliter villosus. Folia sub-sessilia, obovata vel oblonga, mucronato-dentata, subito acuminata, a medio gradatim ad basin rotundatum vel subcordatum angustata, papyracea. Cymae parvae, dense, axillares, longe pedunculatae, pedunculis 12-35 mm. longis. Calyx ad medium lobatus, villosus, 2 mm. longus, lobis acutis lanceolatis; corolla rubella, ore gradatim expansa, minime obliqua, extus puberula, calyce duplo longior, lobis brevibus obtusis; stamina exserta, 8-9 mm. longa; stylus filiformis, apice explanatus, staminibus longiori. Fructus ignotus.

Natural woods near Yenping at 2500 ft. Hongkong Herb. 3390.

Near C. rubella but distinguished by its long peduncles and by the shape of its corolla.

LABIATÆ.

Salvia Bowleyana, Dunn, sp. n.

Herba perennis, 1 m. alta. Caulis cum petiolis pedunculis calycibusque plus minus hirsutus. Folia pinnata, 10-12 cm. longa, petiolo 10-12 cm. longo; foliola 7, ovata vel ovato-lanceolata, crenata, papyracea, utrinque sparse pilosula vel subglabra, acuta, lateralia basi oblique, terminalia recte cordata vel rotundata, omnia petiolulata, petiolulis 5-15 mm. longis. Verticilli circiter 8-flori, distantes. Flores bracteolati; bracteole lanceolatae, pedicello 3-4 mm. longo breviores; calyx 10 mm. longus, supra medium leviter constrictus, intus hirsutus, ore expanso bilabiato; labium superius integrum, rotundatum, inferius bidentatum, dentibus parvis mucronatis approximatis; corolla caerulea, bilabiata, labio superiore recto concavo, inferiore æquilongo oblongo, genitalibus longe exsertis.

Banks of the Yuen Fu River near Foochow. Hongkong Herb. 3409.

Related to S. miltiorrhiza, Bunge, but differing in its 3-jugate leaves and short-hooded corolla.

The specific adjective commemorates the name of Mr. Bowley, Crown Solicitor of Hongkong, and of his sister (now Mrs. L. Gibbs), with whom the early part of our explorations is pleasantly associated.

Lamium foliatum, Dunn, sp. n.

Herba annua, debilis, procumbens, omnino floribus exceptis molliter hirsuta. Folia ovata, crenata, 4-10 cm. longa, papyracea, obtusa, basi rotundata, inferiorum petiolis laminas aequantibus, superiorum etiam haud multo brevioribus. Verticilli densi, multiflori, axillares, bracteolis linearibus. Calyx membranaceus, hirsutus, 8 mm. longus, lobis equalibus ovatis mucronatis 1-2 mm. longis; corolla rubella, 15-17 mm. longa, extus
puberula, intus glabra, tubo angusto recto exserto, labio superiore recto oblongo concavo apice inmargiinato, inferiore æquilongo trilobo, lobis oblongis æqualibus; stamina sub labio superiore approximata, exterioribus longioribus; nuculæ trigone, facie exterioxe in alam angustam apice producta.

Under shady banks in the lower woods near Buong Kang, Yenping. Hongkong Herb. 3427.

An anomalous plant without the facies of the genus, but separable by no obvious characters.

SCUTELLARIA LUZONICA, Rolfe. Hongkong Herb. 3415. This Scull-cap had not previously been found out of the Philippine Islands.

ARISTOLOCHIACEÆ.

ARISTOLOCHIA TUBIFLORA, Dunn, sp. n.
Herba scandens, omnino glabra. Folia triangularia, integra, 8–10 cm. longa, papyracea, acuta, apice summò obtusumurcronato, basi sinu rotundato cordata, auriculis rotundatis, venis pedatim a basi radiatis, petiolis 5–8 cm. longis. Flores 1–2-ni, axillares; perianthium fusco-rubrum, 30–35 mm. longum, basi bulbosa, tubo recto angusto ab ore dilatato in labium oblongum æquilongum producto, labio obtuso 5 mm. lato. Fructus ignotus.

Rocky gorge above the city of Yenping. Hongkong Herb. 3472.

Similar in foliage to A. contorta, Bunge, but the flowers with an obtuse, not caudate lip.

ARISTOLOCHIA MOLLIS, Dunn, sp. n.
Herba breviter scandens. Caulis puberulus, glabrescens. Folia oblongo-triangularia, 8–12 cm. longa, integra, papyracea, supra subscabra, subtus molliter hirsuta, apice summò acuta vel obtusa, basi paullo expansa, sinu rotundato cordata, auriculis rotundatis, venis a basi pedatim radiantis et 2 vel 3 paribus pinnatis, petiolis 2–3 cm. longis. Flores 1–2-ni, axillares, pedunculis pubescentibus 2 cm. longis, bracteolo amplexicauli 4–12 mm. longo circiter medio instructis; perianthium extus molliter hirsutum, subvire, rubro-lineatum; tubus ovalis, 8–10 mm. longus, supra paullo contractus, ore late oblique expanso 15–17 mm. lato, lineis rubris radiantis notato; ovarium dense pubescens. Fructus ignotus.

On walls at Siu Yuk, Min River. Hongkong Herb. 3470.

Recalling A. heterophylla in all but its flowers, which are widely different in shape.

PIPERACEÆ.

EXPEDITION TO CENTRAL FOKIEN.

Piper Futokadsura, Sieb. & Zucc. Hongkong Herb. 3481. The species was previously known from Japan, Liu Chiu Islands, and Formosa.

CHLORANTHACEÆ.

Chloranthus Oldhami, Solms. Hongkong Herb. 3482. Formerly known only from Formosa.

LAURACEÆ.

Machilus Sheareni, Hemsl. Hongkong Herb. 3490. A southern extension of the known area from Chekiang and Kiangsi.

Machilus Grisii, Hance. Drupa nigra globosa, 8–10 mm. diam., calyce persistente 6 mm. longo, pedunculo crasso carnoso corallino.

Woods along the Tap Ling Ho, near Shui Kau, 80 miles from Foochow. The fruit had not been described. The clustered scarlet peduncles of the fruit make the tree in May a beautiful and striking object.

EUPHORBIACEÆ.

Phyllanthus pulcher, Wall. Hongkong Herb. 3513. Previously known only as an Indian species.

Mallotus Roxburghianus, Muell. Arg., var. glabra, Dunn, var. n. Frutex omnino glaber.

Buono-Kane village near Yenping. Hongkong Herb. 3427.

Mallotus reticulatus, Dunn, sp. n.

Frutex 5 m. altus, præter paginam foliorum superiorem omnino breviter hirsutus et plus minus glandulis rubris sessilibus conspersus. Folia oblongo-ovata, serrata, 12–22 cm. longa, chartacea, supra glabra, costa impressa, infra dense reticulata, gradatim acuminata, basi rotundata vel obtusa, venis 7–8 paribus, infinis basalibus, petiolis 3–4 cm. longis. Racemi (foeminei tantum visi) terminales, fasciculati, sessiles, multiflori. Flores foeminei 4 mm. longi, pedicello longiores, bracteis linearibus, minutis; calyx 5-partitus, lobis linearibus 2 mm. longis; ovarium globosum, 3-loculare, stylo brevi, stigmatibus tribus plumosis. Fructus ignotus.

Hill-side at Wong Ka Chi, West Fokien. Hongkong Herb. 3429. Resembles M. philippinensis, Muell. Arg., but the leaves are serrate and finely reticulate beneath.
Ficus heteromorpha, Hemsl. Previously recorded no further south than Kiangsi. Hongkong Herb. 3453.

Nanocnide lobata, Wedd. Only recorded previously from the Liu Chiu Islands and from Chekiang.

Pilea aquarum, Dunn, sp. n.
Herba annua, tenera, 30–40 cm. alta. Caulis simplex, praeter apicem glaber, inferne procumbens, radicans. Folia opposita, elliptica, crenata, 4–6 cm. longa, membranacea, supra punctis minutis linearibus crebre notata, subtus in venis decidue puberula, apice basique angustata, obtusa, venis 3 a basi radiantibus, petiolis 2–4 cm. longis, stipulis membranaceis semicordatis, breviter petiolo adnatis. Cymae axillares, condensate, 5 mm. longae, tandem circinnatæ. Calyx fructescens, hispidus, 1 mm. latus, achenium globulare lucidum flavum includens.
On the “3800 Steps Pass” near Yenping, on rocks under the constant drip of water. Hongkong Herb. 3477.
Distinguished from P. pamila, A. Gray, its nearest ally, by its crenate leaves and large stipules.

Cupuliferæ.

Quercus Harlandi, Hance, var. integrifolia, Dunn, var. n. Folia subplana, integra.
Woods near Yenping, and among the gorges of the Yuen Fu River. Hongkong Herb. 3492. The type is, so far as is known, confined to Hongkong Island.

Quercus thalassica, Hance, var. obtusiglans, Dunn, var. n. Glandes apice rotundatae.
Fong Kong Tze near Foochow. Hongkong Herb. 3486. The same variety occurs in the Island of Hongkong on Mt. Davis under Hongkong Herb. No. 2081.

Quercus Edithæ, Skan. A welcome extension of the known area of this fine oak. Previously only from Kwantung.

Quercus Skaniana, Dunn, sp. n.
Arbor sempervirens, 10 m. alta. Ramuli pubesce molli vestiti. Folia oblongo-obovata, integra, 10–15 cm. longa, coriacea, supra glabra, costa prominula, venis secundariis impressis, subtus precipue in venis molliter pubescentia, costa venisque prominentibus, subito acuminata, basi cuneata,
petiolis 6–10 mm. longis. Spicre axillares, erecte, monoeicæ, circiter 15 cm. longe, pedunculo pubescente. Flores masculi approximati, feminei, 3–5-ni distanter glomerati, squamis pubescentibus. Glans depresso-globosa, breviter acuminata, cupula fere inclusa et ejus basi adherens, 15–20 mm. lata; cupula squamis imbricatis parvis acuminatis apicibus adpressis vestita, sepe cum floribus pannis haud evolutis basi congromerata.

In natural woods at 2500 feet in the Yenping Mountains. Hongkong Herb. 3487.

Allied to Q. Blumeana, Korth., but this has solitary acorns and glabrous leaves.

This species is dedicated to my friend Mr. Skan of the Kew Herbarium staff, to whom we are indebted for much of our knowledge of the Oaks of China.

**Castanopsis Hystrix, A. DC.** Hongkong Herb. 3498. A notable extension of its known Chinese range, which only reached Yunnan.

**CONIFERÆ.**

*Cupressus* (§ *Chamaecyparis*) **Hodginsii**, Dunn, sp. n.

 Arbor 10–15 m. alta, omnino glabra. Rami paullo dependentes, in flabella foliosa lata gracilia complanati. Folia polymorpha, quaterna, inter se connata, ramulis adnata et eos omnino includentia, ramorum vetustiorum linearia, 7–8 mm. longa, apicibus breviter liber is cuspidatis, juniorum facialis et dorsalis cuneata, tricarinata, 8 mm. longa, cuspidata, lateralia alam lanceolatam acuminatam fere medio liberam formantia, sepe infra linea glauca notata. Conus squamis 12 decussatis peltatis apice excavatis formatus. Semina 8–10 plano-convexa vel obtusa trigona, ovalia, 4 mm. longa, acuta, basi obtusa, bialata, ala majora ovata 5 mm. longa, minore angusta apice paullo producta.

Woods about Yenping at 2000 feet (small trees not in flower or fruit). Hongkong Herb. 3505. Large trees in fruit near Foochow, Hodgins.

I am glad to have the opportunity of naming this fine tree after my friend Capt. Hodgins of the S.S. 'Haiching' of Hongkong, who has succeeded in procuring its cones from Foochow. Capt. Hodgins has been remarkably successful in obtaining specimens of scientific and economic interest from the neighbourhood of that port, and many of his collections are exhibited in the Hongkong Court of the Imperial Institute.

**ORCHIDACEÆ.**

*Microstylis minutiflora*, Rolfe, sp. n.

Herba pusilla, caule basi in pseudobulbunum parvum incrassato unifoliato.
Pseudobulbi subglobosi, 3–8 mm. lati. Folia petiolata, ovata vel suborbicularia, apiculata, 1–1.5 cm. lata; petiolus 5–8 mm. longus. Scapi graciles, suberecti, puberuli, 3–9 cm. longi; racemi multiflori; bracteae lineares, acutae, 0.5 mm. longae; pedicelli graciles, 1 mm. longi. Flores 1.5 mm. lati; sepala patentia, oblonga, obtusa; petala linearia, acuta, sepalis paullo breviora; labellum trifidum; lobi laterales lineares, acutis, divergentes, petalis paullo breviore; lobus intermedius triangulari-oblungus, subaequis, lobis lateralibus paullo major; columna brevis, alis minutis.

Damp rocks in shade, Yuen Fu Gorges, at 1800 ft. Hongkong Herb. 3545.

A very distinct species, and remarkable for its very minute flowers, whose structure is only made out with difficulty from dried specimens.

**Liparis Dunnii, Rolfe, sp. n.**
Herba circa 15 cm. alta, basi incrassata, diphylia. Folia breviter petiolata, ovato-oblonga, obtusa, membranacea, circa 13 cm. longa, 6 cm. lata. Scapus crassiusculus, 15–18 cm. altus; racemus multiflorus; bracteae ovatae, acutae, 2 mm. longae; pedicelli circa 1 cm. longi. Sepala divergentia, lineari-oblonga, acuta, subaequalia, circa 1 cm. longa; petala filiformi-linearia, acuta, 1 cm. longa; labellum orbiculari-obovatum, apiculatum, minutissime undulatum, 1 cm. longum, basi minute tuberculatum; columna clavata, incurva, 4 mm. longa.


This species somewhat resembles *L. pauciflora*, Rolfe, in habit and foliage, but has a much stouter, densely-flowered scape, and flowers about twice as large. The colour as recorded is unusual, and is not retained in the dried flowers. [I did not see these plants in a fresh state and cannot confirm the peculiar colour, but it was stoutly averred by the Chinese collector to be as stated.—S. T. D.]

**Phaius maculatus, Lindl.** Hongkong Herb. 3541. An addition to the known flora of China; it was previously recorded from India only.

**Dendrobium Aduncum, Wall.** Hongkong Herb. 3525. Previously recorded only from Kwantung and India.
longa; petala falcato-lanceolata, acuta, 1'-3 cm. longa; labellum trilobum, suborbiculare, 1 cm. longum; lobi laterales late falcato-oblongi, subacuti; lobus intermedius transverse oblongus, apice plicatus; discus bicarinatus; columna clavata, arcuata, 6-7 mm. longa; mentum obtusum, 3 mm. longum.

Rocky banks near Buong Kang. Flowers brownish yellow [S. T. D.].

Hongkong Herb. 3542.

Comparable with the Malayan Tainia latilingua, Hook. f., which has a very similar lip, though the latter is readily distinguished by its broad, very long-petioled leaves and larger bracts.

**Pholidota chinensis**, Lindl. Hongkong Herb. 3546.

A northern extension of the known area of the species, which was previously on record from Hongkong and the island of Hainan.

**Cynosorchis chinensis**, Rolfe, sp. n.

Herba valida, tubere ovoido-globoso, caule brevi saepissime monophylo. Folia subsessilia, oblonga vel elliptico-oblonga, subacuta, 3-5 cm. longa, 1-1.5 cm. lata, membranacea. Scapi graciles, erecti, glabri, 6-10 cm. longi, supra medium vagina lanceolata obtecta; racemi laxi, 5-12-flori; bracteae ovate vel ovato-lanceolatae, acuminatae, 2-5 mm. longae; pedicelli 5-7 mm. longi. Sepala subconniventia, ovata, subacuta, 3 mm. longa; petala sepalis similia, paullo ampliora; labellum trilobum, 5 mm. longum; lobi laterales obovato-oblongi; lobus intermedius obovatus, apice tridenticulatus; calcar gracile, 2 mm. longum; columna brevissima.


Near Cynosorchis gracilis, Kränzl. (Gymnadenia gracilis, Miq.), but the leaves proportionately shorter and broader, and the flowers rather larger and with broader segments.

**PALMÆ.**

**Calamus Hoplites**, Dunn, sp. n.

Frutex erectus, 2-3 m. altus, fortissime armatus. Folia oblonga, 2-3 m. longa, petiolis glabrescentibus, spinis validis paullo compressis 2-3 cm. longis armatis; segmenta linearia, chartacea, costis marginibusque spiculis vestita, infra ternatim opposita (an semper?), apice flabellatim aggregata. Panicula juvenis et vetusta tantum visa; juvenis 40 cm. alta; rami bracteis cinnamomeo-pulverulentis apice laceres 18 cm. longis vaginati. Alabastra 4 mm. longa, 2 mm. lata, extus striata. Rami paniculie evolutae 30 cm. longi, decurvati, pinnatim in spicas multas divergentes divisi.

Lower woods at Buong Kang near Yenping. Hongkong Herb. 3590.

Very near *C. thysonolepis*, Hance, but distinguished by the armature of the leaves as well as by its smaller flowers.

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HAEMODORACEAE.

*Aletris scopulorum*, Dunn, sp. n.

Herba perennis, 15–30 cm. alta, scaposa, rhizomate brevi, radices fibrosas copiosas emittentes. Folia radicalia, linearia, 6–12 cm. longa, 2–4 cm. lata, glabra, acuta. Scapa superne puberula, bracteis 2–4 linearibus 4–12 mm. longis in parte inferiori instructa. Racemus 5–8 cm. longus, sepe 10–15-florus. Flores 4–5 mm. longi; pedicelli 3 mm. longi; bracteae lineares pedicellis excedentes, omnes puberuli; calycis tubus hemisphaericus; lobi 6, tubum aequalis, lineares, acuti; stamina 6, sepalis opposita et eiusmod breviora; ovarium inferum, 3-loculare. Fructus loculicide apice dehiscens.

Damp rocks at Sui Kai Kau, near Foochow. *Hongkong Herb. 3556.*

Closely related to *A. glanduligera*, Franch., and differing only in its acute linear calyx-teeth and its short lower bracts.

IRIDACEAE.

*Iris speculatrix*, Hance. *Hongkong Herb. 3561.* An extension of the known range of this interesting “adventuress,” which was only recorded before from Kwantung.

DIOSCOREACEAE.

*Dioscorea rhizopogonoides*, Oliver. *Hongkong Herb. 3563.* On previous record only from the islands of Formosa and Hongkong.

D. *zingiberensis*, C. H. Wright. *Hongkong Herb. 3564–5.* Known previously only from the province of Hupeh.

LILIACEAE.

*Smilax levis*, var. *ophirensis*, A. DC. *Hongkong Herb. 3570.* Hitherto only gathered in Sumatra.

ARACEAE.

*Pinellia Browniana*, Dunn, sp. n.

Herba perennis, glabra, tuberosa, scaposa. Tuber ovale, 2–4 cm. longum, radices fibrosas copiosas emittentes. Folia triangularia vel oblongo-ovata, 15–25 cm. longa, membranacea, acuminata, basi cordata, imo acuta, auriculis paullo divergentibus rotundatis vel acutis, petiolis 15–25 cm. longis. Pedunculus 15–18 cm. longus; spatha viridis, 5–6 cm. longa, oblonga, obtusa, apice erecto vel nutans. Antherarum spica 8 mm. longa, spadice mire attenuato ad 20 cm. longo filiformi; ovarium 12 mm. longum, in uno latere ovulis plenum.
Damp woods at Fong Kong Tze near Foochow, Hongkong Herb. 3711. Wet rocks at Tam Chuk Hang near Foochow, Hongkong Herb. 3718. Although the leaves of the Fong Kong Tze plants have rounded lobes, while those of the specimens from Tam Chuk Hang are acute, giving the two forms a somewhat different facies, the divergence does not appear sufficient for the foundation of two species or even of two varieties. *P. cordata*, Brown, is allied. The trivial name commemorates the service to Chinese botany of Mr. N. E. Brown, the author of the account of the Aroids in Hemsley and Forbes’s “Enumeration” (Journ. Linn. Soc., Bot. xxxvi. (1903) 173-188).

**Pinellia cordata**, N. E. Br. Hongkong Herb. 3716-7. The known area of the plant is hereby extended southwards from Chekiang to Kiangsi.

**Acorus Calamus**, Linn. Hongkong Herb. 3713. Previously known no further south than Kiangsi.

**Cyperaceae.**

**Scirpus filipes**, C. B. Clarke. Hongkong Herb. 3606. Described from specimens collected in Fokien by De Grijs. It was found in great abundance in the gorge at Buong Kang, where it formed a dense growth on the steep, almost precipitous banks of the stream.

**Carex radiciflora**, Dunn, sp. n.

Caespitosa, scaposa. Folia gradatim acuta, 40-50 cm. longa, 2 cm. lata, margine scabra, basi fibris brunneis cineta. Culmi desunt. Spicarum 1 mascula et 2-3 foeminea, pedunculata cum multis bracteis imbricatis membranaceis ex rhizomate in fasciculo orthe, et ergo fere inter foliorum bases occuese; mascula 3 cm. longa, bracteis paullo longior, pedunculo 3-4 cm. longo; foeminea paullo breviores; glumae utriculis 3-plo breviores, rotundatae, medio trinerviae, mucronate. Stylus trifidus; utriculus 6-7 mm. longus, glaber, brunneus, opacus, striatus, in rostrum subito contractus; nux trigona, rostro cylindrico.

Among rocks at Siu Kai Kau, 1700 feet, near the Min River, about 80 miles above Foochow. Hongkong Herb. 3653. The inflorescence of this remarkable sedge, which in other respects approaches *C. Harlandi*, resembles the tuft that would be left if the flowering stem of one of the scapose sedges were drawn between the fingers so as to remove the bracts and spikes.

**Carex fokienensis**, Dunn, sp. n.

Glabra. Radix caespitosa, fibras copiosas circum culmos gerens. Folia 20-30 cm. longa, ad 5 mm. lata, marginibus venisque scabra. Culmi 25 cm.
longi foliosi. Bracteae longe vaginatae, inflorescentiam superantes, inferiores foliaceae, superiores filiformes. Spicarum 1 mascula, 25 mm. longa, 2–3 mm. lata, 5–9 femineae (paucae basi breviter masculae), 3–4 cm. longe, 10–12 mm. lata, pallide virides, pedunculis exsertis; glumae femineae ovate, acute, hyalinae, costa viridi, utriculo breviores. Stylus trifidus; utriculus patens, globosus, inflatus, 4–5 mm. longus, glaber, levis, in rostrum attenuatum.

Yenping Mountains at 3000 feet. Hongkong Herb. 3658 a.

**CAREX RIVULORUM, Dunn, sp. n.**

Rhizoma repens, foliorum veterum basibus bruneis vestitum. Folia radicale 80–90 cm. longa, 3 mm. lata, margine scabra, parte superiore in tulum externe scabrum, revoluta. Culmus se crispis, 70–100 cm. longus, basi foliis paucis, brevibus vaginatis, medio nudus, apice bracteis 3 laxe vaginati, vaginis levibus. Spicarum 1 mascula, terminalis, 8 cm. longa, 4 mm. lata, 2 parte inferiore femineae, apice masculae, 5–8 cm. longae; glumae femineae lanceolatae, acuminatae, amplexicaules, 9–11 mm. longe. Stylus trifidus; utriculus ascendens, ovalis, longe acuminatus, bruneus, striatus, 7–8 mm. longus.

Among rocks by mountain rivulets at Sui Kai Kau, near the Min. Hongkong Herb. 3651.

**CAREX GRACILIFLORA, Dunn, sp. n.**

Rhizoma repens, scapigerum. Folia 50–60 cm. longa, 7–8 mm. lata, glabra, supra scaberula, infra levia. Culmus 25–28 cm. longus, bracteis laxis membranaceis basi nodisque circiter 5 vaginati, nodo inferior a basi 6 cm., alis inter se superne gradatim minus distantes. Pedunculi 1–3-ni, bracteis semi- vel minus inclusi; spicis glabris, omnes basi breviter femineae, apice masculae 13–15 mm. longae; glumae femineae utriculo breviore, ovatae, obtuse, subovatae. Stylus 2-fidus; utriculus patens, ovalis, apice angustatus, decurvatus, haud rostratus, 2–3 mm. longus, fuscus, striatus, glaber.

By rivulets near the Min at Sui Kai Kau, 1200 ft. Hongkong Herb. 3657. Allied to C. brunnea, Thunb. Well marked when in fruit by its neat linear male spikes, each surmounting a few spreading utricles.

**CAREX GHANIFERA, Dunn, sp. n.**

Rhizoma cespitosum, fibras fuscas copiosas, circum folia gerens, scaposum. Folia glabra, 60–80 cm. longa, 6 mm. lata, supra scabra, subtus levia. Scapa 4–5 cm. longe, bracteis paucis scariosis imbricatis, basi vaginatae, spicam 1 masculam et 2 femineas in apice approximas gerentes; spicis bracteis breviter vaginantibus pedunculos includentibus paullo superatis, paniculose, ovatae, 10–15 mm. longae; glumae femineae lanceolatae, acuminatae, costa viridi, utriculis subaequales. Utriculus ovalis, trigonus, in rostrum æquilongum angustatus, stramineus, glaber, preter rostrum scaberrum levis.
EXPEDITION TO CENTRAL FOKIEN.

Woods at Tap Ling Ho near the Min River, some 80 miles above Foochow. Hongkong Herb. 3655.

The utricles have the peculiar shining yellow appearance of grains of barley.

*Carex cuspidosa*, Dunn, sp. n.

*C. cuspidosa*, glabra et præter apices foliorum culmorum glumorumque asperas levis, 40 cm. alta. Folia 15 cm. longa, 2 mm. lata. Culmi 20–30 cm. longi, foliosi, foliis panicis et bracteis inferioribus superati, apice 4–6 spicas approximatas, umam apice basique vel omnino masculam, alias apice masculas gerentes; bracteae amplexicaules vel brevissime vaginantes; spicæ 1 cm. longæ, masculæ anguste ovatae, fœminæ ovatae. Stylus trifidus; glumea fœminæ, præter infimas rotundate, retuse, costa viridi in cuspidem patentem, lamina longiorum et utriculum longe superantem excurrente; utriculus ovalis, apice angustatus, haud rostratus.

Banks of the Yuen Fu near Foochow. Hongkong Herb. 3643.

The spikes have a peculiar appearance in consequence of the long spreading points of the glumes.

*Carex transversa*, Bl. Hongkong Herb. 3654. Kiangsu and Chekiang were the previously known area of this sedge.

*C. ischnostachya*, Steud. Hongkong Herb. 3647. An addition to the Chinese flora, and in the province where it might have been expected to occur considering its range in Japan and the Liu Chiu Islands.

*C. Spachiana*, Boot. Hongkong Herb. 3618 and 3641. Previously supposed to be endemic to Kwantung.

GRAMINEÆ.

*Phyllostachys nigra*, Munro. Hongkong Herb. 4577. This Japanese bamboo has already been recorded from Szechuen, and is now found to be one of the most used of all the bamboos in Fokien.

(Communicated by W. Botting Hemsley, F.R.S., F.L.S.)

(With 4 Text-figures.)

[Read 19th March, 1908.]

Owing to the material recently collected by Mr. A. Henry and Mr. E. H. Wilson, it has become desirable to attempt a short account and enumeration of the species of the genus *Codonopsis* of the Natural Order Campanulaceae. Under the generic name of *Codonopsis* I have included *Codonopsis* of Wall, as enunciated in Roxburgh’s ‘Flora Indica,’ ed. Carey, vol. ii. p. 105, *Glosocomia* of D. Don, in his ‘Flora Nepalensis,’ p. 138, and many species which though obviously allied to both these genera could not be included under either of them.

An alternative would have been to have kept the original *Codonopsis* and *Glosocomia* distinct genera, but this would have entailed the making of several new genera for those species not coming under either, which have been brought to light by the above-mentioned collectors.

A comparison of the original descriptions of *Codonopsis* and *Glosocomia* shows these differences:—*Codonopsis* has sublinear filaments, a three-lobed stigma, and a three-celled ovary; *Glosocomia* has glabrous filaments dilated at the base, setose anthers, two-lobed stigmas, and a five-celled ovary. The characters of the stigma and ovary have no diagnostic value, as they have been found to vary from 3- to 5-merous in the same species; but with regard to the filaments, which is the only other stated difference, not only do the two distinct forms as given above occur, but also every intermediate stage between them. On these considerations, therefore, it has been thought best to group all the species together, retaining for them Wallich’s original name of *Codonopsis*.

As to the position of the genus in its extended form:—Following the divisions of Campanulaceae as given in Bentham & Hooker’s ‘Genera Plantarum,’ vol. ii. p. 557, it belongs to the tribe Campanuleae with the regular corolla and free stamens, and under the subdivision of those with dehiscent capsules, as opposed to those with indehiscent berries. The genera nearest allied to it are *Platycodon* of De Candolle, the only species of which is an erect, robust plant, with sessile leaves and very large flowers, while *Codonopsis* is a scandent or climbing herb, or at most only suberect with weak stems and nearly always pectioled leaves; *Leptocodon* of J. D. Hooker & Thomson, which differs in having five epigynous glands; and *Campanumera* of Blume, which has baccate fruit.

When Wallich described the genus in 1824 only three species were known, and one of them was so unlike the other two that he says he was of the opinion it ought to have been put in Polemoniaceae. He mistook the short sterile foliaceous branches for compound leaves, resembling those of *Polemonium*. 
The amount of variation in so small a genus, as is shown in the habit, leaves, and hairiness, which is here generally due to variation in habitat, is remarkable, but by far the most striking feature is the various combinations between the two outer floral whorls, and on this I have based the principal divisions of the genus. There are distinctly four—firstly, that with the calyx inferior and the corolla superior (fig. 1); secondly, where the calyx is semi-superior, the corolla still superior (fig. 2); thirdly, where the calyx and corolla are semisuperior (fig. 3); and fourthly, with the calyx superior (fig. 4).

So far as I can ascertain, this case has not been clearly stated before, but only passing allusions have been made to it. De Candolle, in his Monograph of the Campanulaceae in 1830, regards the calyx as an involucre, and I was inclined to that opinion myself at first. Those who have called it an involucre have regarded the calyx to consist of a slight rim or ridge running round the corolla at the point where the latter leaves the ovary.

The following facts support the view that these members form the true calycine whorl. On sections being taken through the corolla the rim or ridge can be seen to be in direct continuation with the rest of the corolla, and
there does not appear to be any trace of an abortive whorl. Moreover, the ridge is not visible in living flowers until the corolla is somewhat faded or pressed, and is merely an infolding of the lower part of the corolla-tube above a thickened basal portion. Again, the varying positions of the calyx are to be somewhat expected, as in some specimens examined the calyx-lobes were seen to be inserted in a distinct spiral and not in a whorl, showing that the insertion of each calyx-lobe is liable to vary. Another point in support of this is its position with regard to the other floral whorls. Its lobes invariably alternate with the corolla-lobes and are opposite to the stamens, while with an involucre one would rather expect its members to alternate with the calyx-lobes and so be opposite the corolla. The venation also is quite normal and does not point to any suppression of parts. There is therefore the calyx inferior, semi-superior, and superior. Similar cases are to be found in Campanum, in several of the Goodeniaceae, and in Lagenocarpus of Ericaceae (see Fl. Cap. vol. iv. p. 417).

The corolla beyond the varying adnation of the base of the tube is more or less constant. In one species, however, it is so deeply cleft as to give it the appearance of a polypetalous corolla. In one or two species also it possesses a projecting rim, generally marking a delimitation in colour, about halfway down on the inner side.

The colour of the corolla would suggest the mode of pollination in some species. For this purpose the genus might be separated into those with bright blue or other highly attractive colours, and those with a dull red or lilac inside and a glistening green outside. Of the latter I have observed one or two interesting points, especially in connection with C. lanceolata. In all the species the outside of the stigma-lobes is densely scabrid, and in the species under observation it was noticed that when the pollen is ripe—that is, before the stigma-lobes are open—the anthers are closely applied to this part of the stigma, after which they resume their normal positions against the corolla, but leaving their pollen on the outside of the stigma. Further homologous cases are mentioned and discussed under the heading of "Autogamy" in Kerner & Oliver’s Nat. Hist. Plants, vol. ii. p. 361. The disc of the flower at first is glistening with honey, and one invariably finds two or three ants inside. These points, coupled with the fact that these flowers generally have a rank smell, would suggest that they are pollinated by ants, flies, and such insects. Similar circumstances in other campamnulate flowers are mentioned by Kerner & Oliver, l. c. p. 163. The disc of the flower is frequently marked with a pentagon of a different colour, so that the minute colouring of the inside of the flowers is often very effective.

The roots of one of the species, Codonopsis Tangshen in particular, and others in a less degree, are extensively used in China for medicinal purposes owing to their "tonic and aphrodisiac properties." Full accounts of this have already appeared in Hooker’s 'Icones Plantarum,' t. 1966, and in the
Kew Bulletin, 1907, p. 9; and I cannot do better than refer to them. Some species, too, have been noticed to contain a milky juice, but as only a few species are known in the living state it is uncertain whether it exists throughout the genus.

The majority of species of Codonopsis in cultivation appear quite hardy and do not require any special attention, although otherwise they scarcely recommend themselves to the gardener owing to their unattractive appearance. One species C. convolvulacea, which is distinctly the prettiest in cultivation, requires some protection and is perhaps more suitable for pot-culture, see Bot. Mag. tab. 8178. The remaining species in cultivation are: C. lanceolata, C. ovata, C. rotundifolia, C. ussuriensis, C. Tangshen, and C. viridiflora.

As to the distribution of this genus:—Owing to the small amount of material at present to hand we can form only a general idea; but this, however, is very interesting and shows that the genus is found almost exclusively at considerable elevations, sometimes reaching an altitude of 13,000 feet. The general area marked out at present is a semicircular band, having its most north-easterly station yet recorded in the north of the Sikhora Alin Mts., on the watershed of the river Amur, about 141° E. and 51° N., thence running along these mountains as far south as Vladivostock. One specimen has been recorded from the mountains near Pekin. It next appears on the mountains of the northern island of Japan, and passes along the mountains in the centre of the south island. There is then a slight break in the line, as its next station is in the mountains of western Hubei, and thence seems to be generally spread over the Yung-ling Mts. as far as the province of Kansu to the north and down through Yunnan in the south. It can then be traced through the mountains of the Shan States in Northern Burma, where it reaches its southernmost point at a latitude of 21° N., to the Khasia Hills of Assam. It is next recorded from the Phari and Chumbi district, and also further north from the Tsangypa watershed and Lhasa. It has been collected all along the southern slopes of the Himalayas through Kashmir to the watershed of the Kurram River in Afghanistan, and its most western representative yet recorded is from the Alexandrovski and Alatau Ranges in Russian Turkestan at about 79° E. and 43° N.

One cannot help thinking from the striking variation in the small amount of material at present available, and the large, though not as yet always connected, area of distribution, that this will probably prove a large and remarkable genus.

My thanks are due to Mr. L. A. Boodle for having examined the morphology of the floral whorls, and to Mr. F. W. Rolfe for the accompanying figures.


Claris Specierum.

| Calyx inferus | 1. Tangshen. |
| Calyx semisuperus | |
| Folia ad apicem ramorum lateralium 3–4 fasciculata. | |
| Semina alata | 2. lanceolata. |
| Semina non alata | 3. asseviensis. |
| Folia opposita vel alterna. | |
| Stamina setosa. | |
| Folia non excedentia 1 cm. longitudinis. | |
| Corolla 3–4 cm. longa; filamenta 16–17 mm. longa. | 4. mollis. |
| Corolla 2–3 cm. longa; filamenta 10 mm. longa. | 5. thalictri folia. |
| Stamina glabra. | |
| Corolla non excedens 9 mm. longitudinis. | 7. micrantha. |
| Corolla saltem 17 mm. longa. | 8. rotundifolia. |
| Scandentes vel volubiles. | |
| Non scandentes nec volubiles. Caules fertiles robusti, steriles numerosi a basi orti. | |
| Folia sinuata | 9. viridiflora. |

† [After this paper was read, and whilst it was still in the printers' hands, a critical revision of this genus was published by Mr. W. Komarov in Act. Hort. Petrop. vol. xxix. As far as it is necessary the new specific names published by him have been adopted.—T. F. C.]
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Folia integra vel obscure serrate.
Folia 5-9 mm. longa .................. 10. fletens.
Folia 15-40 mm. longa ................ 11. ovata.
Folia integra marginibus albidis crassis instructa ... 12. cardiophylla.

** Corolla semisupera.
Scandentes vel volubiles.
Stamina glabra.
Calycis lobi linearis, sinu obtuso saltem 5 mm. lati
sejuncti ......................... 13. viridis.
Calycis lobi triangulares, sinu obtuso 1 mm. latitudinis
Calycis lobi late ovati, sinu acuto sejuncti .......... 15. deltoides.
Stamina pilosa.
Ovarium pilosum ........................ 16. tubulosa.
Ovarium glabrum ..................... 17. pilosa.

Non scandentes nec volubiles.
Pedunculi primarii saltem 30 cm. longi ........ 18. subescaposa.
Pedunculi primarii non excedentes 13 cm. longitudinis ... 19. subsimplici.

Calyx superus.
Corolla ad basin divisa .................. 20. concordulacea.
Corolla non quam ultra dimidium divisa.
Calycis lobi sinu late obtuso sejuncti .......... 21. affinis.
Calycis lobi sinu acuto sejuncti ........ 22. purpurea.

1. CODONOPSIS TANGSHEN, Oliver in Hook. f. Icon. Pl. xx. (1891) t. 1966.—
  Caules volubiles, glabri. Folia alterna vel opposita, lanceolata, basi attenuata
  vel truncata, obtusa, obtusa serrata, pubescentia vel glabra, ciliata, 5-8 cm.
  longa, 2-3 cm. lata; petioli glabri, 1-3 cm. longi. Flores solitarii, axillares,
  extra-axillares vel foliis oppositi; pedunculi glabri, 3-4 cm. longi. Calyx
  inferus, fere ad basin divisus; lobi oblongi, acuti, glabri, 18-24 mm. longi,
  5-7 mm. lati. Corolla supera, campanulata, viridis, purpureis maculis in-
  structa; tubus glaber, 1-5-2 cm. longus, siccitate apice 2-5-3 cm. diam.;
  lobi triangulares, acuti, 6-10 mm. longi, 6-10 mm. lati. Filamenta glabra,
  7-8 mm. longa; antherae glabrae, 4-5 mm. longae. Stylus glaber, purpureus;
  stigma 3-5-lobata. Ovarium inferum, siccitate 5-14 mm. diam.; loculi 3-5.
  Capsula conica, viridis vel purpurea, siccitate 2-2-5 cm. diam. Semina
  elliptica, levia, atro-brunnea, 1-1-5 mm. longa, 0-5-1 mm. lata.—Hemsl. in
  China: Hupeh, Henry, 6468 !, Wilson, 1623 !.

  The root of this species is extensively used for its medicinal properties, vide
  Oliver, l.c. The flowers have a rather disagreeable cabbage-like smell.

2. CODONOPSIS LANCEOLATA, Benth. & Hook. f. Gen. Plant. vol. ii. (1876)
  p. 557.—Caules glabri vel sparsim pilosi. Bracteae basi ramorum lateralis
  inserte, lineari-lanceolata, 8-15 mm. longae, 3-7 mm. latae. Folia ad apices
  brevium lateralis ramorum fasciculata, lanceolata, acuta vel obtusa, basi


The root of this species is mentioned by Planch. *l.c.* as having a bitter taste, and is used for medicinal purposes.

3. **CODONOPSIS USSURIENSIS**, Hemsl. in Journ. Linn. Soc. Bot. vol. xxvi. (1889) p. 6.—Canes glabri vel ad nodos sparsim pilosi. *Bracteae* basi ramorum lateralium glabrae vel pilosae, lanceolatae, acute, 15-25 mm. longae, 5-10 mm. late. *Folia* ad apices brevivum laterali ramorum fasciculata, lanceolata vel elliptica, integra, acuta vel obtusa, basi attenuata, supra glabra, subitus glabra vel sparsim pilosa, minute ciliata, 3-5 cm. longa, 1-5-2-5 cm. lata; petioli glabri vel pilosi, 2-5 mm. longi. *Flores* terminales; pedunculi breves, glabri, 1-2 cm. longi. *Calyx* semisuperus; tubus hemisphericus, glaber, 15-25 mm. longus; lobi lanceolati, acuti, glabri, 1-2 cm. longi, 6-8 mm. lati. *Corolla* supera, campanulata; tubus 16-20 mm. longus, siccitate 2-2-5 cm. diam.; lobi triangulares, acuti, 5 mm. longi, 3-5 mm. lati. *Filamenta* glabra, basi parum dilatata, 4 mm. longa; antherae glabrae, 2-3 mm. longae. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 8-15 mm. diam.

Manchuria: Amur, Maximowicz!

4. CODONOPSIS MOLLIS, Chipp.—Caules fertiles, subrobusti, pilosi, circ. 17 cm. longi; steriles graciles, dense pilosi, circ. 7 cm. longi. Folia alterna vel opposita, subsessilia, ovata, basi subcordata, obtusa, integra, dense hirsuta, 8–10 mm. longa, 7–10 mm. lata. Flores terminales; pedunculi sparsim pilosi, circ. 3 cm. longi. Calyx semisuperus; tubus hemisphaericus, sparsim pilosus, circ. 3 mm. longus; lobi sinus obtusus; ovati, apice dense hirsuti, 5 mm. longi, 3–4 mm. lati. Corolla supera, cylindrico-infundibuliformis; tubus venis sparsim hirsutus, 38 mm. longus, siccitate basi 8 mm. diam., apice 20 mm. diam.; lobi triangulares, acuti, glabri, 5 mm. longi, 7 mm. lati. Filamenta basi parum dilatata, glabra, 16–17 mm. longa; anthere carinate 6 mm. longe; carina setis vestitæ. Stylus glaber; stigma late 3-lobum. Ovarium semi-inferum, siccitate circ. 10 mm. diam.

Tibet: Hills above Lhassa, Capt. Walton!
I have not seen the fruit of this species. It differs from C. thalictrifolia in having a longer corolla, longer filaments, and more hirsute and larger leaves.

5. CODONOPSIS THALICTRIFOLIA, Wall. in Roxb. Fl. Ind. vol. ii. p. 106. —Caules fertiles subrobusti, sparsim pilosi vel glabri, 20–30 cm. longi; steriles gracillimi, pilosi, 4–6 cm. longi. Folia opposita vel alterna, rotundata, basi subcordata vel truncata, integerrima, dense hirsuta vel scabrida, 3–5 mm. longa, 3–5 mm. lata; petioli hirsuti, raro 2 mm. longi. Flores terminales; pedunculi pilosi vel breviter hirsuti, 3–16 cm. longi. Calyx semisuperus, hemisphaericus; tubus glaber vel minute scabridus, 3–4 mm. longus; lobi sinus subobtusus sejuncti, oblongi, obtusi, integri, minute scabridi, 6–7 mm. longi, 2–3 mm. lati. Corolla supera, cylindrico-infundibuliformis, cerulea; tubus glaber, 18–23 mm. longus, siccitate basi 6–9 mm. diam., apice 15–23 mm. diam.; lobi triangulares, subobtusus, integri, 3–4 mm. longi, 7–9 mm. lati. Filamenta basi parum dilatata, glabra, 1 cm. longa; anthere carinate 3 mm. longae; carina setis vestitæ. Stylus glaber; stigma late 3-lobum. Ovarium semi-inferum, siccitate 6–10 mm. diam. Capsula (?) conica.—Benth. in Royle, Illust. Bot. Himal. p. 253; Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 16; Hook. f. Fl. Br. Ind. vol. iii. p. 432. Glosocomia tenera, D. Don, Prod. Fl. Nepal. p. 158. G. thalictrifolia, Wall. Cat. n.1297. Wahlen-
Mr. T. F. Chipp: A Revision of


I have not seen this species in fruit.

6. Codonopsis Benthami, Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 14.—Caules robusti, pilosi. Folia opposita vel alterna, ovata vel lanceolata vel deltoidea, basi truncata vel attenuata, subobtusa vel acuta, grosse serrata, breviter hirsuta, 6-10 cm. longa, 4-5.5 cm. lata; petioli sparsim pilosi, 20-35 mm. longi. Flores terminalis; pedunculi pilosi, 2-8 cm. longi. Calyx semisuperus; tubus hemisphaerius vel obconicus, glaber, 3-6 mm. longus; lobi imbricati, rotundati vel late ovati, breviter acuminati, ciliati, 10-12 mm. longi, 10-12 mm. lati. Corolla supera, campanulato-cylindrica; tubus hemisphaericus vel obconicus, glaber, 3-5 mm. longus; lobi triangulares, acuti, glabri, 3-5 mm. longi, 3-5 mm. lati. Filamenta e basi glabra dilatata, subulata, densissime pilosa, 7 mm. longa; antherae carinate, 4 mm. longae; carinae setis vestita. Stylus glaber; stigma late 3-lobum. Ovarium semi-inferum, siccitate 8-13 mm. diam. Capsula conica; valvae 3, 6-8 mm. longae. Semina oblonga, 1 mm. longa, 0·5-0·8 mm. lata.

India: Sikkim, 9000-11,000 ft., J. D. Hooker! Clarke, 1879 A! 10001! 10224 A! Sikkim frontier, Sim-doong-tang, Dunghoo!

Hooker mentions this plant as having “a heavy, almost rank, hircine smell.”

7. Codonopsis micrantha, Chipp.—Caules glabri, ad nodos pilosi. Folia opposita vel alterna, ovata, basi cordata, acuta vel obtusa, grosse serrata, sparsim pilosa, 5-8 cm. longa, 2-5-3 cm. lata; petioli glabri vel sparsim pilosi, 2-4 cm. longi. Flores axillares; pedunculi glabri, 1-2 cm. longi. Calyx semisuperus; tubus hemisphaericus, glaber, 5-7 mm. longus; lobi sinu acuto sejuncti, triangulares, acuti, glabri vel minute ciliati, 12-14 mm. longi, 4-5 mm. lati. Corolla supera campanulata; tubus glaber, 4-5 mm. longus, siccitate 7-9 mm. diam.; lobi triangulares, glabri vel ciliati, acuti, 3-4 mm. longi, 2-3 mm. lati. Filamenta glabra, basi dilatata, 3 mm. longa; antherae glabrae, 2 mm. longae. Stylus glaber; stigma late 3-lobum. Ovarium semi-inferum, glabrum, siccitate 6-7 mm. diam. Capsula conica; valvae 3 mm. longae. Semina ovoidea, levia, candida, 1 mm. longa, 0.5 mm. lata.

China: Yunnanfu, Duclaux, 513!

This species differs from C. ovata, Benth., in having deeply cordate, coarsely serrate leaves, long petioles, and the corolla under 10 mm. long.

8. Codonopsis rotundifolia, Royle, Illustr. Bot. Himal. p. 254, t. 62.—Caules glabri vel pilosi. Folia opposita vel alterna, rotundata vel ovata, basi truncata vel cordata, grosse serrata, obtusa vel subacuta, glabra vel ad venas sparsim hirsuta, 4-8 cm. longa, 3-6·5 cm. lata, petioli hirsuti, 1-3 cm. longi.
Flores foliis oppositi; pedunculi glabri vel sparsim hirsuti, 1-3 cm. longi. Calyx semisuperus; tubus obconicus, glaber, 3-5 mm. longus; lobi sinu acuto sejuncti, ovati, acuti vel subacuti, integr i vel grosse serrati, glabri vel hirsuti, ciliati, 14-16 mm. longi, 8-11 mm. lati. Corolla supera, campanulata, pallide cerulea, lilacinis purpureis maculis instructa; tubus glaber, 14-17 mm. longus, siccitate ad apicem 17-22 mm. diam.; lobi late triangulares, acuti, 5-6 mm. longi, 7-10 mm. lati. Filamenta basi dilatata, glabra, circ. 4 mm. longa; antherae glabre, circ. 3 mm. longae. Stylus glaber; stigma late 3-lobum. Ovarium semi-inferum, siccitate 10-12 mm. diam. Capsula conica; valvae 3, 8-10 mm. longae. Semina oblonga, candida, 2 mm. longa, 0.8-1 mm. lata.


The variety grandiflora, Hook. in Bot. Mag. 5018, I have not considered sufficiently distinct to retain.

9. CODONOPSIS VIRIDIFLORA, Maxim. in Bull. Acad. Pétersb. xxvii. (1881) p. 496.—Caules sparsim hirsuti. Folia alterna, ovata vel lanceolata, basi subcordata, sinuata, obtusa, breviter setosa, 15-35 mm. longa, 13-25 mm. lata; petioli hirsuti, 7-10 mm. longi. Flores terminales; pedunculi glabri vel sparsim hirsuti, 6-13 cm. longi. Calyx semisuperus; tubus hemisphaericus, ovario omino adnatus, glaber, circ. 3 mm. longus; lobi sinu acuto sejuncti, ovati, grosse serrati vel sinuati, obtusi, ciliati, apice minute setosi, 12-15 mm. longi, 6-7 mm. lati. Corolla supera, campanulata, luteo-viridis; tubus glaber, circ. 1 mm. longus, siccitate circ. 15 mm. diam.; lobi late triangulares, subobtusi, circ. 7 mm. longi, circ. 7 mm. lati. Filamenta glabra, basi dilatata, 5 mm. longa; antherae glabre, 5 mm. longae. Stylus glaber; stigma late 3-lobum. Ovarium (semi-inferum?), siccitate circ. 13 mm. diam.

CHINA: Kansu, Przevalski!

10. CODONOPSIS FETENS, Hook. f. et Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 16.—Caules fertiles subrobusti, pilosi, 30-50 cm. longi; steriles gracillimi, densissime pilosi, 4-7 cm. longi. Folia alterna vel opposita, rotundata, basi truncata vel subcordata, obtusa, integerrima, densissime setosa, 5-9 mm. longa, 5-10 mm. lata; petioli setosi, raro 2 mm. longi. Flores terminales;
pedunculi glabri vel pilosi, sepe bractea instructa, 4–20 cm. longi. *Calyx* semisuperus; tubus hemisphericus, sparsim pubescens vel pilosus, 3–4 mm. longus; lobi sinu obtuso sejuncti, lanceolati vel oblongi, acuti, integri, sinuati vel serrati, extus dense intus sparsim pilosi, 7–13 mm. longi, 2–7 mm. lati. *Corolla* supera, campanulata; tubus glaber, 10–15 mm. longus, siccitate 20–30 mm. diam.; lobi late triangulares, acuti vel obtusi, 5 mm. longi, 7–10 mm. lati. *Filamenta* glabra, basi dilatata, 3 mm. longa; antherae glabrae, 4 mm. longae. *Stylus* glaber; stigma 3-lobum. *Ovarium* post anthesin semi-inferum, siccitate 10–15 mm. diam. *Capsula* conica; valvæ 3, 11–15 mm. longae. *Semina* oblonga, levia, 1.5–2 mm. longa, 0.8–1 mm. lata. — Hook. f. Fl. Br. India, vol. iii. p. 433.

**TIBET:** near Choun, King's collector! Chumbi and Phari, Sham Chen, and 18 miles N.W. of Chumbi, Dungboo! Yatung, Hobson! India: Sikkim, 14,000–10,000 ft., Hooker f. China: Tachienlu, Sousli, 125 ! 540 ! Pratt, 531!


**INDIA:** Kashmir, Falconer, 618 ! 9–500 ft., Thomson! Aitchison, 5 ! 60 ! Clarke, 29251 B ! Sousal nala, Duthie, 13355 ! Chamba, Pangi Valley, Ellis, 5 ! Punjab-Himalaya, Lahul, Jaeschke, 50!
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Var. cuspidata, Chipp. Calycis tubus totus ovario adnatus; lobi sinu acute sejuncti, 10-17 mm. longi. Corolla campanulata; tubus siccate 20-30 mm. diam.; lobi cuspidati.


Var. obtusa, Chipp. Calycis tubus ovario omnino adnatus; lobi sinu obtuso sejuncti. Corolla campanulata; lobi triangulares, acuti.


Var. nervosa, Chipp. Calycis tubus paululo ultra ovarium productus, superne nervorum anamostosantium annulo instructus, 3-4 mm. longus; lobi sinu obtuso sejuncti. Corolla campanulata; lobi triangulares, acuti.

China: Wilson, 3984! Tachienlu, Pratt, 032!

Owing to the remarkable degree of variation presented by the leaves, as shown by material recently received, I have been unable to retain the varieties B. ramossima, Hook. f. & Thorns, in Journ. Linn. Soc. vol. ii. (1858) p. 15, and glabrata, Hook. f. MSS., which were founded on these characters. Lindley mentions this species as having a strong “hircine smell.”

12. CODONOPSIS CARDIOPHYLLA, Diels, ex Kom. in Act. Hort. Petrop. xxix. (1908) p. 117.—Caules fertiles robusti, glabri vel sparsim pilosi, 40-50 cm. longi; sterilis subrobusti, glabri, 10-17 cm. longi. Folia opposita vel alterna, ovata vel lanceolata, basi cordata, obtusa, integra, supra glabra, subtus ad venas sparsim pilosa, 2-3 cm. longa, 2-2.5 cm. lata, marginibus albis crassis; petioli glabri vel hirsuti, raro 2 mm. longi. Flores 1-4, terminales; pedunculi glabri vel pilosi, 6-12 cm. longi. Calyx semisuperus; tubus hemisphericus, glaber, 4-5 mm. longus; lobi sinu acute sejuncti, late lanceolati vel triangulares, obtusi, integri, glabri vel pubescentes, 10-12 mm. longi, 4-5 mm. lati. Corolla supera, campanulata, purpureo-maculata; tubus glaber vel sparsim pilosus, 15-17 mm. longus, siccate 20-22 mm. diam.; lobi ovati, acuti, pilosi, 10-12 mm. longi, 10 mm. lati. Filamenta linearia, basi dilatata, glabra, 6-7 mm. longa; antherae glabrae, 5 mm. longae. Stylus glaber; stigma 3-lobum. Ovarium semi-inferum. Capsula conica, siccate 8-10 mm. diam.; valvae 5-7 mm. longae. Semina levia, 1-1.5 mm. longa, 0.5 mm. lata.

China: Hupeh, Wilson, 2381!

LINN. JOURN.—BOTANY, VOL. XXXVIII. 21E
This species differs from *C. ovata*, Benth., in having a thickened white margin to the leaves.


*Canes volubiles*, labri vel minute pubescentes. *Folia opposita vel alterna, lanceolata, basi attenuata vel subruncinata, acuta, integra, supra minute pubescentia, subulata dense pubescetia, 5–10 cm. longa, 2.5–5 cm. lata; petioli dense pubescentes, 1–2 cm. longi*. *Flores foliis oppositi vel suboppositi; pedunculi pilosi, 3–7 cm. longi*. *Calyx superus; tubus hemisphaericus, minute pubescentes, 6–9 mm. longus; lobi sinu obtuso saltem 5 mm. late sejuncti, lineares, acuti, dense pubescentes, 10–17 mm. longi, 1–1.5 mm. lati.*


**India**: Nepal, Wallich! Kumaon, Wallich! 7000 ft. Madden! Strachey & Winterbottom! Garhwal, Shioli, Edgeworth!


**India**: Khasia, 5000–6000 ft., Hook. f. & Thoms. Lobb! Clarke, 6300! 16301! 44896!

This plant does not appear to me to be specifically different from *C. viridis*, Wall., and Clarke himself states that it may be only a geographical variety. The seeds generally glisten as in *C. viridis*; but this appears to be a variable character.


*Canes glabri vel ad nodos pubescentes*. *Folia alterna vel opposita, lanceolata, basi attenuata, acuminata, grosse serrata, pubescetia, 9–14 cm. longa, 3–6 cm. lata; petioli pubescentes, 10–18 mm. longi*. *Flores axillares; pedunculi glabri vel pubescentes, 7–30 mm. longi*. *Calyx semisupera; tubus glaber vel pubescentis, 4–6 mm. longus; lobi reflexi, sinu obtuso sejuncti, triangulares, acuti, pubescentes, ciliati, 10 mm. longi, 3–7 mm. lati.*

*Corolla semisupera, tubuloso-campanulata, extus purpurea, intus alba; tubus glaber vel pubescentis, 17 mm. longus, siccitate apice 20 mm. diam.;
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lobi triangulares, acuti, 6-7 mm. longi, 6-7 mm. lati. Filamenta basi dilatata, glabra, 7 mm. longa; antherae glabrae, 5 mm. longae. Stylus glaber; stigma 3-lobum. Ovarium semi-inferum, siccitate 10-11 mm. diam.

China: Hupeh, Henry, 6651!
I have not seen the fruit of this species.

15. CODONOPSIS DELTOIDEA, Chipp.—Caules glabri vel sparsim pilosi. Folia opposita, ovata, basi truncata vel subcordata, obtuse acuminata, obtuse grosse serrata, sparsim pilosa vel hirsuta, 7-10 cm. longa, 5-10 cm. lata; petioli pilosi vel hirsuti, 3-8 cm. longi. Flores axillares; pedunculi pilosi, 1-2 cm. longi. Calyx semisupera; tubus glaber, 2-3 mm. longus; lobi sinu subobtuso sejuncti, triangulares, acuti, glabri, ciliati, 6-15 mm. longi, 3-5 mm. lati. Corolla semisupera, cylindrica; tubus basi ovario non adnatus, glaber, 15 mm. longus, siccitate 10-15 mm. diam.; lobi triangulares, acuti, 4 mm. longi, 5 mm. lati. Filamenta subulata, ad basin parum dilatata, glabra, 10-11 mm. longa; antherae glabrae, 3 mm. longae. Stylus glaber; stigma 4-5-lobum. Ovarium semi-inferum, siccitate 8-10 mm. diam. Capsula conica; valvae 4-5, 6-9 mm. longae. Semina ovoidea, candidissima, 1 mm. longa, 0.7 mm. lata.

China: Mt. Omi, Wilson, 3988! 5035!
This species differs from C. Benthami, Hook. f. & Thoms., in having perfectly glabrous stamens and axillary flowers.

16. CODONOPSIS TUBULOSA, Kom. in Act. Hort. Petrop. xxix. (1908) p. 112. — Caules glabri vel ad nodos pilosi. Folia alterna vel opposita, lanceolata, basi attenuata vel subtruncata, obtusa, integra vel minute serrata, supra pubescentia, subtus dense pubescentia, 6-8 cm. longa, 3-4 cm. lata; petioli pilosi, 2-5 mm. longi. Flores 1-3 terminales; pedunculi pilosi, 2-12 cm. longi. Calyx semisupera; tubus obconicus vel hemisphaericus, glaber, 3-5 mm. longus; lobi imbricati, sinu acuto sejuncti, ovati, obtusi, glabri vel sparsim pilosi, ciliati, 7-11 mm. longi, 6-10 mm. lati. Corolla semisupera, tubulosa; tubus glaber, 20-22 mm. longus, siccitate 6-10 mm. diam.; lobi triangulares, acuti, 4-5 mm. longi, circ. 5 mm. lati. Filamenta ciliata, basi glabra dilatata, 10-11 mm. longa; antherae carinatae 3-4 mm. longae; carina setis cristata. Stylus subglaber vel pilosus; stigma 3-lobum; lobi attenuati. Ovarium semi-inferum, densissime pilosum, siccitate 10-15 mm. diam. Capsula conica; valvae 3, 10-12 mm. longae. Semina levia, 1-1.5 mm. longa, 0.5-0.8 mm. lata.

China: Yunnan, Henry, 10167 A!
This species differs from C. pilosa, Chipp, in having a pilose style and ovary, and having the undersurface of the veins of the leaves subglabrous; and from C. affinis, Hook. f. & Thoms., in having a tubular corolla and an acute sinus between the calyx-lobes.
17. **Codonopsis pilosa**, Chipp.—*Caules* glabri vel ad nodos sparsim hirsuti. *Folia* opposita vel alterna, lanceolata, subacuta, basi attenuata, integra vel minute crenata, hirsuta, circ. 5 cm. longa, circ. 3 cm. lata; petioli glabri vel hirsuti, 3-4 mm. longi. *Flores* terminales; pedunculi hirsuti, 16-35 mm. longi. *Calyx* semisuperus; tubus obconicus, glaber, 2-3 mm. longus; lobi imbricati, sinu acuto sejuncti, ovati, subobtusi, dense ciliati, 8-10 mm. longi, 5-6 mm. lati. *Corolla* supera, tubulosa; tubus glaber, 3 cm. longus, siccitate basi 7-8 mm. diam., apice circ. 15 mm. diam.; lobi triangularis, 4-5 mm. longi, 6-7 mm. lati. *Filamenta* et basi glabra dilatata subulata, densissime pilosa, 13-14 mm. longa; antherae muticie, carinate, 5-6 mm. longe; carina setis cristata. *Stylus* basi glaber, supra densissimae pilosus; stigma 3-lobum; lobi attenuati. *Ovarium* semi-inferum, siccitate 10 mm. diam. *Capsula* conica.

**China**: Yunnan, Hancock; 379

I have not seen the mature fruit of this species. The species is distinguished from *C. tubulosa*, Kom., by its glabrous ovary, but more densely pilose style and filaments, and by having a line of setae along the undersurface of the leaf-veins.

18. **Codonopsis subscapos*, Korn. in Act. Hort. Petrop. xxix. (1908) p. 114.—*Caules* fertiles robusti, pilosi, 40-80 cm. longi; steriles gracillimi, pilosi, non excedentes 7 cm. *Folia* alterna, elliptica vel lanceolata vel ovata, obtusa, grosse serrata, hirsuta, 5-8 cm. longa, 2-3 cm. lata; petioli sparsim hirsuti, 1-5-3 cm. longi. *Flores* terminales; pedunculi primarii robusti, glabri vel sparsim pubescentes, 30-90 cm. longi; bracteae lanceolatae, obtuse, minute ciliatae vel hirsuta, 1-2 cm. longe. *Calyx* semisuperus; tubus sparsim pubescens, 5-7 mm. longus; lobi lanceolati, obtusi, serrati, apice minute scabridi, 7 mm. longi, 3 mm. lati. *Corolla* semisupera, infundibuliformis-campanulata; tubus glaber, circ. 13 mm. longus, siccitate fauce circ. 20 mm. diam.; lobi triangulares, acuti, ciliati, 1 cm. longi, 1 cm. lati, siccitate apice 2-5-3 cm. diam. *Filamenta* glabra, 5-6 mm. longa; antherae glabre, 4-5 mm. longae. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 1 cm. diam. *Capsula* conica.

**China**: Tachienlu, 9000-13,500 ft., Pratt, 474! Kiala, Tongolo, Soulé, 426! 11,000-12,500 ft., Wilson, 3985!

I have not seen the mature fruit of this species.

19. **Codonopsis sub simplex**, Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 16.—*Caules* glabri vel ad nodos pubescentes. *Folia* opposita vel alterna, ovata vel lanceolata, basi attenuata vel truncata, grosse serrata vel crenata, acuta vel subobtusa, 3-5 cm. longa, 2-3 cm. lata; petioli glabri vel pubescentes, 10-20 mm. longi. *Flores* 1-3 terminales; pedunculi glabri, 6-13 cm. longi. *Calyx* semisuperus; tubus glaber, 1 cm. longus; lobi
THE GENUS CODONOPSIS, WALL. 389

imbricati, sinu acuto sejuncti, lanceolata vel ovata, acuta vel subacuminata, serrata, glabra, 13-15 mm. longa, 5-10 mm. lata. Corolla semisupera, cylindrico-campanulata, lutea, viridibus albidisque maculis notata; tubus glaber, 11-12 mm. longus, siccitatus apice 10-12 mm. diam.; lobi triangulares, acuti vel subobtusi, 2-3 mm. longi, 3-5 mm. lati. Filamenta glabra, 6 mm. longa; antherae glabrae, 4 mm. longae. Stylus glaber; stigma late 3-lobum. Ovarium semi-inferum, siccitatum 11-12 mm. diam. Capsula conica; valvae 3, circ. 4 mm. longae. Semina levia, atro-brunnea, 1-1.5 mm. longa, 0-8-1 mm. lata.—Hook. f. Fl. Brit. India, vol. iii. p. 432.

TIBET: Chumbi, Gook, Dungboo! Yatung, Hobson! INDIA: Sikkim, 12,000-13,000 ft., Hooker f. ! Darjeeling, Singalela, Clarke, 12542 ! 13450 !

20. CODONOPSIS CONVOLVULACEA, Kurz, in Journ. Bot. vol. xi. (1873) p. 195.—Caules volubiles, glabri. Folia opposita vel alterna, ovata vel lanceolata, basi attenuata vel cordata, obtusa, glabra vel sepe minute ciliata, 20-50 mm. longa, 4-30 mm. lata; petioli glabri, 2-12 mm. longi. Flores terminales; pedunculi glabri, 2-12 cm. longi. Calyx superus; tubus obconicus, glaber, 3-7 mm. longus; lobi sinu subobtusus vel acutus sejuncti, triangulares vel lanceolati, acuti vel subobtusi, glabri vel minute ciliati, 4-11 mm. longi, 1-5 mm. lati. Corolla supera, campanula, cerulea, fere ad basin divisa, siccitata 25-40 mm. diam.; lobi triangulares vel ob lanceolati, acuti vel sepe minutissime mucronati, 10-33 mm. longi, 6-12 mm. lati. Filamenta ad basin dilatata et intus appendice ciliata instructa, cetera glabra, 1-2 mm. longa; antherae glabrae, 1-5 mm. longae. Stylus glaber; stigma 3-lobum. Ovarium inferum, siccitatum 4-10 mm. diam. Capsula truncata vel subconica; valvae 3, circ. 4 mm. longae. Semina brunea, 1-5 mm. longa, 0-5 mm. lata.—Hook. f. Fl. vol. xxiv. t. 2385; Hemsl. in Journ. Linn. Soc. vol. xxxvi. (1904) p. 468; Bot. Mag. t. 8178. C. vinciflora, Kom. in Act. Hort. Petrop. xxix. (1908) p. 103.

CHINA: Yunnan, Mengtze, 5000-6500 ft., Hancock, 74! 385! 4500 ft., Wilson, 3986! between Batang and Tachienlu, Consul-General Hosie! TIBET: Tsanypo Valley, 13,000 ft., Waddell! Walton! Lhasa, Dungboo! BURMA: Shan States, Koni district, 4000 ft., Collett, 917! Melville, 45!

Wilson’s No. 9425 at Kew, from Yunnan, China, consists of three stems, two bearing leaves only and one flowers only. If these are from the same plant this will be a new species allied to C. convolvulacea, Kurz.

21. CODONOPSIS AFFinis, Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 12.—Caules glabri vel ad nodos pubescentes. Folia alterna, ovata vel lanceolata, basi cordata, acuta vel acuminata, sinuosa vel dentata, supra pubescentia, subitus dense pubescentia vel tomentosa, 4-8 cm. longa, 4-6 cm. lata; petioli dense pubescentes vel pilosi, 15-30 mm. longi. Flores foliis
oppositi; pedunculi pubescentes, raro 25 mm. longi. Calyx superus, dense pubescentis, 5 mm. longus; lobi sinu obtuso sejuncti, triangulares, acuti, dense pubescentes, 5–6 mm. longi, 3 mm. lati. Corolla supera, campanulata, viridis purpureis maculis notata; tubus pubescentis, 8 mm. longus, seccitate apice 15 mm. diam.; lobi late triangulares, acuti, pubescentes, 3 mm. longi, 4–5 mm. lati. Filamenta basi dilatata, glabra, 2 mm. longa; antheræ glabre, 1 mm. longæ. Style glaber; stigma late 3–5-lobum. Ovarium inferum, seccitate 8–10 mm. diam.; valvæ 3, 3–5 mm. longæ. Semina ovoidea, levia, brunnea vel candida, 0.8–1 mm. longa, 0.5–0.8 mm. lata.

I have not considered it necessary to retain the var. birmanica, Clarke. The only material is one imperfectly fruiting specimen in Herb. Kew. Var. birmanica, Clarke, Hook. f. l. e. (?).

INDIA : Sikkim, 6000–10,000 ft., Hook. f. ! Clarke, 12897 ! 13003! 25551 ! 25560 ! 25605 !

I have not considered it necessary to retain the var. birmanica, Clarke. The only material is one imperfectly fruiting specimen in Herb. Kew.


INDIA : Nepal, Gossain Than, Wallich! Kumaon, Lohathal, 6000 ft., Strachey & Winterbottom ! Naini Tal, Miss Wall! Khasia, Lailanhote, 5000 ft., Clarke, 44864 ! Collett !

The flowers of this species are mentioned by Wallich, l. c., as being fetid.

Species dubie.


Owing to the very imperfect description and the absence of material, it is uncertain whether this plant belongs to this genus or not. The only specimen mentioned is that collected by Keiske in Japan.
Another Specimen of *Platantiera chlorantha* with Three Spurs

By W. BOTTING HEMLEY, F.R.S., F.I.S.

(With 2 Text-figures.)

[Read 19th March, 1908.]

Early last year I exhibited and described before the Society an inflorescence of *Platantiera chlorantha* in which all the flowers were three-spurred, and the Society did me the honour of publishing my description and figures. This led to a communication from the Rev. E. A. Woodruffe-Peacock, who informed me that somewhere about the year 1902 a lady of Bath sent him a *Platantiera* to name. It turned out that this had three-spurred flowers, and he showed it round at the time, but nobody took any particular interest in it and he finally placed it in the county herbarium at Lincoln. Mr. Woodruffe-Peacock kindly offered to try to recover the specimen should I care to see it. In view of the great rarity of this kind of metamorphosis, I gladly accepted this offer, and I think the result of my examination of the specimen is of sufficient importance to bring it before the Society.

In the specimen I exhibited last year the additional spurs were developments of the lateral sepals. Now, the normal spur of an orchid flower is a basal appendage of the labellum, one of the petal series, produced below the point of its attachment; so that was an instance of what
is termed false peloria. The specimen I now exhibit is an example of true peloria; all the spurred organs being of the inner or petal series of the floral envelope. As in my former exhibit, all the flowers, originally eleven in number, are transformed, and the ovary is not twisted. The spurs in some of the flowers are of unequal length, and the limbs or blades are a little unequal in size and shape. In other flowers the three spurs and three blades are almost uniform in size and shape. But the flowers

Fig. 1.

Front view of a flower with unequal spurs, about twice natural size.

have not become symmetrical as to the sepals and petals, the straight spurs being directed upwards, radiating through about a quarter of a circle; in other words their divergence is about forty-five degrees. The blades of the petals have undergone very little modification; much less than the blades of the sepals of the other three-spur specimen to which I have referred.

So far as my investigations go, this is the first record of what may be termed lip-peloria with spurs, and my colleague Mr. R. A. Rolfe tells me that no other instance has come under his observation. Concerning the occurrence of peloria in orchids generally, Penzig says*: "The formation of peloria is very frequent in orchids, usually occurring, however, in solitary lateral flowers, not in whole inflorescences." Concerning peloria in Platanthera bifolia, he says†: "several instances of peloria have been

described, mostly formed by the labellum taking the shape of the paired petals, the flower being consequently spurless. In most instances there were also three fertile stamens—the outer. Once only I observed another kind of peloria, in which the paired petals were elongated and similar to the labellum, but without spurs.” Of *P. chlorantha* he records two instances of spurless peloria, but no other form of peloria. Spurless labellum peloria he also records for *Platanthera ciliaris*, *P. fimbriata*, and *P. hyperborea*.

**Fig. 2.**

Back view of a flower with equal spurs, about twice natural size.

The exact locality of Mr. Woodruffe-Peacock’s specimen is unknown, but it was presumably taken somewhere in the neighbourhood of Bath, as it is accompanied by the following undated note:

“Queen’s Canal, Bath.

“I am sending an orchid which I thought might be of interest, each flower has three spurs instead of one. I am afraid I have kept it too long to be of much use.

(Signed)  

Susan Allett.”

The flowers of the present specimen are somewhat smaller than those of *P. chlorantha*: the sepals being only about 1 cm. long and the spurs 2-3 cm. long.

I have no explanation to offer as to the cause of this metamorphosis.
It may, perhaps, be regarded as a partial reversion to a regular form, but I do not think it is a deformity in the sense that an extra finger or thumb is. What one would very much like to know is whether it is permanent; whether the successive annual tubers go on producing three-spurred flowers.

Since the publication of the article on my first three-spurred Platanthera, and since my present note was written and in possession of the Society, Mr. S. Sommier of Florence has sent me a copy of a paper of his on Platanthera bifolia Reichb. tricalcarata (Bullettino della Società Botanica Italiana, n. 6, July 1898, p. 186), which I had unfortunately overlooked. Mr. Sommier describes an example of false peloria of exactly the same nature as my published account, namely the production of spurs by the two lateral sepals, all of the flowers being transformed.

His specimen was gathered in a wood in the neighbourhood of Florence, where normal $P.$ bifolia was common, but he could not find another plant of the anomalous form.

What is still more remarkable, though incapable of proof, is the fact that Mr. Sommier believes that he has had under observation an example of true peloria in Platanthera bifolia. In a footnote to the article in question he says:—“I remember to have seen some time ago among the native orchids cultivated by the Marchesa Paulucci some flowers of Platanthera bifolia with supernumerary spurs, and I believe that they belonged to the two lateral petals; but I did not give the matter sufficient attention at the time. In his own words: “Ricordo di aver visto, tempo addietro, fra le Orchidee indigene coltivate dalla Marchese Paulucci, dei fiori di Platanthera bifolia, con speroni soprannumerari, e credo che appartenessero ai due petali laterali; ma non vi feci allora abbastanza attenzione.”

[In a further note on this subject Sommier (Bull. Soc. Bot. Ital., March 1908, p. 21) expresses the opinion that my original tricalcarata belongs to $P.$ bifolia rather than to $P.$ chlorantha.—W. B. H., Sept. 1908.]
INTERNATIONAL CATALOGUE OF
SCIENTIFIC LITERATURE.

The Royal Society has been engaged for some years past in arranging for the publication of an International Catalogue of Scientific Literature, beginning from the 1st January, 1901. Each science is represented in an annual volume containing lists arranged under authors and subjects, of all books and papers published during the year; these are contributed through official channels of information—abroad, by direct control of the respective governments—at home, by means of the various Societies which devote themselves to particular sciences; those Societies whose domains overlap having arranged for mutual cooperation.

The collection of title-slips for the United Kingdom of Great Britain and Ireland as regards BOTANY has been undertaken by the Council of the Linnean Society, and they appeal to all botanic workers for support in their endeavour to compile a complete record, by sending notices promptly of all botanic issues to the undersigned.

The sixth volume, for 1906, will shortly be issued.

B. DAYDON JACKSON,
General Secretary, Linn. Soc.
NOTICE.

The Catalogue of the Library may be had on application. Price to Fellows, 5s.; to the Public, 10s.

All communications relating to the general business of the Society should be addressed to the General Secretary, but letters on library business only may be addressed to the "Librarian."
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The Caryophyllaceae of Tibet. By Frederic N. Williams, F.L.S.

[Read 4th June, 1908.]

The plants collected in the course of the Military Expedition to Lhasa in 1903-4, undertaken by the Indian Government, in relation to the Tibet Frontier Commission, were stored in the Calcutta Herbarium. It was the intention of Col. Prain to issue a Report, which should include an account of the plants collected on the Expedition together with other small parcels of Tibetan plants which had been sent during the previous 20 years to the Calcutta Herbarium and had lain there unexamined. On Col. Prain leaving Calcutta to take up his duties at Kew this idea was abandoned, and those who had undertaken to examine the material of different families were accorded permission to publish the results of their determinations through some other source.

Mr. W. B. Hemsley’s ‘Flora of Tibet’ was published in April 1902, in this Journal (vol. xxxv.), and therefore included none of the material mentioned above. Mr. Hemsley therein enumerates 11 species of Caryophyllaceae. The reason for offering the present paper for publication is that, after examination of the further material available, the number of species of Caryophyllaceae is increased to 43. The limits of Tibet as defined by Mr. Hemsley in his ‘Flora’ are strictly adhered to: otherwise further additions to the Himalayan Flora would have been included, on the confines of Tibet, but politically within the area of Sikkim and Kashmir. Mr. Hemsley has elsewhere pointed out the misapplication of the name of “West Tibet” to a province of Kashmir.

**List of Species.**

Subfam. Alsinineae.

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<td>2</td>
<td>S. gyangtzensis, sp. n.</td>
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<td>3</td>
<td>S. dianthifolia, sp. n.</td>
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<td>S. graminea, Linn.</td>
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<td>S. lanata, Hook. f.</td>
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<td>6</td>
<td>S. Cherlerie, Williams.</td>
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<td>S. arenaria, Maxim.</td>
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<td>Krascheninnikowia himalaica, Korsinsky.</td>
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<td>9</td>
<td>Cerastium pumilum, Curtis.</td>
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<td>10</td>
<td>Alsine Roylei, Fenzl.</td>
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<td>11</td>
<td>Arenaria orbiculata, Edgew.</td>
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<td>A. monosperma, sp. n.</td>
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<td>A. ciliolata, Edgew.</td>
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<td>A. Stracheyi, Edgew.</td>
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<td>A. ramellata, sp. n.</td>
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<td>16</td>
<td>Arenaria melandryiformis, sp. n.</td>
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<tr>
<td>17</td>
<td>A. melandryoides, Edgew.</td>
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<tr>
<td>18</td>
<td>A. acicularis, sp. n.</td>
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<tr>
<td>19</td>
<td>A. ischnophylla, sp. n.</td>
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<td>20</td>
<td>A. monticola, Edgew.</td>
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<tr>
<td>21</td>
<td>A. kansuensis, Maxim.</td>
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<td>22</td>
<td>A. monantha, sp. n.</td>
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<td>23</td>
<td>A. polytrichoides, Edgew.</td>
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<tr>
<td>24</td>
<td>A. pulvinata, Edgew.</td>
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<tr>
<td>25</td>
<td>A. densissima, Edgew.</td>
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<td>26</td>
<td>A. glanduligera, Edgew.</td>
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<td>27</td>
<td>A. yunnanensis, Franc.</td>
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<tr>
<td>28</td>
<td>A. cerastiformis, sp. n.</td>
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<tr>
<td>29</td>
<td>Gooringia Littlealei, Williams.</td>
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<tr>
<td>30</td>
<td>Thylacenspernum rupifragum, Schrenk.</td>
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</tbody>
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| 31. Silene caspitella, sp. n. | 38. Melandryum apetalum, Fenzl. |
| 33. S. suberetacea, sp. n. | 40. M. jugorum, sp. n. |
| 34. S. Moorcroftiana, Rohrb. | 41. M. hassanum, sp. n. |
| 35. S. Waltoni, sp. n. | 42. M. viscidulum, comb. n. |
| 36. Hedona ischnopetala, sp. n. | 43. Gypsophila cerasioides, D. Don. |

1. Stellaria subumbellata, Edgew.

Khamba Fort, 1903 (Col. Youngusband, n. 268; Col. Prain, n. 1150 *). Gooring Valley, 1895, at 5030 m. (Littledale).

2. Stellaria gyangtsensis, sp. n. (Subg. Eustellaria, sect. Stellaria propria.)


Gyangtse, 1904 (Capt. Walton, n. 41, n. 1120).

A plant much resembling S. udi in the arrangement of the flowers and form of the leaves.

3. Stellaria dianthifolia, sp. n. (Subg. Eustellaria, sect. Stellaria propria.)


Tibet, without locality, 1884 (King's collector, n. 366).

4. Stellaria graminea, Linn.

Forma nana, foliis brevioribus minus acutis.

* The numbers from 1098 to 1218 are not collector's numbers, but numbers given in the Kew Herbarium.
Lungyung and Tisum, at 4570 m., 1848 (Strachey & Winterbottom).
Khamba Fort, 1903 (Col. Younghusband, n. 1121).
The Tibetan plant is a high alpine dwarf form distinct in the much shorter and less pointed leaves, and in being more compact in habit.

5. **Stellaria lanata**, Hook. f.
Redong-Oong, near Chumbi, 1878 (Dungboo, n. 1131). Bang Chin, a mountain west of Chumbi, 1882 (King's collector, n. 1130).

   Central Tibet: Gooring Valley, at 5030 m. (Littledale, 1895).
   N. Tibet (Przewalski, 1884). Central Tibet: Gooring Valley, at 5030 m. (Littledale, 1895) between camps 26–27 (Sven Hedin, 14 Sept. 1896).
   E. Tibet: Tangut (Przewalski, 1884). S. Tibet: Chumbi (King's collector, 1882, n. 1168; C. H. Bell, 1904, Tibet Frontier Commission, n. 1154); Phari (Dungboo, 1877, n. 4594).
   N. Tibet (Przewalski, 1884): Yatung, lat. 27° 51', long. 88° 35' (H. E. Hobson, 1897).
   S. Tibet (King's collector, 1882, n. 1167): Za-ne-gang, between Chumbi Fort and Cho Pass (King, 1882, n. 1208); Put-lo, in the Chumbi district (King's collector, 1884, n. 21).

7. **Stellaria arenaria**, Maxim. *Fl. Tangutica*, p. 91, t. 29, fig. 18 (1889).
   Tangut (Przewalski, 1884; type-specimens in Herb. Petropolit).

   **Syn.**—**Stellaria Davidi**, var. himalaica, Franch., Pl. Delavay. i. p. 100;
   **Stellaria bulbosa**, Hook. f., Fl. Brit. Ind. i. p. 231, non Wulf.; Krascheninnikowia rupestris, auct., non Turcz.
   Tibet: on the Bhutan frontier, at Ga-leng-kyä, 1882 (King's collector, n. 1136), and on the Pay-Goong Pass in the Chumbi district, 1884 (King's collector, n. 417).
   Korshinsky has re-established and defined this genus on a satisfactory basis, and clearly distinguishes the 9 species which are now included in it.

   Tibet, without locality, 1884 (King's collector, "Fl. of Thibet, n. 344"); valley around Chumbi, 1904 (E. H. Walsh, n. 18).
   **Var. alpestre**, Williams, comb. nov.
   Phari, 1877 (King, "Fl. of Thibet Himalaya," n. 4583).

The Tibetan specimens of the type agree exactly with specimens of C. pumilum in Herb. Kew. from both N. Persia and Yunnan.

The Phari plant agrees exactly with Willkomm’s Pl. Hisp. exs. 1850, n. 298,—“pumilum, densissime pubescens valdeque viscosum, cymis conden-satis, floribus breviter pedicellatis.” This is Willkomm’s Latin translation of the original description in Loscos & Pardo’s “Series imperfecta de las Plantas Aragonesas espontaneas, particularmente de las que habitan en la parte meridional,” p. 19 (1862).


11. Arenaria orbiculata, Edgew. Doo-ree-Chu, in the Chumbi district, 1884 (King’s collector, n. 555).


Closely allied to A. tenella, Duthie. Each fully matured fruit contains a single large seed almost completely filling the capsule.

Tibet, without locality, 1882 (King’s collector, n. 1119).

13. Arenaria ciliolata, Edgew. Chumbi district, 1884 (King’s collector) ; at Pun-ka-bee-see-mo (King’s collector, “Fl. of Chumbi,” n. 25), at Ka-poop (King’s collector, “Fl. of Chumbi,” n. 142) ; Tibet frontier, 1904 (C. H. Bell).

14. Arenaria Stracheyi, Edgew. Chumbi district: Pan-Thung-lo, 1879 (Dungboo, n. 1137), Tab Trong, 1879 (Dungboo, n. 1148), Sy-am-poo, 1884 (King’s collector, n. 130), and without locality, 1884 (King’s collector, “Fl. of Thibet,” n. 315). Rakas Tal, 1848, at 4730 m. (Strachey & Winterbottom). W. Tibet: on broken granite, 1896, at 5125 m. (Deasy & Pike, n. 876).

What is intended by the “Arenaria Stracheyi” of the Fl. of British India
is somewhat obscure. The material (fragmentary scraps on a single sheet) is so scrappy that the vague description given by no means identifies the "type-specimens." The description seems to indicate a plant quite glabrous, with short stems and solitary flowers, and leaves thickened though not exactly fleshy, and narrower in proportion than those of other species in the section *Sikkimenses*; and more resembling the Persian *A. bulica* rather than any Himalayan species. It is certainly doubtful whether the specimens here referred to *A. Stracheyi* really belong to this species, but they resemble the plant more than they do any of the other specimens of *Arenaria* in the Kew Herbarium; and *A. Stracheyi* is recorded for Tibet.


Nana, glabra. Caules 4–6 cm., divaricato-ascendentes ramosi, ramis divergentibus, foliosi. Folia 8–9 mm., usque ad flores numerosa, lanceolata acuta sessilia firma plana, nervis obscuris, basin versus attenuata, et ibidem interdum margine ciliata, ceterum glabra; folia pedicellaria haud bracteiformia sed aiiis consimilia. Flores ad ramos laxe cymosos solitarii, pedicellis longioribus. Calyx campanulatus, basi attenuatus; sepala lanceolata acuminata, apice recurva, anguste membranaceo-marginata. Petala alba obovata, calyce sesquilongiora, apice rotundata, basi vix unguiculata.

Karoo-la, 15 miles from Lhasa, 1878 (*Dungboo*, n. 1158).

Very near *A. Stracheyi*, but differing both from the type-specimens and also from Edgeworth's description. Readily distinguished from the next species, to which it is closely allied.

16. **Arenaria melandryiformis**, sp. n. (Ejusdem sect.)


a. Forma glandulosapubescens.

Beong-chin, a mountain west of Chumbi in Tibet Himalaya, 1882 (*King's collector*, n. 1127).

b. Forma magis hirsuta.

Syam-poo, in Chumbi district, Tibet Himalaya, 1884 (*King's collector*, n. 123).

17. **Arenaria melandryoides**, Edgew.

Syam-poo, in Chumbi district, 1884 (*King's collector*, n. 129); Rungkia, in Chumbi district, 1879 (*Dungboo*, n. 1122); Naku Pass, 1903 (Col. Young-husband, n. 169).

These agree with specimens in Herb. Kew, from Yatung in Tibet (*II. E. Hobson*, 1897), overlooked in Mr. Hemsley's 'Flora' (p. 170).
18. ** Arenaria acicularis, sp. n. ** (Subg. *Eremogoneastrum*, sect. i.)


Flowers much smaller than in *A. festucoides*, and more crowded at the top of the flowering stem; leaves longer and narrower, never falcate. Somewhat like *A. Przewalskii*, but the leaves in the latter are rough-edged, those of the shoots are obtuse, the cyme is three-flowered, and the disk-glands 5 (not 10).

Kannali River, 1848, at 4730 m. (*Streichen* & *Winterbottom*, "A. festucoides," non *Benth.*). Tibet, without locality ("Fl. of Thibet," n. 66, 1882, and n. 286, 1884, *King's collector*); Khamba Fort, 1903 (Col. *Prain*, n. 1209); Gyantse, 1904 (*Capt. Walton*, n. 95, n. 1116); Phembo Pass, 10–15 miles north of Lhassa, and Yam Doh Cho, 1904 (*Capt. Walton*, n. 1117, n. 1118); Lhassa, at 3600 metres, 1904 (Col. *Waddell*).

19. ** Arenaria ischnophylla, sp. n. ** (Ejusdem sect.)

Dense arcteque caspita. Caudex lignosus polypepalus; rami dense foliati. Folia 7–9 mm. vel paullo longiora, subtriquetra rigida pungentia uninnervia, basi scariso-vaginata, margine incrassata. Flores pauci, breviter pedicellati, pedicellis pilosis. Calyx basi trunca; sepala 4 mm. long., lanceolata acuminata, apice recta, trinervia, nervis lateraliibus tenuioribus, ultra nervos late scariosa. Petala 5 mm. longa, alba ovato-elliptica, calyceum paullum excedentia, basi obsolete unguiculata, apice rotundata. Ovarium globosum.

Near *A. kansuensis*, in which the mass of flowers almost conceals the dense short leaves, whereas in *A. ischnophylla* the dense longer leaves conceal the few flowers.

Khamba Fort, 1903 (Col. *Younghusband*, n. 107).

20. ** Arenaria monticola, Edgew.**

Phari (*Dungboo*, 1877, n. 4559, 1879, n. 1146); Syam-poo, in Chumbi district (*King's collector*, 1884, n. 112, n. 1164).

21. ** Arenaria kansuensis, Maxim.**

Karoo Pass, 15 miles from Lhassa, at 5000 m. (*Dungboo*, 1878, n. 1152 ;
Capt. Walton, 1904, n. 1149): Tibet, without locality (King’s collector, 1882, n. 1164 bis), and Pem Pass, near Chum-la-ri (King’s collector, 1882, n. 1145).

22. ARENARIA MONANTHA, sp. n. (Subg. Erengoneastrum, sect. ii.)
Nana, uniflora, stricta, 5-6 cm. Caulis inferne bifarium pubescens, superne breviter et retrorsum pilosus, simplex. Folia 8 mm., elliptico-linearis acuta subenervia, supra glabra, subtus puberula, marginis parce ciliolata. Flos longe pedunculatus; pedunculus basi sepe foliis 4 approximatis instructus. Calyx basi truncatus, aperte campanulatus; sepala ima basi connata, pilosa elliptica vix acuta, alternatim anguste lataeque scarioso-marginata, obscure nervata. Petala integra ovata alba, basi breviter unguiculata, longitudinaliter evidenter striata, calyce sesqui-duplo longiora. Glandulae luteo-virentes prominentes, staminibus alternantibus.
Not unlike a dwarf and depauperate form of A. Griffithii, but leaves not rigid. There is already an "Arenaria uniflora" from the island of Kurre-Saar in the Gulf of Riga, though, indeed, it is a doubtful species. Otherwise this name would have been adopted for the present species, in accordance with the Latin form of the generic name.
Hills above Lhassa, Aug. 1204 (Capt. Walton, n. 1138).

23. ARENARIA POLYTRICHOIDES, Edgew.
Za-na-gang, 1879, Tibet, 1882, n. 112, Mee-rook Pass, in Chumbi district, 1884, n. 338 (all King’s collector).
Var. perlevis, Williams.
Rungkia, in Chumbi district, 1879 (Dungboo, n. 1151); Tibet, without locality, 1884 (King’s collector, n. 237); Khamba Fort, n. 53, between Kangra Lama Pass and Khamba Fort, at 4650 to 5100 m., n. 1163, Giagong, at 4500 m., n. 1161 (all of Col. Younghusband, 1903): Phari plain and the Upper Chumbi Valley on the way to Phari, 1904 (E. H. Walsh, n. 152), Balch Pass, 1848 (Strachey & Winterbottom): Gooring Valley, 1895 (Littledale). N. Tibet (Woolley & Malcolm; Sven Hedin). South shore of Lake Mangtza Cho (Deasy & Pike, n. 813).

24. ARENARIA PULVINATA, Edgew.
Tibet, 1882 (King’s collector, n. 112, n. 131).

25. ARENARIA DENSISSIMA, Edgew.
Tibet, 1882 (King’s collector, n. 1165).

26. ARENARIA GLANDULIGERA, Edgew.
Chumbi district, 1878 (Dungboo, n. 1201); Ze-lep-la, n. 1202, Kang-bo, one day north of Phari, n. 1203, Gup-ten-de-la, a little above Chumbi, n. 1155, without locality, n. 1166, n. 1204, n. 1205 (all of King’s collector, 1882);

**Var. micrantha, Williams.**

Folia elliptico-oblonga. Flores minores quam in typo. Sepala obtusa, margine distincte scariosa, vix glandulosa.

With somewhat the facies of *A. ciliolata*.

**Mee-rik Pass, 1884 (*King's collector*, n. 628).**

**Var. cernua, Williams.**

Folia elliptica acuta, in caule pauciora. Flores majores quam in typo, in pedicellis tenuioribus suffulti. Sepala paullum latiora, angustius scarioso-marginata, minus glandulosa.

Bears the same relation to the type as does *A. ciliolata* var. *pendula*, Duthie, to the type of this species.

Tibet, without locality, 1884 (*King's collector*, n. 333); Naku Pass, 1903 (*Col. Younghusband*, n. 172).


Bue-tang, 18 miles north-west of Chumbi, n. 1133 (*Dungboo*, 1878); Shand-hu near Phari, n. 1129, and Chumbi district, n. 1134 (*King's collector*, 1882).

These specimens exactly agree with Franchet's authentic specimens in Herb. Kew.

**Forma angustifolia.**—Folia inferiora breviter petiolata anguste lanceolata, superiora sessilia oblonga.

Do-tho in Chumbi district, n. 1128 (*Dungboo*, 1879).

28. **ARENARIA CERASTIFORMIS**, sp. n. (Subg. Macrogynae)


An Arenaria with the facies of *Cerastium*, closely allied to *A. longistyla*, Franch., and, like it, found at high altitudes.

Phari, 1877 (*King*, n. 4588, *Dungboo*, n. 4588 bis), 1879 (*Dungboo*, n. 1147); Mee-rik Pass, Chumbi district, 1884 (*King's collector*, n. 1207); Giagong, 1903, at 4500 m. (*Col. Younghusband*, n. 1160).
Goorling Valley, 1895, at 5030 m. (Littledale; = A. Littledalei, Hemsley).

30. Thylacospermum rupifragum, Schrenk.
Goching, n. 2, and Khamba Fort, at 5700 m. (Col. Youngusband, 1903) ;
Guge, 1848, from 4570 to 5120 m. (Strachey & Winterbottom). W. Tibet,
1896, at 5218 m. (Wellby & Malcolm).

31. Silene cespitella, sp. n. (Subg. Eusilene, sect. Cincinnosilene.)
Perennis, cespitosa, basi fruticulosa. Radix lignosa. Caules florigeri ex
rosula foliorum media editi, erecti, pubescentes, 13-25 cm. Folia 4-7 cm.,
elongato-linearis, rossulata acuminata trinervia, basi membranaceous-vaginata,
margine pubescentia. Bracteeae et prophylls minora uninervia, eeterum
autem foliis conformia. Flores in cincinnos simplices dispositi. Calyx
evenius clavatus, fructifer paullum ampliatus basi rotundatus, crispato-
pubescentes, striis furcatis superne bifurcatim conjunctis, dentibus ovatis
obtusis late scarioso-marginatis. Petala alba, unguibus inclusis superne
utrineque auriculato-dilatatis, lamina anguste oblata, lobis oblongis, appendicibus binis
ovatis obtusi. Genitalia inclusa. Capsula oblonga, fere sessilis. Semina auriformia, dorso camaliculata obtuse tuberculata, faciebus
concava striata.

Somewhat resembles in facies S. tenuis, but differs in many important
characters, the cincinnate sequence of the flowers being quite evident.

32. Silene adeno-calyx, sp. n. (Subg. Eusilene, sect. Dichasiosilene.)
Caulis adscendens, breviter scabreque pubescentes, ramosus, ramis foliosis.
Folia caulina late lanceolata, ramealia angustius lanceolata, omnia acuminata
uninervia breviter scabreque sparsim pubescentia, nervo subitus longius piloso,
margine glanduloso-ciliata. Flores laxi, breviter pedicellati in dichasia paucis
axillarisbus et terminalibus, dichasio 3-vel sepe 5-7-floro. Calyx tubulosus
scaber, basi truncatus, pilis glandulosis brevibus dense vestitus, eveniens, striis
tenuibus viridibus a glandulis fere occultatis; dentes longe lanceolati acuminati
vix acuti, margine obscure scariosi. Petala alba, lamina parva biloba,
ungle exauriculato valde exserta, lobis oblongis, appendicibus binis, lamina
4-½ unguis æquante. Capsula oblonga, carpophorum glabrum æquans.

Khambo Pass, at 1440 m., 1904 (Capt. Walton, n. 1104).
So named from the structure of the calyx. Both this and the next species belong to that group of the *Macranthus* series which includes *S. cretacea*. This plant is, however, a difficult species to study and compare. Rohrbach's description (Monogr. n. 107, p. 135) is brief and somewhat vague; and there are only two sheets of *S. cretacea* in Herb. Kew., including 5 specimens,—(1) and (2) from the Astrakhan Desert, (3) and (4) from chalky hills above the river Don, and (5) from S. Russia.

33. *Silene subcretacea*, sp. n. (Ejusdem sect.)


Khamba Fort, 1903 (Col. Youngusband, n. 73,—flower-specimens); Gyangtse, 1904 (Capt. Walton, n. 105, n. 1108,—fruit-specimens).


Near Rakas Tal, 1848, from 4570 to 5180 m. (Strachey & Winterbottom).


Gyangtse, 1904 (Capt. Walton, n. 1105).

Named after Capt. Walton, of whose assiduity in collecting Col. Youngusband speaks in such glowing terms.
36. **Hedona ischnopetala**, sp. n.  

Near **Hedona Davidi**, Williams, a Sze-chuen plant.  
Tibet: Gum-lo-teen, in the Chumbi district, at 600 m., 1878 (*Dungboo*, n. 1106). Sikkim: Lachen, near the Tibetan frontier, at 2700 m., 1885 (*King’s collector, n. 1211*).

37. **Melandryum nigrescens**, Williams. (Sect. Gastrolychnis.)  
Phari, 1877 (*Dungboo*, n. 4565), Do-tho in Chumbi district, 1879 (*Dungboo*, n. 1215), and Khamba Fort, 1903 (*Col. Younghusband, n. 275*). Lanjar, 1848 (Strachey & Winterbottom).

38. **Melandryum apetalum**, Fenzl. (Sect. Gastrolychnis.)  
Syn. — *Lychnis apetala*, Linn.  
Guge, 1848 (Strachey & Winterbottom). W. Tibet, 1896 (*Deasy & Pike*, n. 894). Karoo Pass, 15 miles from Lhassa, at 4950 m. (*Dungboo*, 1878, n. 1101; Capt. Walton, 1904, n. 1100); To-koo Pass in Chumbi district (*Dungboo*, 1879, n. 1103); Tem Pass, one day north-east of Phari (*King’s collector, 1882, n. 1216*); Ka-po-po (*King’s collector, 1884, n. 1217*); Lomok on the Naku Pass (*Col. Younghusband*, 1903, n. 163); Naku Pass (*Col. Younghusband*, 1903, n. 165); Khamba Fort (*Col. Prain*, 1903, n. 1102); Gooring Valley, at 5030 m. (*Littledale*).

39. **Melandryum indicum**, Walp. (Sect. Gastrolychnis.)  
Pad-lo, near Chumbi, 1878 (*Dungboo*, n. 1125); Rinchin-gong, in the Chumbi Valley, 1877 (*Dungboo*, n. 4286, and Sir G. King, n. 4287); Chumbi district, Lo-Beang near Chumbi, and between Chumbi and the Tangka Pass, 1882 (*King’s collector, n. 1107, n. 1218, n. 1123*).
40. **Melandryum jugorum**, sp. n.  (Sect. Elisanthe.)


Gum-bo-teen, 800 m. above Chumbi, n. 1143 (Dungbo, 1878); Lo-Beang, near Chumbi, n. 1219, and Chumbi district, n. 1098 (King's collector, 1882).

41. **Melandryum lhassanum**, sp. n.  (Sect. Elisanthe.)


Quite distinct from any other species of Melandryum; resembling one or more of the Yunnan species described by Franchet under Silene.

Hills above the city of Lhassa, 1904 (Capt. Walton, n. 1112).
42. *Melandryum viscidulum*, Williams. (Sect. Elisanthe.)


A plant of the habit of *M. Olgae*, as may be seen by comparing this Himalayan plant with specimens from the Chinese province of Manchuria in Herb. Kew. It tallies with the description of *S. viscidula*, Franch., of which there is no specimen in Herb. Kew. *M. Olgae*, Maxim. (*= S. Olgae*, Rothb.), is not to be confused with *S. Olgae*, Regel & Schmalh., a quite different plant from Russian Turkestan.

Lo-Beang, near Chumbi, 1882 (*King’s collector*, n. 1109), in the same locality where *M. jugorum* occurs.

43. *Gypsophila cerastoides*, D. Don.

Chumbi Valley, 1879 (*Dungbo*, n. 1132); Gup-ten-de-la, a little above Chumbi, Aug. 1882 (*King’s collector*, n. 1220,—a poor and stunted specimen); Ta-che-Kung, Mee-rook Pass, and Ha-toom-py-ong, all in the Chumbi district, 1884 (*King’s collector*, n. 10, n. 345, n. 499); Chumbi Valley, 1904 (*E. H. Walsh*, n. 44).

(Plate 36.)

[Read 4th June, 1908.]

The time of the visit to South Africa by the British Association during the autumn of 1905 was very enjoyable from the traveller's point of view, but not the most profitable from a botanical standpoint. In Central Africa the seasons are simply two—the wet and the dry. The rainy season or summer extends from October to April, and the dry season or winter (during which scarcely any rain falls) from May to September. It was at the end of the latter period when the visit was made, and the dry and parched appearance of the vegetation contrasted very strongly with the hearty welcome and cordial hospitality extended by the colonists to their guests. In winter the thermometer would register 90° F. at mid-day, falling to 40° at night.

Notes on Distribution.

The present contribution adds 25 species to the Mycologic flora of Africa, one of which is new to science.

This addition tends to prove what has for some time been suspected, that the numerous large and typical genera are cosmopolitan, with specialized forms—so-called species—characteristic of each region.

Among such may be enumerated Poria vaporaria, Polyporus elegans, Schizophyllum commune, and Polystictus sanguineus. Some of these, like the last-named, are most abundant in tropical regions, with but few outliers in temperate regions. Others, as Poria vaporaria and Polyporus gilvens, have their headquarters in temperate regions. An examination of the list reveals the fact that various species more or less common in the New World, Europe, and Australasia respectively are now added to the African list.

Excluding the Myxogastres, it will be observed that of the 30 species of the larger fungi 10 are cosmopolitan, whilst the remaining 20 are here recorded for the first time from the African continent; and again, 12 of the 30 are found in Australasia, two, viz. Polyporus nanus and Hexagonia decipiens, being hitherto recorded only from that quarter of the globe. This fact may be another indication of the supposed ancient land-connection.
between South Africa and Australasia, a theory which is suggested so strongly in many of the Phanerogams of South Africa.*

The writer wishes to acknowledge his indebtedness to Mr. Geo. Massee for determining many of the species, and for his kind help and suggestions.

* The Natal Coal-bearing rocks of Permo-Carboniferous age produce some six or eight species of the fossil plant *Glossopteris*, which are also abundant in the Coal-beds of the same age in Australia.

*Linn. Journ.—Botany, Vol. XXXVIII.*
Mr. W. N. Cheesman on the

Schizophyllum commune, Fr.
On mine-props, 2000 feet deep, in Langlaagte Gold Mine, Johannesburg, and in the deep workings of the Wesselton Diamond Mine, Kimberley.
Distrib. Cosmopolitan.

Polyporaceae.

Trametes hydnoipes, Sw.
Victoria Falls: thickly imbricate, on a fallen Ficus-log, East Ferry.
Distrib. Africa, America.

Poria cithina, Massee.
Victoria Falls: Rain Forest.
Distrib. Asia.

Poria vaporaria, Fr.
Groot Schuur near Cape Town.
Distrib. Cosmopolitan.

Polystictus sanguineus, Fr.
Victoria Falls: Palm Kloof and Rain Forest.
Distrib. Asia, Africa, America, Australia.

Fomes senex, Nees.
On Livingstone Island fine specimens occurred on several fallen logs and also on the dead trunk of the tree bearing the initials of David Livingstone, which is now fenced round.
Distrib. Asia, America.

Fomes hemileucus, Berk.
Victoria Falls, near Leaping Cascade.
Distrib. America.

Polyporus nanus, Massee.
Victoria Falls: Rain Forest.
Distrib. Australasia.

Polyporus elegans, Fr.
Victoria Falls; Matoppo Hills; Cape Town.
Distrib. Europe, America, Australasia.

Polyporus gilvus, Schwein.
Victoria Falls: Rain Forest.
Distrib. Europe, America.
POLYPORUS CRISTATUS, *Fr.*
Victoria Falls; Park Town, Johannesburg.
*Distrib.* Europe, America.

POLYPORUS OCHROLEUCUS, *Fr.*
Matoppo Hills.
*Distrib.* Asia, Australasia.

POLYPORUS ECKLONI, *Heun.*
Victoria Falls: Rain Forest.
*Distrib.* Africa.

POLYPORUS VARIUS, *Fr.*
Victoria Falls: Rain Forest.
*Distrib.* Europe, Asia, America.

HEXAGONIA DECIPiens, *Berk.*
Victoria Falls: on fallen branches, on the edge of the Rain Forest.
*Distrib.* Australasia.

HEXAGONIA POLYGRAMMA, *Fr.*
Victoria Falls: on a fallen tree, near East Ferry.
*Distrib.* Asia, Africa, America.

STROBLomyces STROBILACEUS, *Berk.*
Victoria Falls: edge of Rain Forest.
*Distrib.* Europe, America.

THELEPHORACEÆ.

STEREUM LOBATUM, *Fr.*
Groot Schuur near Cape Town; East London.
*Distrib.* Asia, Africa, America, Australasia.

HYMENOCÆTE TABACINA, *Lev.*
Groot Schuur near Cape Town.
*Distrib.* Cosmopolitan.

HYMENOCÆTE TENUISSIMA, *Berk.*
Victoria Falls: Livingstone Island.
*Distrib.* Asia, America, Australasia.

CYPHELla CHEESMANN, *Massee,* sp. nov.
Victoria Falls: Rain Forest.
Membranacea, sessilis, cupularis, demum explanata, extus villosa, nivea.
1 mm. diam.; hymenio leniter plicato. Basidia clavata, apice 4-sterigmatica;
sporis ovoideis, tenuiter asperulis, hyalinis, 12–15 × 7–8 μ.
*Hab.* in ramis decorticatis.
MR. W. N. CHEESMAN ON THE

TREMELLAEE.

Hirneola auriformis, Fr.
Victoria Falls: north bank of the Zambesi River.
_Distrib._ America, Australasia.

Guelpinia flabellata, Fr.
Victoria Falls: west side near Leaping Cascade.
_Distrib._ Asia.

Calocera cornea, Fr.
Victoria Falls: Rain Forest.
_Distrib._ Europe, America, Australasia.

PYRENOYCYCTAE.

Hypoxylon colliculosum, Nitschke.
Victoria Falls: Palm Kloof.
_Distrib._ America.

Hypoxylon annulatum, Fr.
Victoria Falls: Livingstone Island.
_Distrib._ America, Australasia.

Rosellinia aquila, De Not. (Byssospheria, Cooke.)
Ladysmith, Natal; on decaying wood, Klip River.
_Distrib._ Europe, Asia, America.

MYXOGASTRES.

Stemonites fusca, Rost.
Pietermaritzburg, Natal.
_Distrib._ Europe, Asia, America, Australasia.

Stemonites Friesiana, De Bary.
Bloemfontein, near Sannah’s Post, O.R.C.
_Distrib._ Europe, America.

Arcyria serpula, Massee.
Victoria Falls: Rain Forest, East London.
_Distrib._ Europe, Asia, America, Australasia.

Chondrioderma difforme, Rost.
Victoria Falls: Rain Forest, Umtali, East Rhodesia.
_Distrib._ Europe, Asia, Africa, America.
MYCOLOGY OF SOUTH AFRICA.

DIACLAEA LEUCOPODA, Rost.
Victoria Falls: Rain Forest. Mombasa, B.E. Africa.
Distrib. Europe, Asia, Africa, America.

TLMADOCH NUTANS, Rost.
Victoria Falls: Palm Kloof. Umkomaas, near Durban.
Distrib. Europe, America, Australasia.

BADHAMIA VARIA, Massee.
Port Elizabeth, on decaying wood; East London, bright orange-yellow plasmodium on Stereum.
Distrib. Europe, America.

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NOTE ON THE COPROPHILOUS FUNGI.

(By Thomas Gibbs.)

Four samples of the dung of wild animals gathered by Mr. Cheesman during his South African tour were entrusted to the writer for laboratory examination. Of the material sent one sample was that of the Hippopotamus, and gathered on Livingstone Island, Victoria Falls. The others were from the Matoppo Hills; the kind of animal to which they belonged was not ascertained, a circumstance not, however, of much importance for, as Massee
and Salmon * remark, coprophilous Fungi seem generally to be quite indifferent as to their particular hosts. One sample, however, was in small round pellets similar to rabbit-dung, the other two being of larger animals, all apparently belonging to herbivorous mammals.

The material was received by the writer in November 1905, and was treated as recommended by Massee and Salmon *, being kept under glass covers upon wet blotting-paper. The water used was sterilized by boiling to prevent infection by spores from outside sources. Notwithstanding their subtropical origin, the cultivations were carried on through a Derbyshire winter and spring in a room without a fire, but in a window warmed by the morning sun.

The first appearance of a fungus-growth was noticed soon after Christmas, when the round pellets mentioned above (which had for a few days been placed in a warm room) appeared as if sprinkled with soot owing to a profuse growth of Saccolobus depauperatus, Rehm. From this time for upwards of three months, indeed so long as the material was kept moist, the fungus crop continued, and fresh species appeared from time to time.

 Altogether thirteen species were seen: of these, eight were of known species; one (Coprinus Cheesmani, Gibbs) is now described for the first time; of two others, (6) Sordaria sp. and (8) Delitschia sp., the portions seen were too fragmentary for certain recognition; while of two more, (2) Coprinus sp. and (13) Ascolephalum sp., which could not be identified with any known species, the scanty material seen did not justify new specific diagnoses.

A full bibliography of the whole subject will be found in Messrs. Massee and Salmon’s paper in the Oxford Annals of Botany,” xv. (1901) 353–355.

List of Fungi observed.

HYMENOMYCETE.

AGARICACE.E.

1. Coprinus Cheesmani, Gibbs (sp. nov.). (Plate 36.)
Livingstone Island, Victoria Falls.
C. pileo tenerrimo, aliquandiu ovato-campanulato, tunc expanso, umbonato, posthoc sursum curvato, plicato-sulcato, tandem ad partem dorsalem lamellarum fissum, latitudine ad 23 mm., pallido-fulvo vel subrufo, disco obscuriore tandem depresso, pilis erectis hyalinis non septatis vestito. Lamelle griseo-nigrantes adnatae vel adnexae anguste, 50–70 numero in pileis majoribus.

COPRINUS CHEESEMANI, Gibbs.
COPROPHILOUS FUNGI OF SOUTH AFRICA. 415

Stipes ad 4½ cm. longitudine, circiter 1 mm. crassitudine, fistulosus, flaccidus, hyalinus, in parte inferiore dense pilosus, prope apicem glaber. Sporae fusco-purpureae, ellipticae, polis obtusis, 12–16 × 6–8 μ.

Hab. in fimo Hippopotami.

This fungus appears to be closely allied to the well-known Coprinus radiatus, Fr., but is much larger in all its parts. The spore measurements given above cover what appears to be the normal range, but individual spores were seen 20 μ in length.

2. Coprinus sp.
Matoppo Hills.
Two specimens occurred of a very minute species. Pileus 1–2 mm., pallid, with rust-coloured scurfy patches. Stem ¼–1 cm. high, slightly hairy; spores elliptical, 11–15 × 6–9 μ. The material was not, however, sufficient for identification with any known species nor for a new specific diagnosis.

PYRENOMYCETÆ.

Matoppo Hills.
Distrib. Europe, North America.

4. Sordaria pleiospora, Wint.
Matoppo Hills.
Distrib. Europe.

5. Sordaria platyspora, Plowr.
Matoppo Hills.
Distrib. Britain.

6. Sordaria sp.
A fungus allied to, but in some respects differing from, S. anserina, Wint.; it occurred on Hippopotamus-dung gathered on Livingstone Island, Victoria Falls.

7. Delitschia bisporula, Hans.
Matoppo Hills.
Distrib. Europe.

8. Delitschia sp.
Matoppo Hills.
Fragments, including large chestnut-brown spores, 45 × 15 μ, occurred on the dung of a large animal.
Matoppo Hills.
*Distrib.* Europe, North and South America.

10. **Sporormia ambigua**, Niessl.
Matoppo Hills.
*Distrib.* Europe, South America.

11. **Sporormia pascua**, Niessl.
Matoppo Hills.
*Distrib.* Europe.

**DISCOMYCETÆ.**

12. **Saccobolus depauperatus**, Rehm.
Matoppo Hills.
*Distrib.* Europe, North America.

Two forms occurred, a larger and a smaller, but both probably belonged to this species. The larger (ascophores $\frac{4}{2}$ mm. across, spores $13-16 \times 6-7 \mu$) was so abundant on the small pellets like rabbit-dung that it appeared as if sprinkled with soot. The smaller form (ascophores up to $\frac{4}{2}$ mm., spores $10-12 \times 6-6\frac{3}{4}$) appeared on one of the other samples and was much less abundant.

13. **Ascophanus sp.**
Matoppo Hills.

A few ascophores occurred of a minute brick-red *Ascophanus*, which Miss A. Lorrain Smith considered nearest to though not identical with *A. granuliformis*, Boud. The material, however, was not sufficient to justify a new specific diagnosis.

A noticeable feature in the above list is the predominance of the Pyrenomycete family Sordariæ, 9 of the 13 species observed belonging to that family, a much larger proportion than is usual in a like gathering in England, where the leading place is more usually taken by the Ascoheleæ. The total absence of Hyphomycetæ and Mucoraceæ is also remarkable, and is perhaps explained by the prolonged desiccation the material had undergone, the conidia of these families being probably less able to withstand such conditions than are the spores of the more highly organised Basidiomycetæ and Ascomycetæ.

It will also be noticed as an interesting fact that eight of the thirteen species seen belong to known European species: this confirms the opinion
expressed by Massee and Salmon (supra) as to the wide distribution of individual species of coprophilous fungi.

It only remains for the writer to acknowledge his indebtedness to Miss A. Lorrain Smith for much assistance in determining species, and to Mr. G. Massee for assistance in the genus *Coprinus*.

**EXPLANATION OF PLATE 36.**

Fig. 1. *Coprinus Cheesmani*, Gibbs. Group of plants, nat. size.
Fig. 2. Plants marked "a" and "b" in fig. 1, x 3.
Fig. 3. Section slightly magnified.
Fig. 4. Cells of epidermis and hairs, x 200.
Fig. 5. Spores, x 400.

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*Gardenia/Thunbergia* and its Allies.

By Dr. Otto Staff, F.R.S., Sec.L.S., and J. Hutchinson.

(Plate 37.)

[Read 18th June, 1908.]

The small group of plants which forms the subject of this paper is represented in the 'Flora of Tropical Africa,' vol. iii. pp. 100 & 101, by two species: *Gardenia Thunbergia*, L. fil., and *G. Jovis-tonantis*, Hiern; but under the former not less than five names originally intended for as many distinct species appear in the list of synonyms. As *Gardenia Thunbergia* was described from a Cape plant, and the reduced species from material collected mainly in the northern parts of Tropical Africa, the area of *G. Thunbergia* was assumed to cover practically the whole of Africa, with the exception of the temperate north. Guided by this assumption, subsequent authors were frequently led to refer to this apparently common and widely spread species, plants which differ from it at least as much as *G. Jovis-tonantis* does, and in some cases indeed much more. Thus *G. Thunbergia* grew more and more into a collection of incongruous forms. More recently three new species, evidently closely allied to *G. Thunbergia*, were described. They were not split off from that species, and in so far did not touch its composition; but, on the other hand, they made the incongruity of its components still more glaring, at least to those who had an opportunity of mustering a considerable accumulation of specimens of "*G. Thunbergia*." Ample opportunity of this kind was given to Mr. Hutchinson, who during the last two years, under my direction, sorted and named the Rubiaceae of the large African collections which had accrued to Kew. We therefore
conceived the idea of revising the whole group, and of placing its constituents on a more equal basis. For that purpose we studied, in the first place, the material at Kew; but we had also, of course, to direct our attention to the valuable material in the herbarium of the British Museum; we asked for and had, thanks to the courtesy of Dr. De Wilde, the loan of the "Gardenia Thunbergia" specimens of the Congo State collections; and finally we availed ourselves of Mr. Casimir De Candolle's ever ready help for the elucidation of some critical species, the types of which were in the Candollean herbarium. We might have extended the field of our investigation, but for want of time and the conviction that after all the time had not yet come for attaining anything like finality. What we can and ought to do, in cases like the present, is to revise our knowledge from time to time and clear the basis for a further advance. Our paper is an attempt in this direction. The Gardenias of the "Thunbergia" group are rather striking objects when in flower, and it may be hoped that the collectors and field-students will, in the future, pay more attention to them, and supply us with more complete material and their own observations on the mode of growth, the range of individual variation, and any biological conditions which may influence their morphological characters.

The genus Gardenia, in the sense of Bentham and Hooker's 'Genera Plantarum,' consists of three sections: Eu-Gardenia, Ceriseoides, and Rothmannia. The first section ranges over the whole of the palearctic region, and is represented in Africa by the Gardenia Thunbergia group—the subject of the present paper—and two more species which are characterised by long, almost cylindrical fruits. From the Indian, Malayan, and Polynesian species the "Thunbergia" group differs on the whole in the number of the placentas, which rarely falls below six, and the more or less abundant development, in the mesocarp, of sclerotic fibres, which in the endocarp fuse into a very hard woody shell, and finally in the more xerophyllous structure of the leaves. The species forming this group are very closely connected. This and the very considerable variation in the size and shape of the leaves, the size of the flowers, and the degree of development of the calyx-teeth or lobes—even in the same individual—make the discrimination of the species very difficult if the specimens are scrappy or badly selected. The number of parts in the plan of the flower, though also subject to a certain amount of variation, is much more constant, and the same may be said of the surface condition and the nervature of the leaves, and the shape of the calyx-teeth or lobes. The very copious material of G. Joris-tomantis which we had before us was most instructive in this respect. Then there are certain species which stand out from the rest on account of some special peculiarity, as the cucullate and more or less petioled sepals of G. Thunbergia, the cuff-like prolonged calyx-tube of G. cornuta, with its laterally attached segments, the
small flowers and ribbed fruits of *G. Aqualla*, and the almost entirely suppressed overground stems of *G. subacaulis* and *G. Tinnea*. The two last-named species are interesting instances of adaptation of arborescent types to the peculiar edaphic conditions of the savannas.

With our present knowledge of *Gardenia* it would be idle to speculate on the phylogeny of the "*Thunbergia*" group. They certainly represent a distinct branch of the greater phylum of *Eu-Gardenia*, from which they must have become differentiated a very long time ago. We know nothing about the dispersal of their seeds except what can be inferred from the structure of their fruits and seeds, and the casual observations of the collectors. It seems that the fruits of some of them, at any rate, are eaten by elephants and antelopes, and probably other animals, evidently for the succulent pulp in which the seeds are embedded. The seeds would in this way get into the intestinal canals of those animals, and might finally be carried to great distances from the mother plant; but no means of transport across the seas suggest themselves, and it is evident that the *Eu-Gardenias* must have reached their areas, in so far as they are separated by water, at a time when those areas were still connected by land, that is in pre-Tertiary times.

In the following enumeration of the species of the "*Thunbergia*" group we have confined ourselves to describing only those which are new or were imperfectly known, the key which precedes the enumeration including sufficient characters for the determination of the others. In the key we have placed together two acaulescent species for purely practical reasons. They have no doubt descended independently from each other, *G. subacaulis* probably being more intimately connected with *G. asperula*, and *G. Tinnea* with *G. lutea* and *G. ternifolia*. (Otto Stapf.)

**Key to the Species.**

Subacaulis; flos solitarius cum foliis in rosulam dispositis.

- Folia seabra; corollae tubus 4–8 cm. longus .................. 1. *subacaulis*.
- Folia levia; corollae tubus circiter 3–5 cm. longus .................. 2. *Tinnea*.

Arbores vel frutices.

- Corolla 8–9-mera.
  - Ovarium 9-merum.
    - Calycis tubus ultra 5 mm. longus, lobis oblongis ......... 3. *Jovis-tonantis*.
    - Calycis tubus infra 3 mm. longus, lobis subtilifloribus demum reflexis ............................................. 4. *Volkensii*.
  - Ovarium 3–6-merum.
    - Calycis lobi spatulati, infundibuliformes .................. 5. *Thunbergia*.
    - Calycis lobi oblongi (non spatulati).
      - Calycis lobi dorsaliter complanati, non decurrentes .... 7. *asperula*. 
Corolla 6-7-mera (raro 2-mera in G. spatulifolia).

Calycis tubus ultra loborum insertiones productus .......... 8. corymba.
Calycis tubus non ultra loborum insertiones productus.

Calycis lobi non filiformes; calyx et corolla fere glabra vel beviter pubescentia.

Folia levia.
Folia late obovato-cuneata, nervis lateralibus ± flabel-
latis ................................. 9. spatulifolia.
Folia oblanceolata ad obovata, nervis lateralibus magis
patulis quam in precedente.
Folia arce reticulata; fructus ellipsoides, sepe ± obtusus vel utrinque angustatus .......... 10. ternifolia.
Folia laxe reticulata; fructus oblongo-ellipsoides,
± stipitatus ........................... 11. latea.
Folia scabrida.

Corollae tubus quam lobi vix duplo longior .......... 12. triacantha.
Calycis dentes filiformes; calyx et corolla magis minusve
tomentosa.
Folia scabrida; fructus 3—4 cm. longus, multicostatus .. 14. Aquilla.
Folia levia; fructus 6—9 cm. longus, ecostatus .......... 15. erubescens.

1. GARDENIA SUBACAULI, Stapf et Hutchinson (sp. nov.).

Suffrutex subacaulis, uniflorus. Folia sessilia, oblanceolata, basi longe
attenuata, usque ad 15 cm. longa et 7 cm. lata, coriacea, apice rotundata,
utrinque scabrida, marginibus undulatis, nervis lateralis utrinque 9—14
patulis prominentibus, venis arce anastomosantibus utrinque conspersis;
stipule late ovate, obtuse, circiter 4 mm. longe, coriaceae, extus parce
pilosae. Receptaculum oblongum, circiter 1 cm. longum, puberulum. Calyx
tubulosus, 6—9-lobus; tubus 8—10 mm. longus, extus fere glaber, intus
pares pubescentes; lobi oblongi vel lineares, obtusi, incrassati, a latere
compressi, interdum subfoliacei, in tubo decurrentes, 2—5—8 mm. longi.
Corolla alba, dennum flava; tubus 4—8 cm. longus, medio 3—4 mm. diametro,
extus minute pubescentes, intus superne pubescentes; lobi 6—8, oblique obovati
vel elliptici, 2—3—5 cm. longi, 1—2 cm. lati, supra basin parce pubescentes.
Antherae 11—12 mm. longae, inclose. Stylus 4—5—8 cm. longus, supra medium
tenuiter pubescentes, apice incrassato, inaequaliter 6-lobatus, lobis latis
obtusis circiter 2 mm. longis. Ovarium placentis 6. Fructus ambitu ellipti-
cus, circiter 5 cm. longus, medio 3 cm. diametro; pericarpium fibro-
signosum, 2 mm. crassum. Semina matura ignota.

Northern Rhodesia, and throughout Nyasaland:—Broken Hill, Kässner,
2020 feet (Herb. Mus. Brit.)! Kondome to Karonga, 2000—6000 feet,
Whyte! plains near South Rukuru, 4000 feet, McClounie, 114! Upper
Loangwa River, Nicholson! Mt. Malosa, 4000—6000 feet, Whyte! Namasi,
GARDENIA SUBACAULIS, Stapf & Hutch.
Cameron, 77! Manganja Hills, Waller! Eastern Nyasaland, Archdeacon Johnson, 498!

K. J. Cameron states that the flower of this species is pure white, but only remains so for a day, when it turns yellow and withers.

**Plate 37.**

1. Whole plant in fruit (n.s.). 2. Plant in fruit, from collector's sketch (reduced to \(\frac{1}{5}\)). 3. Calyx cut open (\(\times 2\)). 4. Section of ovary (\(\times 5\)). 5. Mature fruit (n.s.).


Bahr-el-Ghazal; Bongo-land, Tinne and Heuglin.


From the Shari and Bahr-el-Ghazal to Uganda and Angola:—Central Shari; swamps of Baseli, Chevalier, 8582! Jur-land, Schweinfurth, 13! 1339! 1730! 2888! Wayo, in Muro Territory, Petherick!—Uganda; scattered woods near Changu, at the mouth of the Katonga River, Scott Elliot, 7472! without precise locality, in the jungle, Wilson, 146! Buddu, Dawe, 240! German East Africa; Marungu, Volkens, 2145! (Herb. Mus. Brit.).—Congo State; Lower Congo, without precise locality, Smith, 72! (Herb. Mus. Brit.), Mayombe, Laurent! Boma, Laurent! Matabi, Ducoiffe! Cataract District; Bingila (?) Dupuis! without precise locality, Laurent! Luvituku, Pynaert, 79! Stanley Pool District; Stanley Pool, Desmeuse, 192! Laurent! N'Dembo, Gillet! Kisantu, Gillet! Leopoldville, Pynaert, 162! Lake Leopold District; Fini, Laurent! North East District; Route Guruza to Mangara (near Suronga), Seret, 389! Mapussi to Koko, Seret, 389! Lualaba District; Lula River, Descamps! Lulubourg, Cambiers! Lescrauwaet, 314! Eastern Province; Katanga, Lukofu, Verdick!—Angola; Catomba, Welwitsch, 2573! district of Malange, Gossweiler, 1237!

All the specimens quoted above from the Congo State, excepting that by Smith, are in the Brussels Herbarium, and were kindly lent us for examination by Dr. E. De Wildeeman.

An interesting superstition exists amongst the natives of Angola regarding this species. Ficalho, in Pl. Uteis, p. 198, states:—"It is a small tree not exceeding 5-9 feet in height, but it has a relatively large trunk, and inhabits the stony, rather dry lands of Cazengo, Golungo Alto, and Ambaca. The wood is of a clear yellow colour, extremely hard, and of a notably fine grain. It is like boxwood—for which it might be substituted for many purposes,
perhaps even in engraving. The same species is met with in Huilla, particularly in the woods near the lake of Iabantala, where it attains larger dimensions. In those parts it is called muldbi. It is one of the fetish plants. The negroes of the interior of Angola believe that it is a protection from lightning—perhaps in virtue of the great hardiness of its wood, as Welwitsch observes—and are in the habit of putting the branches on the tops of their huts, believing that they thus obtain shelter from electrical discharges. From this supposed virtue Welwitsch derived the specific name of Jovistonantis, dedicating it to the God of Thunders.”

According to Seret, the seeds yield a black dye for painting the skin. The wood is very hard, and is used for the manufacture of knife-handles.

Flowering specimens much resembling this species were collected by H. Waller at the foot of Morambala Hill, where the fruits form the favourite food of the elephants.

  German East Africa; sandy creeks of the coast; Emple, 2199, Kirk! (fruit in Kew Museum).

5. G. Thunbergia, Linn. fil. Suppl. p. 162 (descr. emend.).
  Bot. Mag. t.1001 ; Drapiez, Herb. Amat. Fl. vii. t. 554 ; Wood, Natal Plants, t. 40 ; Sims, For. Fl. Cape Col. t. 78. Gardenia verticillata,

Arbuscula, 2-5 m. alta, vel frutex; rami cortice griseo vel albido tecti, etiam juniores glabri. Folia cum floribus coetanea, rotundato-ovata vel
  obovata, breviter vel longius acuminata, acumine pleurnque obtuso, basi
  enneatim attenuata lamina magis minusve in petiolum brevem decurrente,
  5-7 cm. longa, 3-4 cm. lata, papyracea, fere concoloria, glabra nisi in
  nervorum axillis pilosa, nervis lateralis utrinque tenuissimis obliquis,
  venis laxis inconspicuis; petiolus 2-4 mm. longus; stipula in tubum
  connata, scarioso-membranacea, unilateraliter fissae, demum circumcissiles,
  summae ad 12 mm. longae. Flores ad ramulorum breviorum apices, solitarii,
  sessiles inter ramulos orti. Receptaculum obconicum, 10-12 mm. longum,
  tenuiter sericeo-pubescentis. Calyx tubulosus, 5-8-lobus; tubus superne uno
  latere fissus, extus glaber vel magis minusve appresse pilosus, intus densissime
  appresse tomentoso, ultra lorum insertionem breviter productus; lobi foliacei,
  breviter vel longiusculae petiolati, laminis spatulatis vel obovato-
oblongis vel ovatis basi infundibuliformibus 5–12 mm. longis, petiolis sepe in tubo breviter decurrentibus. *Corolla* albae tubus cylindricus, 4–8 cm. longus, medio 3–4 mm. diametro, extus glaber, intus superne pubescens; lobi 8 (raro 9), oblique obovati vel obovato-oblongi, 2‘5–4‘5 cm. longi, 1‘5–2‘5 cm. lati, glabri. *Antherae* medio affixe, 22–23 mm. longe, 4–5 mm. exsertae. *Stylus* 5‘5–9 cm. longus, a medio pubescens, sursum multo densius vestitus; stigmatis lobi obovato-oblongi, 6–7 mm. longi. *Ovarium* placentis 3–5. *Fructus* ellipsoideus, 4–5‘5 cm. longus, 2‘75–3‘5 cm. diametensis, albidus; pericarpium durum, fibris lignosis crassiusculis ereberrimis. *Semina* =, lenticularia, majora 6–7 mm. diametro, nigra.


South East Africa:—Gazaland; Lebombo Mountains, Saunders! Delagoa Bay; Rikaltu, Junod, 218!

7. G. ASPERULA, Stapf et Hutchinson (sp. nov.).

*Frutex* vel arborescens, spinis validis (ramis commutatis). *Rami* juniores pubescentes, demum fere glabri. *Folia* lanceolato-vel elliptico-oblonga, rarius subobovata, sessilia, 4–6‘5 cm. longa, 2–3 cm. lata, obtusa vel subacuta, tenuiter coriacea, utrinque puberula, nervis lateralis utrinque 8–10 obliquis intra marginem areatis, utrinque prominentibus, venis conspicuis; stipulae scariosae, 2 mm. longe, pubescentes. *Receptaculum* oblongo-obconicum, 5–10 mm. longum, brevissime pubescentes. *Calyx* tubulosus, 6–9-lobus; tubus sepe superne uno latere fissus, 9–12 mm. longus, extus brevissime pubescentes, intus infra medium appresse tomentosus; lobi subfoliacei, oblongi vel spatulati, obtusi, ad 15 mm. (raro 20) longi et ad 4 mm. lati, interdum parte coaliti. *Corolla* alba, suaveolens; tubus cylindricus, 4–6 cm. longus, medio circa 3 mm. diametro, extus parce longe pilosus, intus fere glaber; lobi 6–9, oblique obovati, 2–3 cm. longi, 1–1‘5 cm. lati. *Antherae* 1–2 cm. infra faucem insertae, medio affixe, 10–13 mm. longe. *Stylus* 4‘5–8 cm. longus, supra medium pubescens, infra medium fere glaber; stigmatis lobi exserti, complanati, ob lanceolati, obtusi. *Ovarium* placentis 6. *Fructus* pyriformis, durus (fide Sieynaert).
Nyasaland to South-East Rhodesia;—British Central Africa; Lake Shirwa, 
Meller! Shire Highlands, Buchanan, 174! Portuguese Nyasaland; between Unango and Mt. Mtonia, Archdeacon W. P. Johnson! South-
East Rhodesia, Melsetter District, open woods at Chirinda, Swynnerton, 56!
(Herb. Mus. Brit.; fruit in carp. coll.). Chihere Hills, 3500 ft., Swynnerton,
56! (Herb. Mus. Brit.). Chindas name, ‘Chindharara’; Singum name,
‘Isivalhungwii’.

A specimen collected by the Hon. Mrs. E. Cecil in Matabeleland near
Enkeldoorn, no. 88, has quite the facies of G. asperula, excepting the more
obovate leaves and narrow calyx-lobes. It is described by her as a bush
8–10 feet high, with ivory-white or pale-yellow flowers.


South-East Africa;—Gazaland, Lebombo Mountains, Saunders! Natal
and Zululand, Gerrard, 1620!

9. G. Spatulifolia, Staff! et Hutchinson (sp. nov.).

G. Thunbergia, K. Schum. in Baum Kunene-Samb. Exped. p. 385 (non
Linn. f.).

Arbor circiter 7 m. alta. Rami glabri. Folia obovato-spatulata, basi
cuneata, 3–9 cm. longa, 2–5 cm. lata, apice rotundata, vel breviter obtuse
acuminata, chartacea, utrinque glabra vel leviter scabrida, nervis lateralibus
5–11 fere flabellatim divergentibus utrinque prominentibus, venis utrinque
conspicuis; stipula latae, scarioso-pubescentes, circiter 2 mm. longae. Recep-
taculum oblongum, 1 cm. longum, breviter pubescens. Calyx tubulosus;
tubus spathaceus vel cylindricus, 7–14 mm. longus, extus glaber vel breviter
pubescens, intus pilosus; lobi 7–9, spatulati et tunc foliacei vel magis
minusve redncti et lineares, usque ad 1.5 cm. longi et 8 mm. lati, interdum
minuti, in eodem calyce variabiles, glabri. Corolla primo pallide, demum
saturate flavo; tubus cylindricus, 5–7.5 cm. longus, medio circiter 3 mm.
diametro, extus glaber, intus glaber vel superne parce pubescens; lobi 6–7
(raro 9), elliptici vel oblique obovati, 2–5 cm. longi, 1.5–3 cm. lati, glabri.
Antherce 2 cm. longe, 1.5 cm. infra faucem insertae. Stylus 5–8 cm. longus,
pubescent; stigmatis lobi 6, 4–7 mm. longi, obtusi. Ovarium placentis 6.
Fructus ignotus.

Tropical South Africa, from the Cunene to Gazaland;—Mossamedes;
Bumbo, Welwitsch, 2579! (Herb. Mus. Brit.). Cunene River, Johnston!
Chihinde, Baum, 39! Bechuana Land; Lake Ngami, Atherstone, 34!
Botlelle River, Lugard, 7! South Africa, without precise locality, Chapman
& Baines! Rhodesia; Sebakere tree 15–20 feet, flowers cream-coloured,
sweet-scented, alt. 4000 ft., Eyles, 175! (Herb. Mus. Brit.). Gazaland;
Sabi River, Swynnerton, 715! (Herb. Mus. Brit.).
Baum (Kunene-Sambesi Exped. p. 19) observes that this tree is frequent from the Lower Kunene to the Kuito River, mostly growing in the valleys of the rivers. The tree attains rarely more than 15-18 feet, having a short stem with a greenish bark, and a large dense and rounded top. The fruits are eaten by the Kudu Antelope, and the hard wood is used by the natives for making handles, &c. The tree is known to the Boers as 'stumpdorn.'


Arbor vel frutex divaricatus, 2-5 m. altus. Rami glabri. Folia oblongo-lanceolata vel obovata, sessilia, subacuta vel rarius rotundata, basi cuneata, 4-9 cm. longa, 2-4.5 cm. lata, subcoriacea, utrinque glauca, glabra, nervis lateralis utrinque 7-11 obliquis, venis utrinque prominentibus arcte anastomosantibus; stipulae late ovatae, 2 mm. longae, glabrae. Receptaculum oblongum vel oblongo-obconicum, 6-10 mm. longum, glabrum. Calyx tubulosus, subtruncatus vel 6-lobus; tubus 8-15 mm. longus, utrinque glaber; lobi oblongi, usque ad 5 mm. longi, obtusi, glabri, interdum minuti. Corolla flavida; tubus cylindricus, 4.5-9 cm. longus, medio 2-3 mm. diametro, utrinque glaber; lobi 6, oblongo-elliptici, 2.5-5 cm. longi, 1-2.5 cm. lati, utrinque glabri. Antherae 1.5 cm. longae, 1.5 cm. infra faucem insertae. Stylus 5-9 cm. longus, breviter pubescens; stigmatibus lobi 5-6, usque ad 5 mm. longi, exserti. Ovarium placentis 6. Fructus ambitu oblongo-ellipticus, 5-7 cm. longus, usque ad 5 cm. diametro; pericarpium fibrosum, 1 cm. crassum. Semina subglobosa, maiora circa 4 mm. diametro, fulva.

Nigeria to the Gold Coast:—Northern Nigeria; Kuka, Bornu, E. Vogel, 92! Katagum District, Dalziel, 162! 161 (in part; fruiting specimen)! Zungeru, low bush, Elliott, 30! Dalziel! Nupe Country, Baikie! Barter, 1205! Southern part of N. Nigeria, without precise locality, Kentish-Rankin! Southern Nigeria; Oloke Meji, 6 feet high, flowers white, Dodd, 401! Gold Coast; Accra (Gah) and Adampi, Thonning! (Herb. DC.).

11. G. lutea, Fresen. in Mus. Senckenb. ii. (1837) p. 167 (descr. emend.).


Arbor vel frutex magnus. Rami tenuiter pubescentes. Folia 3-4-na, verticillata, sessilia, obovato-oblonga, obtusa, basin versus angustata, 4-13 cm. longa, 2-5 cm. lata, coriacea, glabra, fere concoloria, utrinque nitida, nervis lateribus 8-12 patulis vel interdum leviter obliquis, venis laxis utrinque conspicuis (praecipue subtus); stipulae scariosae, late ovatae, pubescentes, usque ad 4 mm. longae. Receptaculum oblongo-obconicum, 5-8 mm. longum, glabrum vel pubescens. Calyx tubulosus, 6-7-lobos; tubus cylindricus, sepe superne uno latere fissus, extus glaber vel pubescens, intus glaber vel
breviter pilosus; lobi 6–7, lineares, in tubo breviter decurrentes, usque ad 5 mm. longi, glabri. *Corolla* flavae; tubus cylindricus, apicem versus leviter dilatatus, 5–9 cm. longus, medio 1.5–3 mm. diametro, utrinque glaber; lobi 6–7, elliptici vel obovato-oblongi, 2.5–3.5 cm. longi, 1–2 cm. lati, utrinque glabri. *Antherae* 1–8 cm. longae, 1–5 cm. infra faucem insertae. *Stylus* inferne minute pubescens, apice incrassatus, 5–9 cm. longus; stigmatis lobi oblongi, obtusi. *Ovarium* placentis 6. *Fructus* ambitu oblongo-ellipticus, 4–6 cm. longus, breviter stipitatus, 2–3 cm. diametro; pericarpium fibroso-lignosum, circiter 5 mm. crassum. *Semina* ellipsoidea, 4 mm. longa, glauca.


According to Capt. Speke ('Nile Journal,' Append, p. 636) the roots of this species boiled with the flour of *Andropogon Sorghum* are considered by the 'Wanyamwezi' to be a cure for haematuria; the contorted branches make an impenetrable fence.


From the Senegal to Sierra Leone:—Senegambia; *Roger! Leprieur & Perrottet!* (Herb. *DC.); north bank of Gambia, *Ozaune,* 7! *Whitfield* (in part)! (Herb. Mus. Brit.). *Sierra Leone, Smythe,* 1!

We are much obliged to M. Cas. De Candolle for the loan of the type which enabled us to confirm Mr. Williams's conception of it as a distinct species.

According to Voight the plant described by Carey as *G. macrocarpa* was raised at Sibpure from seed received from Loddiges & Co. in 1822. This was the year when (Feb. to April) G. Don collected in Sierra Leone for the Horticultural Society of London, and it is very probable that Loddiges obtained the seeds from him.
13. *G. Goetzei*, Stapf et Hutchinson (sp. nov.).

Frutex vel arborescens. Rami dense tomentosi, deinde cortice flavescente tecti. *Folia* sessilia, obovata, apice rotundata, 2–6 cm. longa, 1:5–4 cm. lata, tenuiter coriacea, utrinque scabridula, nervis lateralibus utrinque 8–11 subpatulis utrinque prominentibus, venis arce anastomosantibus; stipulae breviter vaginantes, truncate, extus tomentose. *Receptaculum* oblongum, 5 mm. longum, dense pubescens. *Calyx* tubulosus, 6-lobus; tubus superne uno latere fissus, 1 cm. longus, utrinque tenuiter pubescens; lobi oblongolati, obtusi, ad 1 cm. longi et 2 mm. lati, glabri, in tubo decurrentes. *Corolla* tubus cylindricus, 3–5 cm. longus, medio 3 mm. diametro, utrinque tenuiter pubescens; lobi 6, ovato-elliptici, obtusi, 1–1:5 cm. longi, 5–10 mm. lati, utrinque parce pilosuli. *Antheræ* circiter 1 cm. longae, 8 mm. infra faucem insertae. *Stylus* 3–4 cm. longus, parce pubescens; stigmatis lobi 8 mm longi, fere inclusi. *Ovarium* placentis 6. *Fructus* ignotus, German East Africa: —Ulunguru, Kissaki-Steppe, Goetze, 44!

14. *G. Aequalla*, Stapf et Hutchinson (sp. nov.).

Frutex ramosissimus, 1–2:5 m. altus, ramis subprostratis (vide Schweinf.). *Folia* magnitudine valde variabilia, oblongolata vel (minora) elliptica, 2:5–18 cm. longa, 1–5 cm. lata, apice rotundata, rarius obtuse subacuminata, supra scabrida, subtus hispidula, coriacea, nervis lateralibus utrinque 14–17 praecipue subtus distinctis; stipulae late triangulares, 4 mm. longae, pilose. *Receptaculum* oblongum, 6 mm. longum, dense appresse pubescens. *Calyx* tubulosus, 6-lobus; tubus cylindricus, 8 cm. longus, utrinque appresse pubescens; lobi lineari-subulati, 3–4 mm. longi, subacuti, pubescentes. *Corolla* alba, demum citrina; tubus cylindricus, 2:5–4 cm. longus, medio 2 mm. diametro, extus dense appresse pubescens, intus tenuiter pilosus; lobi 6, oblique ovati vel elliptici, 2–2:5 cm. longi, 1–1:5 cm. lati, extus parce pubescentes, intus glabri. *Antheræ* 5 mm. infra faucem insertæ, 1 cm. longae. *Stylus* 4:5 cm. longus, parce pubescens; stigmatis lobi brevi, obtusi. *Ovarium* placentis 6. *Fructus* ambitu ellipticus, costatus, 3:5–4 cm. longus, 1:5–2 cm. diametro; pericarpium durum, 3 mm. crassum, brunneo-maculatum.

From the Bahr-el-Ghazal to Yoruba: —Jurland; Seriba Kurschuk Ali, Schweinfurth, 1751! Seriba Ghatta, Schweinfurth, 1969! at Okel, Schweinfurth, 1761! (Herb. Mus. Brit.). Upper Ubangi; Snussi Country, Ndelle, Chevalier, 8071! Nigeria; Katagum and district, Dalziel, 352! Yoruba, low spreading shrub, not frequent (fruit spec. only), Barter, 1234!
15. G. erubescens, Stapf et Hutchinson (sp. nov.).


_Arbor_ 5-6-5 m. altus, cortice platanoideo (_fide_ Schweinf.). _Rami_ juniores dense sericeo-tomentosi. _Folia_ late obovata vel oblongo-lanceolata, basi cuneata, 4-5-16 cm. longa, 2-9 cm. lata, chartacea, utrinque glabra, supra interdum purpurascens, subtus glauca, nervis lateralibus 6-8, venis supra sepius distinctis subtus inconspicuis; petioli usque ad 4 mm. longi; stipulae late, 3 mm. longe, tomentose. _Receptaculum_ oblongum, 4-8 mm. longum, dense tomentosum. _Calyx_ tubulosus; _tubus_ 6-12 mm. longus, dense tomentosus, demum subglaber, intus longe pilosus, dentibus 6 filiformibus 6-10 mm. longis. _Corolla_ pallida, demum citrina (_fide_ Schweinf.); _tubus_ cylindricus, 2-5-7-5 cm. longus, medio circa 3 mm. diametro, utrinque tenuiter pilosus; _lobi_ 6, elliptici, 2-3 cm. longi, 1-5 cm. lati. _Antheræ_ 6, fere incluse, 7 mm. infra faucem insertae, supra medium affixe, 2 cm. longe. _Stylus_ 3-7 cm. longus, breviter pilosus; stigmati _lobi_ oblongi, obtusi, 3-5 mm. longi. _Ovarium_ placentis 6. _Fructus_ ambitu oblongo-lanceolatus vel fere ellipticus, 5-8 cm. longus, 2-5-3 cm. diametro.

From the Bahr-el-Ghazal to the Senegal:—Mittu-land; at Reggo, _Schweinfurth_, 2792! French Sudan; Nigalia, _Chevalier_, 160! Northern Nigeria; Kontagora, common in the bush, _Dalziel_, 224! Katagum District, _Dalziel_, 161 (in part; flowering specimen)! French Guinea; Samu Country, near Tombia, in bush near the village, _Scott Elliot_, 4370! near Wallia, _Scott Elliot_, 4574! Gambia; _Whitfield_ (in part)! (Herb. Mus. Brit.).
Altitude and Distribution of Plants in Southern Mexico. By Hans GaBOW, M.A., Ph.D., F.R.S. (Communicated by Dr. A. B. Rendle, M.A., F.L.S.)

(With two diagrams.)

[Read 18th June, 1908.]

Professor A. Heilprin, in his very important paper, "The Temperate and Alpine Floras of the giant Volcanoes of Mexico" * , makes the following summarising statement:—"The preponderating element in the upper Mexican flora [from 10,000 feet upwards] is made up of forms which distinctly represent the temperate and arctic regions, and not of modifications, suited to a more rigorous climate, of the lower or basal floras of the same region. This condition characterises the high mountain floras of tropical regions generally, as distinguished from those of temperate climes." He refers to Engler † as the originator of this view, and continues: "Most of the Mexican plants occurring above 10,000 feet are specifically distinct from the congeneric forms of temperate North America, while about 10 per cent. of the species of high Mexican mountains are identical with those of the much more distant Andean summits.”

According to Engler the alpine plants of Mexico are not connected with the plants of the subtropical and tropical regions of the same country, and he says further that, "whilst in California and on the Rocky Mountains part of the alpine flora is indeed derived from that of the plains, this is not the case in Mexico, because there the plants of the lower regions vegetate during the whole year. It is impossible for them quickly to acquire an organisation necessary for a prolonged period of rest, or the means of protection necessary for defence during such a time of rest. The plants of California’s plain are already organised for enduring a prolonged and more or less inclement period, so that their descendants can gradually acquire the features necessary upon the new highlands.”

These statements, probably as correct as they are ingenious, yet convey a somewhat erroneous impression, because they are incomplete and too general. If the alpine flora of a mountain in the tropics has not been derived from its base, it can have got to the top in two ways only—either by accident (wind, animals), or as a relic. The latter notion resorts, of course, to a glacial period as the favourite explanation; its importance has been greatly exaggerated, and good instances of arctic, even subarctic, animals and plants as derelicts on subtropical, leave alone tropical, mountains are exceedingly

† Versuch einer Entwicklungsgeschichte der Pflanzenwelt, ii. 1882.
rare. Within subarctic and temperate countries such cases are naturally more common, although even there the principle has been greatly exaggerated. In either case, relics or accidental,—restricting ourselves to the Mexican mountains, the species should be presumably the same on the tropical tops and in the more distant arctic regions. But if the top flora has been derived from the basal, by modification, then there is every reason for suspecting that the plants should be specifically different. This is actually the case, to a great extent. Such a top flora may assume even an arctic facies, by convergence, by adaptation to similar environmental conditions.

Engler's explanation of the Californian and Rocky Mountain floras applies also to Mexico. Without exception the highest mountains of this country arise from the plateau, at least with one side, whilst the other, most conspicuously on Citlaltepetl, slides right into the tropics. Now, this plateau gives the temperate and cool flora a very good lead, so much, indeed, that the implied change into alpine species need be but very gradual, and the huge central plateau sloping from 7000 feet in the south to 3000 in the north, whilst maintaining continuity all along the backbone of the western Sierra Madre, insures an ideally perfect continuity of the same conditions from California, Arizona, and Sonora (the ancient Sonoraland, which stood out long before the rest of Mexico came into existence during the later Cretaceous epoch) to the truly alpine heights which now border the southern edges of the plateau.

So far, then, it must have been easy for plants of temperate North America to spread to the high Mexican mountains, but the distance is great and physical conditions have changed, and after all the bionomic conditions of the Mexican highlands are not the same as those of the United States, even if the mean temperatures be the same: consequently most of the congeneric plants have become specifically distinct. But this same high Mexican plateau is possessed also of a great number of endemic, autochthonous plants, many of which have sent representatives into the alpine regions. Consequently these have received part of their flora from the immediate adjoining basal regions or plains. If these mountains were isolated, if they did arise as solitary cones out of the tropics, the investigation would be simple. We should have to deal only with those species, about 10 per cent. according to Heilprin, which they have in common with some of the Central American peaks, e. g. Irazu, and with the distant Andes: plants which owe their scattered, high-level distribution possibly to wind, birds, and similar accidental agencies.

But the high Mexican mountains stand in a very peculiar condition, namely on the edge of the plateau. For instance, on the west side of Citlaltepetl it rises gradually from 7500 to 9000 feet before we come to the shoulder of the giant, while the south-eastern side glides much more rapidly into the tropics. These mountains have, in fact, two base levels, one of them
being the plateau; the other, for instance, on the Sierra de Ajusco, which forms the southern border of the Valley of Mexico, finds its southern level in the plain of Cuernavaca, about 5000 feet, thence sloping further into the tropical Balsas basin. Similar conditions apply to Popocatépetl and to the Nevado de Colima.

Consequently all these mountains possess a very mixed flora. First, northerners (or shall we call them long migrants?); secondly, endemic ascendants from a temperate or cool immediate base; thirdly, southerners, or ascendants from the tropics; fourthly, the "Andines." It is difficult, perhaps impossible, to keep the main categories asunder, since the distinction between hot, temperate, cool and cold is arbitrary. Specialists in American plants will be able to do it better than the present writer, who has but little, secondhand, botanical knowledge.

Yet the attempt has been made to group the flora of Mexico into several main categories.

1. Northern plants*, with their presumable home in the temperate northern hemisphere.

2. Endemics of Mexico, which again naturally fall into a cool to temperate and a tropical or "Southern" category.

3. Southerners are of course also those which for the sake of shortness we refer to as Andines, leaving the question of their original home in abeyance; for instance, Acena (Rosaceæ), Tauschia (Umbellifææ), Perrottetia (Ericaceæ), Chionolea (Composite). Those which occur on Mexican high mountains do not, as a rule, extend further north, whilst they are found also in Central America and in South America, especially on the Andes.

I had no idea what the outcome would be of the necessary, almost endless, calculations and plottings, and yet they assumed a shape apparently so reasonable that it can scarcely be accidental. Thanks mainly to Heilprin the flora from 10,000 feet upwards is fairly well known, and his lists proved of the greatest value. But thence downwards all available data are vague. Papers like that by Liebmann on Citaraltepelt ("Botanische Zeitung," 1844), and Kotschy's "Survey of Mexican Plants," Sitzungsberichte Wien. Akad. Wiss., Feb. 1852, viii. (partly suppressed !), are very scarce; and unfortunately altitudinal distribution does not seem to have appealed much to the authors of the 'Biologia Centrali-Americana,' at least I have failed to find therein such general conclusions as I had, perhaps unreasonably, been looking for. The fourth of the volumes on Botany, more especially pp. 145-151 and 282-315, by W. B. Hemsley, forms nevertheless the main supply of data for

* For instance Pinus, Alies, Juniperas, Abies, Quercus, Sambucus, Platanus, Ulmus, Cornus, Viscum, Veratrum, Fingicula, Spirea, Thalictrun, Aquilegia, Delphinium, Pyrola.
this investigation. In this I have restricted myself to Phanerogams, minus Grasses, and I have assumed * for the Southern third of Mexico, i.e. from 21 degrees North to the Isthmus railway of Tehuantepec:

1600 species as found in the tropics.
2500 " " in the temperate belt, up to 7000 feet.
1300 " " thence upwards.
200 " " at 10,000 feet level, according to Heilprin.

Heilprin has ascended and thoroughly investigated Citlaltepetl, Popocatepetl, Hztacchuatlt, and the Nevada de Toluca. I myself have ascended the first two (with camps at 8500 and at 12,500 feet level) and the Nevada de Colina; of lower mountains the Sierra de Ajusco up to 10,000 feet, the Sierra Madre del Sur, above Omilteme near Chilpancingo, to about 9000 feet, and the Cerro de San Felipe near Oaxaca, of the same height.

Let us start with the 10,000 feet level. Heilprin mentions 117 genera with 199 species. Of these, leaving a few genera unclassed, there are about 62 Northern, 42 endemic, temperate and high-level ascendants, and 10 Southern ascendants and Andines.

Thence upwards we notice a rapid decline. At 12,000 feet the genera are reduced to 29, namely 21 Northerners, 3 endemic temperate (Echeveria, Arctostaphylos, Pentstemon), 4 Andines (Colobanthus, Avena, Pernettyia, Alchemilla?), and 1 Southern (Ageratum).

At 13,000 feet the genera are reduced to 17, namely 12 Northern, 2 endemic temperate (Echeveria, Arctostaphylos), and 3 Andines, Colobanthus having dropped out, and the southern Ageratum is likewise soon falling behind.

At 14,000 feet the 15 genera are composed of 11 Northerners, 3 Andines and the Echeveria.

Above 14,000 feet are only Arenaria, 2 Senecio, Castilleia, Echeveria, and Chionolana; in all 5 genera with 6 species. Engler (op. cit. p. 223) mentions Alchemilla tripartita for this high level on the Orizaba mountain. Only Arenaria bryoides, Chionolana lavendulaea, and Alchemilla tripartita reach the snow-line.

The tree-line lies between 13,500 and 14,000 feet, but since the only trees (Pinus Montezuma) are scattered for the last few hundred feet, the tree-line does not affect the few other plants.

Whilst at the 10,000 feet level the 62 Northern genera are still almost

* The numbers are necessarily vague and the tropical element of the Mexican flora is still very imperfectly known. These circumstances may, I trust, be an excuse for those corrections in my calculations which future research will no doubt find necessary. The principles which I have tried to draw attention to will, however, not be affected.
balanced by the 53 others, at 13,000 feet the Northerners have rapidly gained the preponderance, owing almost entirely to the rapid falling behind of the endemic ascendants, which are now reduced to the solitary Echeveria. This is very significant, as it seems to indicate that the native basal genera find it more difficult to adapt themselves to these arctic heights than do the long migrants, the Northerners, which were already prepared for such eventualities, to put the matter in homely language. But it is equally significant that the Andines, although always few in numbers, hold their own. Thus it comes to pass that above 14,000 feet the few Northern plants are balanced by the others, and that near the snow-line a solitary Northern Arenaria is confronted by the Andine Chionolea and by an Alchemilla.

From 10,000 feet downwards species and genera increase rapidly. This is not so much a fancy level as it would appear from the round number in feet, or 3100 metres. It fairly well marks the average top level of the main cloud-belt with its resultant moisture. Various calculations, notably at 9500 feet, at 8500 feet at our Xometla camp, and at 7000 feet, indicate that the increase is rather steady, and it seems that the absolute maximum of species is reached somewhere between 4000 and 5000 feet, the level of Orizaba. It is therefore possible to construct a curve from the 4500 feet level with 2500 species to the 10,000 feet level with 200 species. Further, it stands to reason, first, that the number of Southern species, which of course have their maximum in the tropics, decrease steadily from that base upwards; secondly, that the Northerners decrease steadily to sea-level, where we are not far wrong in assuming that they represent less than 5 per cent. of the plants found in the true tropics. But it is very difficult to ascertain in which level lies the absolute maximum of the Northerners. It lies, of course, not as low as 4500 feet, that is quite obvious, not even at 5000 feet. On the other hand, it does not stand at 9000 feet, since thence downwards Northern species and genera show a rapid increase. The mean between the two limits is 7000 feet, and this seems to agree fairly with actual conditions. It marks, moreover, the lower level of the cloud-belt, at least on the sides away from the plateau, with the average height of which it also coincides, and this is an important point. Lastly, broadly speaking, this level marks the change from the Oak to the Pine belt.

All such calculations must be vague; they are to a bewildering extent influenced by local conditions. On the northern side of Citlaltepetl, Popocatepetl, and Nevado de Colima the floral aspect is much more Northern than it is at the same level on the south slopes which are in direct communication with the tropics. The plateau side of Citlaltepetl strikes one

* It is important to note that the proportion differs but slightly whether we consider all the highest Mexican mountains, or restrict ourselves to Citlaltepetl.
Altitude and Distribution of Phanerogamous Plants in Southern Mexico
according to H. Gadow.

The number of species occurring at the various levels is indicated by the horizontal distances.

Original scale: 1 mm. = 6.5 species; reduced to one-half.

TOTAL SPECIES 200

TOTAL SPECIES ABOUT 1350

NORTHERN SPECIES, FROM 7000 FT
CLEARLY ASCENDANT

AT THIS LEVEL BALANCE BETWEEN NORTHERN & THE OTHER SPECIES

ENDEMIC MEXICANS, WITH GREATEST ABUNDANCE & PREPONDERANCE OVER THE OTHERS, IN THIS MID LEVEL OF 4500 FT, DESCENDING WITH STILL 300 SPECIES TO SEA LEVEL, ASCENDING TO, & DISAPPEARING IN HIGH ALPINE LEVELS

SOUTHERN SPECIES, WITH MAXIMUM IN THE TROPICS, PRESUMABLY AT 1500 FT

AT THIS LEVEL BALANCE IN NUMBERS OF SPECIES BETWEEN SOUTHERN & TEMPERATE + NORTHERN PLANTS

TOTAL NUMBERS OF SPECIES ABOUT 1300

100 NORTH, 300 TEMPERATES

900 TROPICAL SOUTHERN

TOTAL NUMBER OF SPECIES AT < 5000 FT
LEVEL ABOUT 2500

NORTHERN SPECIES DESCENDING TO SEA LEVEL

19000 FT
SNOWLINE

BELT OF CLOUDS & OAK & PINE FOREST

FRIA

TEMPLOADA

CALIENTE

19000 FT
SNOWLINE

BELT OF CLOUDS & OAK & PINE FOREST

FRIA

TEMPLOADA

CALIENTE

19000 FT
SNOWLINE

BELT OF CLOUDS & OAK & PINE FOREST

FRIA

TEMPLOADA

CALIENTE
Altitudinal distribution of the 250 species of Amphibia and Reptiles (in Southern Mexico).

The horizontal distances between the lines indicate the number of species occurring at the various levels. For instance, at level 4500 feet there are about 100 species, of which Northerners 20 ascendant and 10 descendant, about 15 restricted to temperate belt, and 53 ascendant Southerners. At level 3000 feet are about 125 species, of which 30 non-tropical and 95 tropical.

Original scale 2 mm, reduced to \( \frac{1}{2} \)ths = 1 species.
as barren, whilst the south and east appear luxuriant. Then there is the impressionist bias of the leading features to contend with. We are impressed, for instance, at Xometla (south-east side of Citlaltepetl, 8500 feet) by the forest composed of Pines, Oak, Arbutus, and Alder; they are the dominant feature, truly characteristic of that level, but they do not make up the majority of the species, which being smaller, although much more numerous, are far less impressive. But when we gather during an hour's ramble at haphazard an armful of plants, even if with the unscientific intention of making a bouquet of flowers, then the true state of affairs soon becomes clear. The Northerners are comparatively easy to sort out, they being old friends, while the others are endemic Mexicans, and in such the country is extremely rich.

They increase the lower down we go. At such a delightful level as Orizaba, Oaxaca, or Chilpancingo, i.e. between 4000 and 5000 feet elevation, whence high levels or a deep and wide valley can be reached by a few hours' excursion, we are struck with another state of affairs. The Northerners are few and far between, no longer obtrusive, nearly every plant is new to us; but the plants after an hour's climb higher up give a very different impression from those which we meet at the bottom of the valley. The latter kinds, in looks and behaviour, make up a tout ensemble which we recognise as typical of the Tierra caliente, even if we have but slight experience of the tropics. Indeed, it is surprising what a change a thousand feet up or down can imply, not everywhere, but at the right level, and such a level is that mysterious border-land between what the natives call the Tierra caliente and the Tierra templada. Not much happens when safely within the Tierra templada, whether we are at 4000, 5000, or 6000 feet, but the changes are truly surprising which meet the traveller who crosses the ranges of hills, themselves only a few thousand feet high, which run parallel with the coast of Guerrero. There, at the bottom of the valleys, for instance on the Rio Omitlan, we are in the unmitigated tropics with nothing whatever to remind us of Northern influence; but one thousand feet higher, on the ridge, we are amongst Oaks and Pines and the tropical life is gone, although there, at 17° N., we are at a level of less than 2000 feet above the sea. We descend within an hour on the other side, to meet the same river winding its way through the full glory of the tropics.

It is one of the great attractions, and a circumstance which makes Mexico so valuable for the study of altitudinal distribution, that there we can get so easily into and out of the tropics. This is the case, first because the country is so extremely varied in its structure, secondly because most of it lies just upon the border-line of the tropical belt of the world.
But to return to our diagram. The area of the Southern species, and the long strip of the Northern species according to the plan adopted for the plotting out, enclose of necessity a large odd-shaped area which of course is not a vacuum. It represents the endemic temperate species of which we know how many extend into the alpine region, and of which many more grow down into the hot lands. It does not matter much whether we allow 200 or 600 species for this base; nor does it matter whether we increase the absolute total number from 2500 to 4000 and refer it either to the 3500 or to the 5000 feet level. The general shape of the diagram with its three areas will remain essentially the same; in other words, the broad principle expressed by it is correct. The shape of the diagram is odd, bulging out as it does at the 4500 feet level; but this very odd shape is another great point in its favour of being correct, since it graphically represents the respective areas of the hot, temperate, and cold regions of the country. A great portion of Mexico is high plateau with a mean elevation of perhaps 5000 feet, fringed east, south, and west by high Sierras, whilst the hot country, although formed by extensive coast-lands, is of comparatively small extent. But the southern portion of Mexico is much intersected by mountain-ranges and by deep depressions; for instance, the large Balsas basin extends so far inland that it is exceedingly difficult to apportion the various areas, especially if we remember that much of the country is but imperfectly surveyed.

The following calculations can therefore be approximate only. Reckoning the country between 21° N. and the Isthmus to contain 185,000 square miles, I have apportioned 75,000 square miles to the Tierra caliente, 85,000 to the Tierra templada, and 25,000 square miles to the Tierra fria or to what lies above 7000 feet elevation. What lies above 10,000 feet can amount at most to a few hundred square miles.

The quotient of the areal number of square miles, divided by the number of species occurring, I call the areal density of species.

Thus we have:

<table>
<thead>
<tr>
<th></th>
<th>Area in square miles</th>
<th>Number of species</th>
<th>Areal density, i.e., an average of - sq. miles to every species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tierra caliente</td>
<td>75,000</td>
<td>1600</td>
<td>47</td>
</tr>
<tr>
<td>Tierra templada</td>
<td>85,000</td>
<td>2500</td>
<td>34</td>
</tr>
<tr>
<td>Tierra fria</td>
<td>25,000</td>
<td>1300</td>
<td>19</td>
</tr>
</tbody>
</table>

The result is somewhat surprising: the areal density of species increases steadily from the tropical belt upwards! That of the tropics compared with
that of the temperate zone is almost exactly like $2$ to $3$; tropics compared with the cool zone like $1$ to $2\frac{1}{2}$. If the temperate zone be taken as the normal condition, then the hot zone with its 75,000 square miles should have 2200 species instead of the assumed 1600, and the cool zone with 25,000 square miles should possess only 730 instead of 1300 species—i.e., the cool zone has twice as many as expected; and this is the case because most of the 1300 cool zone species have got up there so easily from the temperate base.

It would be ridiculous to conclude from the above Table that the Tierra fria is more favourable for plants, as regards number of species, than the Tierra caliente.

It seems a paradox that the areal density should increase from the tropical belt upwards. But the underlying principle, or solution, appears clear if we remember that on a very small area—say that of 10,000 feet elevation—with 200 species, the areal density would be enormous, perhaps averaging one species for every square mile, since in such places the species, although few, are crowded as if they were on refuge islands. If the area of the Tierra fria were three times as large as it is, equal to that of the tropical belt, there would probably be still not more than 1300 species, i.e. with an areal density of $19 \times 3 = 57$, i.e. much smaller than that of the tropical belt.

But the fact remains that the Tierra templada of Southern Mexico is richer than the tropical belt, probably for the following reasons. The upper limit of the Tierra caliente is generally assumed to lie at 3000 feet elevation; undoubtedly this is not enough on the moist Atlantic side, but rather too much on the much drier Pacific slope. The belt of the Tierra templada, in this paper from 3000 to 7000 feet, comprises 33 per cent. more in vertical extent, and it comprises, moreover, in its larger area the most varied features, more varied and juxtaposed than exist in the other regions, from sweltering tropical rain-forests to vast arid tablelands. All the mountain-ranges of middle height lie in the Tierra templada, with their mysterious cloud-belt (not to be confounded with the cloud-belt which reaches from 7000 to 10,000 feet elevation on the giant mountains). Innumerable brooks exist in the Tierra templada before they combine into larger and therefore less varied rivers; there are deep depressions in the Central Plateau with a semi-tropical climate, and also high wind-swept plateaus exposed to excessive heat in the summer days and to frost in the winter.

In short, the great variety of environmental conditions is responsible for the richness of the flora of this intermediate belt, the most delightful and prettiest of all Mexico.

It is therefore all the more interesting that this obviously reasonable
conclusion does not at all apply to the distribution of Amphibia and Reptiles, two groups which I have submitted to a detailed scrutiny.*

Tierra caliente with 173 species. Areal density 434 square miles.
Tierra templada ,, 100 ,, ,, 850 ,, ,,  
Tierra fria ,, 86 ,, ,, 290 ,, ,,  
Above 10,000 ft. ,, 10 ,, ,, 20 ,, ,,  

The total number of species in Southern Mexico is 250.

The actual number of species decreases from the tropics to the higher levels, just as we might expect; and the fewer species of the cool regions, just over half of those in the tropics, being condensed upon one-third of space, show naturally a much larger areal density. This is also not surprising, and it agrees with the plants. But the temperate belt possesses only 100 species; it is therefore comparatively by far the poorest of the three zones. I have been able to sift the total of 250 species into two categories.

I. Southern or hot-country species.
Restricted to hot countries ............. 44 per cent.
Ascending into temperate countries ... 16 ,,  
Ascending into cool zone ............. 5 ,,  

II. Northern or cool-country species.
Restricted to cool or cold zone ........ 17 per cent.
Descending into temperate zone ...... 8 ,,  
Descending into hot countries ...... 4 ,,  

The remaining 6 per cent,—or, allowing for the difficulty of sorting intermediate species, at most 10 per cent,—are species which seem to be restricted to the temperate belt. This surprisingly small number—only about 15 to 20 species—does not represent the Sonoran or truly endemic stock, but is for the most part composed of Southern ascendants or Northern descendants, which, so to speak, have stuck at this level and there have been modified into the respective species.

* The "Distribution of Mexican Amphibians and Reptiles," Proc. Zool. Soc. 1905, ii. pp. 191-244 (with tabulated lists and 6 diagrams to illustrate the contours of Mexico at different geological ages).
Mexico, although genetically part of the North American continent, has received its present fauna from both North and South America. The Northern fauna, which includes the Sonoran, and therefore what may be called the endemic Mexican stock, is the oldest arrival and its species belong now mostly to the cool and cold zone: the fauna of the plateaus is made up essentially of those Northerners which have spread, although thinly, over the elevated plains; some have remained in the temperate zone and a few have passed into the tropics. The Southern fauna has surged northwards through the Tierra caliente, both east and west of the plateau. This plateau as such presents a most effective barrier to the Southerners, few of them having to a small extent spread on to it, whilst some Southern species have succeeded in reaching greater elevations on those mountains which slope into the tropics. Lastly, those few species—about 15 to 20—which are restricted to the temperate zone and yet are not ancient endemics, show that, for Reptiles and Amphibia, the temperate belt is rather no-man’s land than the happy medium favourable to the majority.
Reports on the Marine Biology of the Sudanese Red Sea.—IX. Algæ.
By R. J. Harvey Gibson, M.A., F.L.S., Professor of Botany, University of Liverpool.

[Read 5th December, 1907.]

[Reprinted from the Journal, Zoology, Vol. xxxi, pp. 70-80.]

The following notes are the result of an examination of a small collection of Marine Algae made by Mr. Crossland during 1904 and 1905, while engaged in investigations on the Sudan Marine Fauna, under the direction of Professor W. A. Herdman, F.R.S. Professor Herdman has handed me the collection for identification and report.

The plants were collected chiefly in the neighbourhood of Suakim and Trinkitat, and include 35 species, of which 12 belong to the Chlorophyceae, 12 to the Phaeophyceae, and 11 to the Rhodophyceae. In addition, 4 species of marine or brackish-water Phanerogams occur among the Algae, and are given in an Appendix.

I am greatly indebted to Dr. M. Foslie, of Trondhjem, Dr. Reinhold, of Itzehoe, and to Mrs. Gepp for aid in identification of some of the calcareous and other forms both among the Rhodophyceae and Chlorophyceae, and also to the officials of the Cryptogamic Department of the Natural History Museum for aid rendered to me during a brief visit to the Museum for the purpose of identifying some of the more critical forms.

In addition to records of Algæ of the Indian Ocean and East Africa in more general works such as those of Agardh, Engler, Harvey & Sonder, &c., the following papers, dealing more especially with the forms occurring in the Red Sea and its immediate vicinity, have been consulted:—

ZANARDINI: "Plantarum in Mari Rubro lucusque collectarum enumeratio" (Mem. dell! I. R. Ist. Veneto, 1858).
HAUCK: "Ueber einige von J. M. Hildebrandt in Rothen Meere und in Indischen Ocean gesammelte Algen" (Hedwigia, 1886-89).

CHLOROPHYCEÆ.


This variety was dredged in 2-3 fathoms off Suez. It is recorded from LINN. JOURN.—BOTANY, VOL. XXXVIII.

[76]
the Red Sea by Agardh, from Suez by Zanardini, and from the Somaliland Coast by Piccone.


Collected on coral-reefs at Khor Dongola, Suez. Recorded by Zanardini, under the name of *C. chemnitzi*a, var. *peltata*. It is not recorded by Piccone.


Dredged at 2–3 fathoms at anchorage off Suez. Recorded by Zanardini, under the name of *H. monile*, from Suez, Akaba, and Kossieir.


Collected in shallows in Suakini Harbour.

5. *Halimeda opuntia*, Lamx.

The plant here referred to seems intermediate in character between the f. *typica* and f. *cordata* of Barton’s Monograph. This identification is on the authority of Dr. Reinhold.


Suez Bay. Recorded from the same locality by Zanardini, under the name of *Chloroplegma sordidum*.


Suakim. This is a Malayan and Indian Ocean species, not recorded in any of the Red Sea lists above referred to.


Mud-flats in Suez Bay. Recorded and figured by Zanardini as a new species. The present plant agrees in all respects with Zanardini’s figure and description, as was pointed out to me by Mrs. Gepp.


This form occurred along with sponges forming large patches on the sands at Khor Dongola. It is recorded as *Valonia favulosa*, Ag., from the Red Sea by Zanardini and by Piccone.


One small and somewhat mangled plant was found attached to *Lithophyllum affine* (34). It was unmistakably, however, *C. tomentosum*, which has been recorded by several authors from the Red Sea.
11. 
Bryopsis plumosa, Kütz.
Suakim and Trinkitat.

12. 
Enteromorpha compressa, Gree
Suez Bay and Suakim.

**PHAEOPHYCEÆ.**

Dredged from Trinkitat Harbour. One of the most common Sargassa in the Red Sea. Recorded both by Zanardini and Piccone from Suez, Akaba, Tor, &c.

Dredged from 9 fathoms in Suez Bay. Recorded by Zanardini from the same locality. Hanck records a var. zanzibarica from the Somaliland Coast, but the present plant agrees more closely with the type itself.

15. Sargassum crispum, Forsk.
Suez Bay. Recorded also by Zanardini from the same locality.

16. Sargassum subrepandum, J. Ag.
Suez Bay. Trinkitat.

17. Cyrtoseira Myrica, J. Ag.
Several fragments referable to this species occurred in the collections. The species is described by Zanardini as "in mari rubro vulgatissima."

Dredged from 10–12 fathoms at Khor Sinab. Recorded by Zanardini from Suez, Akaba, and Tor.

19. Padina pavonia, J. Ag.
Suakim, Suez Bay, and one young plant from Trinkitat.

Suez Bay. I am a little doubtful of this identification as the plant is a young one, but it agrees with the description given by Zanardini, who records it from the same locality.
Tella Tella Kebira.

22. Sphecelaria rigida, Kütz.
An epiphyte on several Sargassum.

23. Ectocarpus siliculosus, J. Ag.
Suez Bay, Suakim.

Suez Bay. Suakim.

RHODOPHYCEÆ.

25. Laurencia pinnatifida, J. Ag.
Suez Bay. Recorded by Portier from Hodeida.

26. Laurencia divaricata, J. Ag.
Suez Bay. Recorded by Zanardini from Suez, and by Hauck from Madagascar and the Somaliland Coast.

27. Laurencia papillosa, Grev.
Suakim. Recorded also by Piccone from Massaua and the Assab Archipelago and by Hauck from the Somaliland Coast, and by Zanardini from: Suez, Tor, Djedda, &c.

Trinkitat. Recorded from the Red Sea by Zanardini, from Massaua and the Assab Archipelago by Piccone, and by Hauck from the Zanzibar Coast.

29. Gelidium corneum, Kütz.
A form of this species occurs among the collection obtained at Trinkitat, which appears to be near Piccone’s var. ambiguum.

30. Polyzonia jungermannioides, J. Ag.
On Sargassum dentifolium, but fragmentary.

31. Hypnea valentiiæ, J. Ag.
Trinkitat and Suez Bay.

32. Spyridia filamentosa, J. Ag.
Suez Bay. Recorded also by Zanardini from the same locality, and also from Akaba and Kosseir.
33. Corallina tenella, Kütz.
Suakim. This plant was identified for me by Dr. Reinhold.

34. Lithophyllum affine, Fosl.
Suakim. Dr. Foslie informs me that this species is probably only a variety of L. Kaiserii, Heydr., or both may be varieties of the Pacific species L. pallescens, Fosl.

35. Goniolithon myriacarpum, Fosl.
Suakim. According to Dr. Foslie this is a variable species, and he identified the plant I sent him with a query.

APPENDIX.

The following two species of Potamogetonaceae were also present in the collection, viz., Cymodocea nodosa, Aschers., and Halophila stipulacea, Aschers.; and also Najas marina, Linn. (Naiadaceae), from Suez mud-flats. Fragments of Salicornia fruticosa, Linn., were also present in the same gatherings.
In 1883, Mr. J. G. Baker, F.R.S., F.L.S., at the suggestion of the late Lord Cathcart, made a study of the various species of tuber-bearing Solanums, the results of which were embodied in a paper presented to the Society on January 17th, 1884*.

Lord Cathcart was interested chiefly in the discovery of some wild species of tuber-bearing Solanum which could be utilized for crossing with the commonly cultivated potato, in the hope of obtaining new forms capable of resisting the attacks of the potato-disease fungus, Phytophthora infestans.

It was concluded that Solanum Maglia of Schlechtendal, generally known as Darwin's potato, afforded the best prospect of success in the direction, since this species does not appear to suffer from the disease in its indigenous habitat in the low-lying swampy soil of the Chonos Archipelago, whereas the ordinary potato is practically destroyed by the fungus on wet soils in damp seasons.

On August 6th, 1886, I obtained tubers of Solanum Maglia from a plant growing in the gardens at Kew, the tubers being dug up in the presence of Mr. Baker and myself.

(Plate 38. Flowers, foliage, &c., of Solanum Maglia, Schlecht., drawn from living specimen grown at Reading.)—This species, so far as my experience goes, does not produce fertile seeds when pollinated with its own pollen: although it blooms very freely, the flowers drop off prematurely. Many hundreds of attempts were made to fertilize Maglia flowers with the pollen from cultivated potatoes, but in one instance only was a hybrid seedling obtained, the latter being the produce of a cross made in July 1887.

The hybrid, which has been cultivated continuously during the past 20 years has smooth tubers nearly white in skin (the tubers of Solanum Maglia are a dull, dark purple colour), with leaflets more pointed than those of cultivated potatoes.

In addition to experiments with Solanum Maglia, crosses were attempted with Solanum Jamesii, but from none of these were seedlings obtained.

Resembling Solanum Maglia in its general refusal to set "seed" either when pollinated with its own pollen or with that from other species, is Solanum Commersonii of Dunal.

(Plate 39. Solanum Commersonii, Dun., white-flowered form, foliage, flowers, &c.)—Two forms of this species are known: one bearing lilac
flowers and corresponding both in this and in all other respects with Dunal's description, and the other very similar to it but bearing white flowers. In both forms the jessamine-like scent of the flowers is very noticeable. Of the violet-flowered form I have had very many tubers collected in a wild state in Uruguay, and Professor Archeavaleta of Montevideo assures me that there is no other form to be found in a wild state in Uruguay. There is, however, reason to think that the white-flowered variety was introduced into France from Uruguay by a Colonel Robido in the year 1895. Many attempted pollinations were made with both varieties, but only one weak seedling from each has been obtained.

In 1901 M. Labergerie, of Verrières, Vienne, stated that some of the tubers of Solanum Commersonii (white-flowering type), which had been given him in the spring of that year by Professor Heckel of Marseilles, had given rise to a new variety by "sporting" or bud variation. The supposed new plant was named by M. Labergerie "Solanum Commersonii 'Violet.'" (Plate 40. "Solanum Commersonii 'Violet,'" Labergerie, foliage, flowers, &c.)

Much controversy has arisen in regard to it, since it differs entirely from Solanum Commersonii in the character of its tuber, foliage, flower, and habit of growth, as well as in the form and size of its pollen-grains. On account of the very close resemblance in all its morphological features to the variety of the cultivated potato known on the Continent as Paulsen's "Blue Giant" (Plate 41. Paulsen's "Blue Giant" Potato, foliage, flowers, &c.), it has been concluded by most investigators who have grown the so-called "sport" and the latter variety side by side in the same soil, that a stray tuber of the "Blue Giant" must have found its way accidentally into the plantations of Solanum Commersonii in M. Labergerie's garden.

(Plate 42. Solanum Commersonii, Dun., flowers, tubers, &c. Plate 43. "Solanum Commersonii 'Violet,'" Labergerie, flowers, tubers, &c. Plate 44. Paulsen's "Blue Giant" Potato, flowers, tubers, &c.)—On reference to Plate 39 it will be noticed that the seed-berries are distinctly cordiform in shape, much more so than is seen in any other tuber-bearing Solanum, the usual form of berry in the wild species being round or slightly oval, and in almost all the cultivated potatoes distinctly round. The pollen-grains shown on Plate 39 are entirely regular and elliptical in form. In both these respects true Solanum Commersonii differs greatly from the "sport" supposed to have been derived from it, as will be seen on reference to Plate 40.

A comparison between Plates 42 and 43 will show not only the relative form and size of the tubers in Solanum Commersonii and in the presumed sport, but also the fact that the tubers of the former (see Plate 42), as in the case of nearly all other wild species, are borne at the extremity of long underground stolons, whereas the tubers of the "sport," like all cultivated potatoes, are produced close to the base of the stem. A further comparison
between Plates 40 and 41 will show the complete similarity which exists between the pollen-grains of the supposed sport and Paulsen's "Blue Giant," and also between the seed-berries of these two. A comparison of the hairs of the tips of the petals on Plates 39, 40, and 41 is also suggestive. It will also be seen on comparing Plates 43 and 44, that the tubers of the supposed sport and Paulsen's "Blue Giant" correspond in all respects.

Besides Solanum Maglia and Solanum Commersonii, I have had the following wild species under observation and experiment at Reading:—

1. Two distinct forms of Solanum tuberosum sent me by Mr. Stuart, of the Vermont Experiment Station, U.S.A. One of them, collected in Mexico, Mr. Stuart considered to be a practically unaltered ancestral form of Solanum tuberosum.

(Plate 45. Solanum tuberosum, Linn., var.)—The chief points of interest in this plate are:—

(a) The regular and elliptical form of pollen-grains.
(b) The wheel-shaped corolla, in contrast with the star-shaped corolla of Solanum Commersonii (Plate 39). This wheel-shaped corolla is also seen in Solanum Maglia (Plate 38), in Solanum etuberosum (Plate 46), and almost universally in the cultivated potatoes.
(c) The round form of the seed-berry, in contrast with the cordiform seed-berries of Solanum Commersonii (Plate 39).

2. Solanum polyadenium, Greenman, also from Mr. Stuart. This species is one of the most distinct of all wild tuber-bearing Solanums with which I am acquainted, the leaves and stems being covered with a dense coat of hairs, and emitting a strong scent somewhat resembling that of Feverfew, Pyrethrum Parthenium, Sm.

3. Solanum verrucosum, Schlecht.

4. Solanum tuberosum, var. boreale (= Solanum Fendleri, A. Gray), from Arizona.

The latter was sent to me by the Rev. J. Aikman Paton, of Castle Kennedy, N.B.

5. Solanum etuberosum, Lindley. (Plate 46.)

All the five last mentioned wild species, except Solanum etuberosum, flower freely, and produce fruits containing an abundance of seeds. The plants raised from seed of these wild species (excepting only Solanum etuberosum) exhibit no variation whatever from the parents or among themselves, even when the seeds are taken from plants allowed to flower in close proximity to
other species. Seedlings, however, of the commonly cultivated potatoes differ very widely from each other, those raised from the seed-berry or fruit generally exhibiting extensive variation in foliage, colour of tuber, and in habit of growth.

I find that the pollen-grains of all these wild species are of one particular shape, namely oval or elliptical, whereas the pollen-grains of all the cultivated potatoes which I have examined are very irregular in form and size, and possibly degenerate. This fact is clearly illustrated on Plate 49.

One of the forms or species which has proved of great interest, and which on account of its remarkable exemption from disease may become of economic value, is Solanum etuberosum, Lindley. This name was given by Lindley in 1834 to a tuberless Solanum, which he states was obtained from Chile some years previously by the Horticultural Society. He described it as exceedingly like the ordinary potato, Solanum tuberosum, Linn., in all its characters, except that it possesses thickened rhizomes devoid of definite tubers, and the calyx and flower-stalks are smooth instead of hairy.

It may be remarked here that if Lindley's plant of Solanum etuberosum produced no tubers, it would have been difficult to propagate it except from seed; and judging by the behaviour of the plants I have experimented with, it is not likely that Lindley's plants reproduced themselves from seed, for two reasons: 1st, that seed-berrys are very rarely formed, and 2nd, when formed, the seedlings resulting therefrom differ so markedly from the parent stock. It may be suggested that the Solanum etuberosum when growing in the wild state, the tubers, of course, not being lifted from year to year and replanted, might produce tubers so small as to be mistaken for "thickened rhizomes devoid of definite tubers,"—or that possibly the plants which Lindley examined may not have been fully developed, in which case the tubers would not yet have been formed.

The examples of Solanum etuberosum which I possess came originally from the Botanic Gardens, Edinburgh, in March 1887, through Mr. Lindsay, and again from the same stock in 1897 from Dr. Bayley Balfour. They produced at first small tubers about the size of walnuts, and the calyces are hispid; in other respects the plants are similar to the type specimen described by Lindley.

Solanum etuberosum has been grown continuously for more than twenty years in the Trial Grounds at Reading. During that time no variation has occurred in the characters of the foliage or flowers of the plants. The tubers have also retained their original form and colour with the exception of an increase in size.

Up to 1906 the plants had never been seen to bear fruits, but in that year a single berry was found in the centre of the plantation and allowed to ripen. Whether this was the product of self-fertilization or the result of a cross with some other Solanum growing near, it is impossible to say.
The seeds taken from this fruit were sown, and during the past season (1907) twenty young plants were raised. None of these resemble the parent form very closely, but they exhibit the same variation that is met with among seedlings of the cultivated potato.

The tubers of the parent Solanum etuberosum are white in the skin and flesh, and after twenty years of garden culture average about 1½ inches in diameter. Those of the seedlings, however, vary very much in size, some being already as large as cultivated potatoes: they are also very varied in colour of skin, some being white, others dark purple, pale blue, or rose white; one seedling has given tubers the flesh of which is deep purple and the skin almost black, characters which are met with in some of the cultivated varieties now growing in Chile.

The pollen-grains of the parent are elliptical like those of all wild species, and the seed-berries are round or slightly oval, but are covered somewhat closely with distinct white spots, in which they differ from the fruits of all other wild types.

(Plate 47. Solanum etuberosum, Lindl.—White-flowered seedling.) I was only able to examine the pollen-grains of one of the twenty seedlings above referred to, and that happened to be a plant bearing white flowers. In this case the pollen-grains were regular and elliptical, and entirely similar in form to those of the parent. The coming season I hope to examine more of the seedlings, to determine if the pollen-grains of any of them are irregular like those of the cultivated potatoes.

[P.S. (Sept. 1908).—In order to avoid any doubt as to the parentage of the seedlings above described, several different blooms of Solanum etuberosum were artificially self-pollinated under controlled conditions in 1907. Ripe fruits were obtained from several flowers. Seedlings raised from these in 1908 exhibit the same variability in character of foliage, and colour of the flowers as those obtained from the single berry collected in 1906, the male parent of which was uncertain, and they vary also in the form and colour of tuber.

Some of the plants raised from the same berry have white flowers, others lilac-coloured blooms.

The pollen-grains of the white-flowered plants of 1908, like the one white-flowering plant of 1907 alluded to above, are elliptical like those of the lilac-flowered parent, while those of the lilac-flowered seedling are irregular and polygonal in form, corresponding closely in these respects with pollen-grains of the cultivated potatoes. These are illustrated in Plate 49, and on Plate 48 is figured one of the lilac-flowered seedlings raised by selling flowers of Solanum etuberosum in 1907, with drawings of its irregular pollen-grains.

From the uniform character and shape of its pollen-grains, it would appear
SOLANUM MAGLIA, Schlecht.
SOLANUM COMMersonii, Dun. (White flowered form).
"SOLANUM COMMersonii 'Violet', Labergerie.
Paulsen's "Blue Giant" Potato.
SOLANUM COMMersonII, Dun. (White flowered form).
"SOLANUM COMMersonII 'Violet', Labergerie.
Paulsen's "Blue Giant" Potato.
SOLANUM TUBEROSUM, Linn., var.
SOLANUM ETUBEROSUM, Lindl.
SOLANUM ETUBEROSUM, Lindl. (White flowered seedling.)
SOLANUM ETUBEROSUM, Lindl. (Lilac flowered seedling).
POLLEN OF VARIOUS SPECIES OF SOLANUM.
SPECIES OF TUBER-BEARING SOLANUMS.

that Solanum etuberosum is a primitive specific form, since it agrees in this respect with admittedly wild species of tuber-bearing Solanums. Moreover, in the great variability of its seedlings it closely resembles the cultivated potato. These facts, I think, point to the conclusion that Lindley's Solanum etuberosum may probably be the parent form of the cultivated potato of to-day.

ARTHUR W. SUTTON.

EXPLANATION OF THE PLATES.

The figures on the Plates were all drawn from specimens growing in the Reading Trial Grounds.

PLATE 38.

Solanum Majtvia, Schlecht.

A. Inflorescence and upper leaves, 1/2.
B. Flower showing anthers, x 2.
C. Flower showing calyx, x 2.
D. Flower, side view x 2, showing cleft stigma.
E. Flower section, x 2, showing cleft stigma.
F, G, H. Cymes with flowers removed, 1/2.
J. Largest leaf on examples examined, 1/2.
K. Pollen, x 300.

PLATE 39.

Solanum Commersonii, Dun. (White-flowered form.)

A. Inflorescence and upper leaves, large lower leaf behind, 1/2.
B. Cymes with flowers removed, 1/2.
C. Flower-bud, x 2.
D. Hairs from tips of petals, x 50.
E. Hairs from limb of corolla, x 50.
F. Pollen, x 300.
G. Self-fertilized berries, 1/2.
H. Seed, x 2.
J. Cross-fertilized berries, 1/2.
K. Sections of do., 1/2.
L. Seed, x 2.

PLATE 40.

"Solanum Commersonii 'Violet,'" Labergerie.

A. Inflorescence and upper leaves, large lower leaf behind, 1/2.
B. Cyme with flowers removed, 1/2.
C. Hairs from tips of petals, x 50.
D. Hairs from limb of corolla, x 50.
E. Pollen, x 300.
F. Berry, 1/2.
G. Section of berry, 1/2.
H. Seed, x 2.

PLATE 41.

Paulsen's "Blue Giant" Potato.

A. Inflorescence and upper leaves, large lower leaf behind, 1/2.
B. Cyme with flowers removed, 1/2.
C. Hairs from tips of petals, x 50.
D. Hairs from limb of corolla, x 50.
E. Pollen, x 300.
F. Berry, 1/2.
G. Section of berry, 1/2.
H. Seed, x 2.
Plate 42.

*Solanum Commersonii*, Dun. (White-flowered form.)

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Flower section, × 2.

E, F, G. Tubers, ⅓.
H. Stolon cut at +++ showing distance from plant at which tubers are produced, ⅓.
J. Section of stolon at K, ⅓.
K. Point of section shown at J.
L. External cells of tuber, × 60.

Plate 43.

"Solanum Commersonii 'Violet'" Labergerie.

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.

D. Section, × 2.
E, F, G. Tubers, ⅓.
H. External cells of tuber, × 60.

Plate 44.

Paulsen’s "Blue Giant" Potato.

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.

D. Section of flower, × 2.
E, F, G. Tubers, ⅓.
H. External cells of tuber, × 60.

Plate 45.

*Solanum tuberosum*, Linn., var.

A. Inflorescence and upper leaves, ⅔.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Pollen, × 300.
G. Cyme with berries, ⅓.
H. Berry, vertical and horizontal sections, ⅓.
J. Tubers, ⅓.

Plate 46.

*Solanum etuberostum*, Lindl.

A. Inflorescence and upper leaves with large lower leaf, ⅔.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view × 2.
E. Flower section, × 2.
F. Bud, × 2.
G. Bud, × 2.
H. Berry, ⅓.
I. ⅓ White-spotted berries, ⅓.
J. Berry section, ⅓.
K. Pollen, × 300.
L. Tubers, ⅓.
PLATE 47.

*Solanum tuberosum*, Lindl. (White-flowered Seedling.)

A. Inflorescence and upper leaves, large lower leaf behind, ½.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Cyme, with flowers removed, ½.
G. Pollen, × 300.

PLATE 48.

*Solanum tuberosum*, Lindl. (Lilac-flowered Seedling.)

A. Inflorescence and upper leaves, ½.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F, G, H. Cymes with flowers removed, ½.
J. Pollen, × 300.

PLATE 49.

Pollen of Various Species of *Solanum*.

A, B, C. Figures representing the pollen-grains of *Solanum verrucosum*, *Solanum polyadenium*, and *Solanum tuberosum* respectively, each × 300. Although varying somewhat in size, the form in each case is regular and elliptical, and is typical of the pollen-grains of all the wild types I have examined.

D, E, F. Representing the pollen-grains of the cultivated potatoes "Up to Date," "Main-crop," and "Discovery" respectively, each × 300. There is little if any difference in the size of these three groups of pollen-grains, and in each case the form is irregular and polygonal, and thus typical of the pollen of all the cultivated potatoes I have examined.

G. Pollen-grains of *Solanum etuberosum*, × 300.

H. Pollen-grains of a seedling plant bearing white flowers raised from a berry produced in 1906. The form of pollen-grains still remains regular and elliptical. × 300.

I. Pollen-grains of a seedling plant bearing white flowers raised from a berry produced in 1907. The form of pollen-grains still remains regular and elliptical. × 300.

J, K, L. Pollen-grains of three seedling plants raised from berries produced in 1907, each bearing lilac flowers. The form of pollen-grains in each case is irregular and polygonal, corresponding to that of the cultivated potatoes. × 300.

In each case all pollen-grains shown in I, J, K, and L, the flowers had been artificially selfed under controlled conditions.
The seedling plants which gave the pollen-grains shown in I and J were raised from the same seed-berry.

N.B.—The figures of pollen-grains on this Plate, and those also shown on previous Plates, were drawn when the pollen-grains were dry.
On a Method of Disintegrating Peat and other Deposits containing Fossil Seeds. By ELEANOR M. REID, B.Sc. (Communicated by CLEMENT REID, F.R.S., F.L.S.)

[Read 6th February, 1908.]

At the present time much interest is being taken in the investigation of deposits of peat, and many inquiries reach us as to the methods of disintegrating these deposits so that an examination may be made of the fossils contained in them. It may be well, therefore, to describe a very simple method which I have used of late with great success. By it the examination of peat is rendered as easy as that of loam, and can be accomplished with the same degree of thoroughness.

The method is an extension of one used for many years by Mr. Reid and myself, though without any striking results. We have long been accustomed to boil peats with a small quantity of carbonate of soda, as we have found that this assisted the process of disintegration. But even so, we have always regarded peat as one of the most difficult and intractable of the materials with which we have to deal. The change in method which I have employed lately with such satisfactory results, is to use a very large, instead of a small, percentage of carbonate of soda. I have used dehydrated soda, sold commercially at a very cheap rate as concentrated soda. This is stronger, and therefore less bulky and more convenient, than common washing soda.

The method was first tried last summer on three samples of an ancient highly-compressed peat, sent from Hornsea and Bielsbeck respectively, by the Committee of the British Association "appointed to investigate the Fossiliferous Drift deposits at Kirmington, Lincolnshire, and at various localities in the East Riding of Yorkshire." The samples were sent as being most difficult, if not impossible, to deal with. Similar samples had been treated with dilute soda solution, but with no success, and the Secretary, Mr. Stather, writes of the Bielsbeck peat: "The material will not break down, in fact it seems tougher at end of process than at the beginning." He adds that the Hornsea peat is "equally intractable." It was evident that strong measures would be necessary, so I boiled each sample with a large quantity of dehydrated soda, perhaps a third or more of its bulk in each case. To my surprise, when I came to wash them, I found that instead of being difficult to break up, I had never before experienced anything like such ease in dealing with peat. A very little crumbling with the fingers loosened the fibre so that the matrix could easily be washed away. The seeds were clean and quite unharmed by their treatment, and I was able to collect even such minute and delicate seeds as those of \textit{Junecus} and \textit{Epilobium} from the Bielsbeck peat, though before boiling I had been obliged to break it with hammer and chisel.
Seeing the unexpected results of this treatment with strong soda solution, I was anxious to test whether we had really found a satisfactory method of dealing with recalcitrant peats, but no opportunity presented itself till a few weeks ago, when through the courtesy of Mr. Rankin, of the Storey Institute, Lancaster, I was enabled to test a specimen of a particularly difficult peat. Mr. Rankin had previously experimented with various methods, including Dr. Gunnar Andersson's nitric acid treatment, but with comparatively little success, and had come to the conclusion that "the best method, though laborious, was to go carefully over the dry peat and pick out the seeds with a needle, or dry it a little and tease it out under water." The specimen sent by Mr. Rankin was of a "swamp peat from the base of a high peat moor" near Lancaster. It weighed about 2 oz. I boiled it for two hours with its own weight of dehydrated soda, crushing it once slightly so as to allow the water to have access to all parts. This I did with a sort of pestle made by a flat piece of cork on the end of a stick. At the end of the time, the matted fibre appearing to be completely loosened, I poured the contents of the pan into a sieve of very fine mesh—we always use perforated zinc in preference to wire, as seeds are apt to get entangled in the wire and damaged—and held it under a tap, moving it slightly with the fingers now and again, so that the water could percolate freely. The matrix of humus had been either completely dissolved, or disintegrated to an exceedingly fine sediment, for the water which streamed off, though at the first dark brown in colour, flowed unimpeded through the sieve. After a few minutes the water ran through perfectly clean, and the contents of the sieve were completely loosened and separate. I therefore washed them into the middle of the sieve, inverted it over a bowl, and allowed water to run through it the wrong way. By this means the residue was washed into the bowl, where it was, as in the sample exhibited, clean, quite separate, and ready to be looked over with a dissecting microscope, and the vegetable and other remains in no way injured by their treatment.

The result of the examination by this method was that from the exceedingly small sample sent by Mr. Rankin, only 2 oz., I was able to pick out nearly three hundred specimens of moss, seeds, and insects, in a fit state to be determined.

The species of flowering plants represented are:

Lychnis Flos-cuculi, Linn.
Menyanthes trifoliata, Linn.
Betula alba, Linn.
Cladium Mariscus, R. Br.

Seirpus pauciflorus, Lightf.
" fluitans, Linn.
Carex 2 sp.

Many specimens of moss.
Several elytra of beetles, and wings of flies.
A few fragments of charcoal, or carbonised wood.
This is a very large number of specimens to be derived from so very small a sample of peat. It is partly due to the richness of the deposit, but largely also to the completeness with which it was disintegrated and the ease with which all the individual constituents could be examined. And it would seem that by working peats in bulk by this method, an enormous supply of material for the study of their natural history may easily be obtained. Indeed, it would appear that the complete study of peat deposits would be limited rather by the great amount of material available, and the consequent great length of time required to work through it, than by the difficulty, hitherto so frequently felt, of treating peat so as to obtain any material at all.

Further, what is true of any other kind of deposit is true of peat, that if we are to gain an accurate knowledge of the flora contained in it, some such method of intimate examination is absolutely necessary. For it is not only the often recurring species, which formed the mass of vegetation growing on the spot, that we have to take into account. Peat, like all other deposits, contains over and above such vegetation, seeds of plants which have been carried into it by wind and other agencies, and except by such a minute inspection as we have been enabled to make, these chance comers would almost inevitably remain undiscovered. But it is frequently these very seeds which are the most interesting, and have most to tell us about the climate and physical conditions of the time. We have an instance of this in the present case, where the wind-borne birch-seed tells, that though the peat was laid down in a swamp, hard by there was drier ground where the birch-tree grew. That is, the swamp conditions were local, not general, and local conditions, not climate, must account for the nature of the vegetation.

The result of the experiment with this swamp peat was so encouraging that I was desirous still further to test the efficacy of the method, and at Mr. Reid's suggestion tried what could be done with the Eocene lignite of Bovey Tracey. This material, of which a sample is exhibited, is not a true peat, but is probably a reconstructed vegetable mould of tropical or sub-tropical formation. It is formed of decayed wood and other vegetable matter, together with a few seeds and a great quantity of structureless humus. The bulk of the material bears evidence of having been much decayed before its deposition. It is extremely hard and close-grained, and is burnt as lignite. I boiled a very small sample of this material for three hours with double its weight of dehydrated soda. The result was encouraging so far, that at the end of the time the water was dyed a deep brown, but the peat was not disintegrated. Next day I boiled it for twelve hours, the day after for ten hours, and the day following for eight hours, taking it off occasionally to examine what effect the treatment was having, to pick out any specimens which had become free and clean, and
to change the old solution for new. At the end of the time, after thirty-three hours' boiling, the humus was practically dissolved and the process of separation complete.

Unfortunately the specimen used in the experiment, the only one available at the time, is devoid of remains of much interest. Still I think the purpose for which the experiment was undertaken may be regarded as demonstrated, viz., that peats of any degree of obduracy may be disintegrated by the treatment described, provided a sufficiently strong soda solution be used, and a sufficiently long time be allowed for boiling. As far as I have tested the method, it is shown that, in any peat which does not need exceedingly strong solutions and long boiling, there is no danger of even the most delicate structures, such as leaves and fronds of ferns, being injured. With regard to the far more rigorous treatment accorded to the Bovey Tracey lignite, owing to the nature of the specimen examined, it is not easy to say what might be the effect on such structures, already much decayed. I found, however, small leaf-fragments and other delicate tissue. These, though not complete enough for identification, indicate by their state of preservation that, if they had been present in the lignite in a perfect condition, they would in all probability have been washed out uninjured. Without a doubt hard woody seeds would be preserved. We can tell this from the state in which we find the fragments of wood and other vegetable tissues.

During the above experiments, we found reason to believe that mineral impurities such as clay were disintegrated at the same time as the humus and possibly to some extent also the pyrites. It proved to be so. I took a small sample of highly fossiliferous pipe-clay from the Eocene beds of Bovey Tracey, and after boiling it for three hours with a large quantity of soda, found it was completely disintegrated, though a similar sample, boiled for a much longer time without soda, remained unaltered. The seeds and other vegetable remains collected from this small quantity of pipe-clay proved to be of the highest interest, and even the most delicate structures were found to be preserved in a perfect condition. Several of these seeds are, I believe, unrecorded from these deposits, though the sample examined weighed scarcely more than $\frac{1}{4}$ lb.

It is here that the interest of these investigations lies. We hope that by the use of this very simple process we may now have complete access to those deposits which hitherto it has been possible to examine only in the most imperfect manner, and to others which, owing to the extreme labour or even impossibility of disintegrating them, it has not been possible to examine at all. It is our wish to apply to such deposits the same methods of complete and intimate investigation which have long been used for deposits of sand and loam.

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