ANNALS

OF THE

ROYAL BOTANIC GARDENS, PERADENIYA.

EDITED BY

J. C. WILLIS, Sc.D., F.L.S. (1911); R. H. LOCK, Sc.D., F.L.S. (1912); AND T. PETCH, B.A., B.Sc. (1912–1914).

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ERRATA.

Page 311 *et seq.* .. *For* " *Duthei* " *read* " *Duthiei.*"
Page 531, line 27 .. *For* " Glaziov " *read* " Glaziou."
Page 535 .. *Insert* " *H. scutata* " *after* " *H. convexa.*"

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DIRECTOR.

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Further Notes on the Phalloideæ of Ceylon.

BY

T. PETCH, B.A., B.Sc.

AN account of the phalloids of Ceylon, as far as they were then known, was published in a previous paper (Ann. Perad., IV., pp. 139–182). The present contribution adds details of two more species and further notes on some of those previously recorded.

Mutinus Fleischeri Penzig.

In a letter to Berkeley, quoted in the introduction to Berkeley and Broome's Enumeration of the Fungi of Ceylon, Thwaites wrote: "At an elevation of more than 7,000 feet I found a single specimen of a new species of *Phallus* of a deep red colour, which has not occurred to me elsewhere." This specimen is not mentioned in the list of species, nor is it in the Peradeniya herbarium.

In August, 1908, I found what may be the same species in the jungle at Hakgala, at an elevation of about 6,000 feet. The collection consisted of one expanded specimen and four "eggs"; two of the latter subsequently expanded in the laboratory.

The "egg" is vertically elongated, oval, the upper end being at first rounded, then pointed, up to 2·5 cms. high and 1·5 cm. diameter, white at the base, usually mottled with reddish-brown in the upper half. My specimens were clustered, three in one group and two in the other. The mycelial cords are white, and moderately stout, up to 2 mms. in diameter.

The expanded specimen was 10·5 cms. high. Its stalk was 1·5 cm. in diameter just below the head and 1·2 cm. in diameter just above the volva; it tapered to a blunt point within the volva. The head was conical, pointed at the apex, imperforate, 1·8 cm. high. The colour of the stalk was reddish-pink, becoming paler towards the base, and fading slightly after expansion ; the head was crimson, sharply defined from the colour of the stalk. The gleba was dark olive, with a fœtid, but weak odour.

The surface of the stalk is practically smooth, as will be evident from the photograph of the fully expanded specimens figured on Plate III. The wall of the stalk is composed of a single layer of comparatively small, isodiametric, thin-walled chambers, not arranged in vertical rows ; the walls of these chambers are not perforated either internally or externally. The head is rugose, being thickly covered with rounded hemispherical or bolster-shaped tubercles. Its lower boundary is sharply defined from the stalk by a thickened ring, which is more evident on alcohol specimens. In one specimen there is a slight constriction of the stalk just below the head.

The wall of the head is slightly thicker than that of the stalk, and it differs from the latter wall in being almost solid. Viewed from the inner surface, it is seen to be pitted with numerous cavities separated by thick partition walls. In cross section, these cavities are seen to penetrate to about one half the thickness of the wall. The protuberances on the outer surface are more numerous than the cavities seen on the inner surface, but some of the cavities are branched, and thus each tubercle lies over the blind end of a cavity. The structure of the head thus differs altogether from that of the stalk, and the cavities of the former bear very little resemblance to the chambers of the latter. In an alcohol specimen, the chambers of the stalk are about 2 mms. in diameter, with walls about 0·05 mm. thick. The substance of the head of the same specimen is up to 2·5 mms. thick ; it is penetrated from the inner surface by cavities 0·25–0·5 mm. in diameter, but these only penetrate to a depth of about a millimetre and are separated from each other by septa about 1 mm. thick. The outer half of the wall of the head is therefore solid ; and though the tubercles are situated over the endings of the cavities, they are not hollow. In section the head appears to have a solid wall, half penetrated by narrow tubes ; if it consisted originally of a series of chambers, their lateral and outer walls have become so thickened that their cavities are almost obliterated, while their inner walls have disappeared. The substance of the head is crimson throughout. The apex of the head is solid, not perforated; and in my specimens it terminates in a point which is not covered by the gleba.

A second specimen, which expanded in the laboratory, was only 7 cms. high. Its stalk was 8 mms. in diameter at the base and 1 cm. in diameter at the widest part, which was about 5 mms. below the head. The head was 1·2 cm. high.

The apex of the "egg" is at first rounded, but as it ripens it becomes pointed owing to the shape of the receptaculum. In my specimens the volva was first perforated by the naked pointed apex of the receptaculum, and the fungus remained in this stage for some time without expanding further. The eggs were found on Monday, and brought to the laboratory, with some soil, in a closed tin. They were then planted in a pot, well watered, and covered with a bell glass. On Thursday morning the red tip was visible in one specimen, but the receptaculum did not expand further until Saturday. At 8 A.M. on Saturday it had protruded to about half its final height, but it was not fully expanded until 12 noon. It remained rigid the whole of the next day, and meanwhile the colour of the stalk faded to some extent. This prolonged period of expansion is in striking contrast to the behaviour of other Ceylon phalloids, all of which expand rapidly.

Plate IV., fig. 1, shows a half expanded specimen. The stalk is somewhat rugulose and of uniform diameter. The head, except at the tip, is covered by a fine white membrane. I have previously pointed out that most of our Ceylon phalloids possess this membrane, which disappears as the fungus expands or soon after. In *Colus Gardneri*, *Simblum periphragmoides*, *Dictyophora phalloidea*, and *Dictyophora irpicina*, it lies outside and covers the gleba, but in *Aseroe rubra* it lies underneath and supports the gleba. In the latter case, the gleba retracts into a ring round the opening of the stalk when the membrane vanishes. In *Aseroe arachnoidea* also, it covers the orifice of the stalk and supports the gleba in part; in this species the gleba does not form a continuous sheet, but a series of rounded lobes at the bases of the arms; when these lobes are supported by the membrane, the latter is visible as a clear star-shaped area, as shown in Penzig's figure; when the membrane deliquesces, the gleba retracts round the opening of the stalk as in *A. rubra.*

This species appears to be *Mutinus Fleischeri*, which was first described from Java by Penzig. In structure, *Mutinus Fleischeri* would appear to differ from these Ceylon specimens in having the head abruptly contracted and of smaller diameter than the stalk, but from Penzig's figures this feature would seem to be variable; it is well marked in Penzig's drawing, Pl. XXII., fig. 1, but the diameter appears to diminish regularly from stalk to head in his photograph on Pl. XXI. A similar variation is noted by Lloyd (Synopsis of the Known Phalloids, p. 28) for *Mutinus caninus.* The internal structure of the wall of the head is the same in the Ceylon and Java specimens. Penzig states that the colour of the head is similar to that of the stalk, but it must be remembered that he had only specimens preserved in alcohol. The latter fact may also account for the rugose appearance of the stalk in Penzig's specimens.

The specimen photographed by Penzig (Pl. XXI.) is more obese than the Ceylon forms, and it seems to be more regularly fusoid, though Penzig states that the stalk is "am oberen und unteren Ende kaum merklich verjungt." There is a marked difference in this respect, *i.e.*, in the fusoid appearance, between the same specimen in the fresh state and after preservation in alcohol. For example, one of my specimens measured when fresh 1·2 cm. in diameter just above the volva and 1·5 cm. just below the head, an increase of 25 per cent.; preserved in alcohol, the corresponding measurements are 1 cm. and 1·4 cm., an increase of 40 per cent. In another specimen similar measurements give 0·8 cm. and 1 cm. when fresh, an increase of 25 per cent.; but 0·6 cm. and 0·9 cm. in alcohol, an increase of 50 per cent. The contraction in alcohol is greatest in the lower part of the stalk, and this alters the general appearance of the fungus. The contraction in length too would make the fungus appear more obese. It would appear that the apparent differences between the Ceylon and Java forms are attributable to the fact that the latter were photographed after preservation in alcohol, while the former were photographed when fresh. Their identity appears to be indisputable. Whether the structure of the head is distinct from that of *Mutinus caninus* I have no means of ascertaining.

It may be noted that this species is only found in the higher regions of Java and Ceylon. In Java it occurred in the jungle near the mountain garden at Tjibodas; in Ceylon it was found above the mountain garden at Hakgala.

Ithyphallus tenuis Ed. Fischer.

This species was recorded for Ceylon by Fischer (Neue Untersuchungen Phalloideen, 1893), who found Ceylon specimens in Berkeley's herbarium and the British Museum. It was not recorded by Berkeley and Broome, nor are there any specimens in the Peradeniya herbarium.

It was rediscovered in August, 1908, in the jungle at Hakgala at an elevation of about 6,000 feet. The specimens grew on decaying wood—on a fallen tree about two feet in diameter. They grew along the sides and the under surface, emerging in dense clusters through cracks in the bark, or filling up hollows in the exposed wood, for a length of about three yards. On a moderate estimate, there were more than one hundred fully expanded specimens and over five hundred eggs above 5 mms. in diameter, in addition to countless numbers of tiny eggs just beginning to develop. The mycelium permeated the rotten wood, and ran in thick cords, up to 4 mms. in diameter, between the wood and the loosened bark. A smaller group of specimens was found in the same jungle, also on a rotting log, in May, 1910.

The "eggs" are up to 2 cms. in diameter, and spherical; but as they grow in dense clusters they are often distorted owing to their mutual pressure. They are at first white, but those which have been fully exposed to light during development become almost black. The outer coat of the volva splits as the egg increases in size, and forms brownish, somewhat floccose, scales on the exterior.

None of the specimens found expanded in the field were in a fit state to be photographed. Practically all of them had collapsed. Eggs were brought down to the laboratory, and placed in plant pots covered by bell glasses. These expanded during the night, and some of them were photographed on the following morning. The time of expansion appears to be short. All the expanded specimens were removed from one pot at 7.45 A.M., and it was then noted that some of the eggs were ruptured at the apex, and that the peculiar crown of the pileus was just protruding. Arguing from the case of *Mutinus Fleischeri*, it was expected that these would remain in that condition at least until the next morning; but by 8.45 A.M. they were all fully expanded; a favourable opportunity of observing the expansion was thus unfortunately lost.

The specimens varied in height from 3·5 cms. to 14 cms. The smallest specimen was 3·5 cms. high, with a stalk 4 mms. in diameter and a pileus 1·2 cm. long. The largest was 14 cms. high, with a stalk 1 cm. in diameter and a pileus 2·6 cms. long.

The wall of the stalk consists of a single layer of chambers, varying much in size in different specimens. The chambers are not arranged in definite lines. When the chambers are small the stalk stands erect; but as a rule it is curved. This curvature is the result of the extreme weakness of the stalk, partly because the chambers are large, but chiefly because most of them are perforated on the exterior. In some cases the chambers form merely a network of ridges on an inner membrane. The stalk therefore soon collapses under the weight of the pileus, as is shown on Pl. I., B; these specimens were developed under a bell glass and were photographed in the early morning soon after expansion, but they began to collapse as soon as the bell glass was removed.

In the smaller specimens the stalk is practically of the same diameter throughout, but in the larger it diminishes towards the apex. The colour of the stalk in all my specimens is white, while that of the pileus is pale yellow.

The pileus is somewhat ovoid; it swells out regularly from the apex, but contracts again below, so that the lower edge is sometimes in contact with the stalk. It is united to the stalk only at the apex. It is covered by a network of fairly deep ridges with corresponding grooves on the under surface. The apex is perforated and spreads out, in typical specimens, in a horizontal disc. The inner layer of the wall of the stalk is thickened at the apex and bends out horizontally, the cross walls of the chambers being continued as struts underneath; the pileus is attached to this horizontal disc usually towards its margin, though in this respect there is considerable variation. The diameter of the disc varies; in some specimens it is 1·5 cm. in diameter, while in others it is scarcely recognizable. As a rule the disc is destitute of gleba on both sides; its upper side is usually smooth, but the lower surface may be ornamented with ridges in continuation of those which bear the gleba.

The odour of the fungus was very fœtid, but the effect was of course heightened by the massing together of so many specimens.

Penzig figures a specimen of *Ithyphallus tenuis* with a membrane between the pileus and the stalk. He points out, however, that Fischer has already remarked on similar structures and shown they are remains of the primordial tissue which divides the pileus from the stalk. They are usually thin white membranous patches, adhering to the stalk. I have previously stated (Ann. Perad., IV., p. 15) that these are not homologous with the veil of *Dictyophora*, for the latter species often possesses them in addition to the veil. They do not, therefore, afford any ground for uniting *Dictyophora* with *Ithyphallus*. Lloyd (Synopsis of the Known Phalloids) writes concerning *Ithyphallus tenuis*: "The original description makes no mention of the plant having a veil, but one of Penzig's figures shows a rudimentary veil hidden under the pileus." This interpretation is incorrect. The structure referred to is not a rudimentary veil; nor is it a normal feature of the plant, though it occurs fairly commonly in this species. As a rule it forms a loose ring, hidden by the pileus, but not united to the apex of the stem. If a nearly ripe egg of *Ithyphallus tenuis* or *Dictyophora phalloidea* is partly dried, *e.g.*, by leaving it lying on the table for two or three days, it will usually be found, on making a longitudinal section, that this tissue forms a complete sheath all round the stem, from the base to the apex. But expanded specimens never have more than a remnant of it. It is, as Fischer states, the remains of the primordial tissue which lies between the developing stem and the pileus; and, in general, it disappears entirely during or before expansion.

In one specimen which was brought into the laboratory in the " egg " stage, and which expanded, under a bell glass, during the night, the following injury occurred. The upper part of the volva split off as a hemispherical cap, which remained attached to the lower part at one side. The apex of the pileus adhered to this lid, and the expanded receptaculum therefore took the form of an inverted U. Moreover, the pileus was divided by a circular fracture parallel to its lower edge, and the lower part was left as a ring round the stalk within the volva. Examples of this kind show that the ludicrous figures of phalloids which were published in the early days of mycology are not necessarily " fakes." They may very probably have been based on specimens similarly damaged during expansion. The example here recorded was collected with part of the wood on which it was growing, and was certainly not injured during its conveyance to the laboratory.

Dictyophora phalloidea Desv.

Two examples of this species were brought to me in the laboratory at 8.45 A.M. One of them was complete, but the other had been lifted out of the volva, the latter being left behind in the ground. In both specimens the stalk had expanded, but the net was folded up into a wrinkled sheet beneath the cap. In the one with a volva, the net was completely hidden by the cap, and if it had been dried in this state it would have been mistaken for *Phallus impudicus* ; in the other, the contracted net projected for about 2 mms. beyond the lower edge of the cap. An attempt was made to obtain a photograph of them in this state, but during the process the net of the first was extruded from beneath the cap for a length of about 4 mms., while the net of the second extended further, and began to open out. At 9.10 A.M., both specimens were fully expanded, with the usual rigid net extending almost to the base. During all this time the specimens were lying on a sheet of glass in the laboratory without any protection from evaporation, nor was any water supplied to them. When the specimens were photographed they measured 14 and 13·5 cms. in height respectively, but after the completion of the expansion of the veil each measured 18·5 cms. The stalks had therefore lengthened by 4·5 and 5 cms. respectively during the time occupied by the expansion of the veil.

It is evident from this that the veil begins to expand before the elongation of the stalk is complete. In the first stages of expansion of the stalk the veil remains hidden by the pileus, and the attachment of the veil to the stalk appears to be at the apex of the latter. But in the final stage of expansion, the part of the stalk above the attachment of the veil is lengthened, and thus the junction of the veil and stalk comes to lie at the level of the lower edge of the cap. Of course, the whole of the 5 cms. extension in the present case is not due only to the lengthening of the part of the stalk beneath the cap : probably not more than 2 cms. can be attributed to that, the remainder being due to the final stages of elongation of the lower part of the stalk.

The veil is, therefore, in some degree, left behind during the expansion of the stalk. When the pileus, which is attached only to the apex of the stalk, is gradually removed by the elongation of the latter, the veil appears first as an apparently continuous wrinkled sheet. It retains this appearance until a length of about 5 mms. is exposed, when it begins to open out into a net. Apparently the veil does not begin to expand so long as it is covered by the pileus ; but it does not seem probable that the latter could exert any pressure on it which would prevent it from expanding.

The above examples show that *Dictyophora* does not require any supply of water from an external source during the final stages of expansion. Both specimens had been gathered and carried for some distance ; but both, even the one which had been torn out of its volva, expanded completely when lying in the laboratory. This agrees with the results obtained by Burt in experiments on *Phallus duplicatus*. " While the rapidity of elongation is favoured by an abundant supply of water, still any very appreciable amount in addition to that already contained in the egg is not absolutely necessary. Elongation of the receptaculum is not dependent on any contribution of water or other substance from the volva during the progress of elongation." [Burt. The Phalloideæ of the United States, Bot. Gaz. XXIV. (Aug. 1897), p. 84.]

Further examples of the small form noted on page 150, and figured on Pl. XI. of my previous paper, have been obtained. The pileus appears to be always yellow, while the net is white or pale salmon. I am inclined to consider this a distinct species, characterized by the peculiar reticulation of the pileus.

Abnormalities in *Dictyophora phalloidea* are not very common, and such as do occur are usually irregularities in the form of the net. In a specimen, total height 20 cms., the stalk was vertical for a height of 14 cms., but the upper part, 6 cms. long, was bent over at an angle of 45°. The upper side of the inclined portion of the stalk was covered with a reticulation of open chambers, eight millimetres deep at the lower end and diminishing gradually to the usual thin bars beneath the cap. The net was attached to the whole inclined part of the stalk along the edges of this reticulation ; or, in other words, the reticulation of chambers confluent with the stalk represented the part of the net which should have merely rested in contact with it.

Clathrus crispatus Thw.

I have not yet succeeded in obtaining a photograph of an expanded example of this species. It grows only in the higher districts, above 4,000 feet, and apparently is rare even there. Two specimens have been sent to me, but they were in fragments when found. The " eggs " were about five centimetres in diameter, and had the same structure as that previously photographed (Ann. Perad. IV., Pl. XIII. B). As Thwaites's specimens were similar, this is evidently a constant character which (apparently) distinguishes *Clathrus crispatus* from other species.

Externally the net is pale pink. It becomes deeper pink along the sides of the arms, and deep crimson along the inner median line. The arms are up to 2 cms. in breadth, and 1 cm. thick in the middle ; the meshes (openings) are consequently small, rounded, or slightly polygonal, 1·2 to 2·2 cms. in diameter. In cross section, the arms are truncate-triangular, *i.e.*, the section has the shape of an isosceles triangle with the apex cut off, the base of the triangle being outermost. The inner side is flat or slightly rounded, and covered with a network of crimson ridges, while the sloping sides are slightly fluted. The gleba is dark olive, and is confined to the crimson ridged area on the inner side of the arms.

The arms are composed of large irregular chambers in one or two layers, but the arrangement of the two layers is not regular. The walls of these chambers are perforated by minute crowded openings on the outer surface, and by larger, more scattered openings on the inner surfaces of the arms. Internally, the chambers communicate by large openings in their walls, so much so that in places there appears only a series of struts from side to side within the arm. It is probably owing to this excessive perforation that perfect examples have never been observed. The arms break at any point, and apparently soon after expansion. In one of my specimens the base of the net had broken up into mere fragments.

The mycelium is white, and up to 4 mms. diameter. The spores are greenish-hyaline, oblong, with rounded ends, $4–5 \times 2\mu$.

Judging from the broken specimens, the fungus would be 15 to 20 centimetres high when expanded.

Simblum periphragmoides Klotzsch.

This species proves to be even more common at Peradeniya than was previously supposed. It frequently occurs in numbers on small areas, which yield successive crops of specimens for a long period. These patches are usually found among short grass, and the fungus is not then conspicuous except at close quarters. Five specimens were gathered from one such patch on July 17, 1908. During the drier weather of August no more were seen, but between September 30 and October 12, twenty-seven more were collected from the same area. It was not possible to make continuous observations, but on a chance inspection of the same spot in June, 1909, *i.e.*, during the next rainy period, seven more specimens were observed. It was remarkable that the specimens usually stood apart from one another, or if two occurred close together both were expanded at the same time. There were never any " eggs " closely connected with the expanded specimens. This is in striking contrast to the habit of *Dictyophora*, for on digging up expanded specimens of the latter species, one frequently finds immature " eggs " attached to their bases. Of course, the number of specimens gathered in thirteen days, viz., 27, proves that immature eggs were present in the patch, and could have been obtained by digging over the ground carefully, but the point of interest is that they were not in immediate connection with the expanded specimens.

It is not too much to suppose that all these specimens originated from the same mycelium. I would include those of June, 1909, in the same category, since the patch occurred on a bank well shaded by trees and with a northerly aspect, and would therefore not be exposed to the full sunshine of the dry period. Consequently it is of interest to note that only two out of the thirty-nine specimens could be referred to the form which has been considered to be *S. gracile* Berk. I have previously pointed out that Berkeley, as is proved by the paintings which he named, did not rely on the slender stalk as a character of *Simblum gracile*, although it seems to have been assumed that he did by subsequent authors. As a matter of fact, he referred to *gracile* both slender and stout-stalked specimens, provided they were of Ceylon origin. The two specimens which occurred in this thirty-nine measured, (*a*) total height 10·8 cms., stalk 1·5 cm. diameter, head 2·4 cms. diameter and 2·5 cms. high ; (*b*) total height 9 cms., stalk 1·4 cm. diameter, head 2 cms. diameter and 2·5 cms. high. The occurrence of these specimens in company with others in which the head was of the same diameter as the stalk, or only slightly exceeded it, is in confirmation of the former conclusion that *S. gracile* is only a form of *S. periphragmoides*.

Of the specimens measured since the publication of the previous paper, the smallest was only 6 cms. high, while the largest attained a height of 15 cms. The diameters of the stalks were 1·3 cm. and 2·5 cms. respectively.

The following abnormalities have been noted. In one specimen the head was laterally compressed and bent over almost horizontally, while in another the head curved over to one side in almost a semicircle, but was not laterally compressed. Specimens with part of the jelly of the volva adhering to the head are not uncommon, and in one instance the head of the expanded fungus was completely hidden by the volva, the "egg" having ruptured towards the base instead of near the apex. Berkeley's figure of *Simblum gracile* shows a part of the volva adhering to the head. The meshes of the netted head are usually pentagonal, but in one specimen the apex was occupied by a single circular mesh; fitting in between this and the pentagonal meshes on one side were three isolated triangular meshes, while the four pentagonal meshes which bordered it on the other side were separated from it by double bars. One specimen, collected when fully expanded and rigid, had a head 3 cms. high and 2·4 cms. diameter; but at the top, on one side, there was a horizontal, projecting, netted swelling, 1 cm. diameter; it resembled another head attached laterally to the original head.

The stalk of *Simblum periphragmoides* usually consists of an inner layer of large chambers, surrounded by one to three layers of smaller chambers, and the chambers of the inner layer are continuous from the top to the base of the stalk. Of six specimens gathered from the same spot at the same time, four had the usual inner layer of large chambers, surrounded by a single layer of small chambers, while the other two had a single layer of large chambers only, sometimes with a small chamber wedged in at the periphery. These chambers were open, as usual, from the apex to the base of the stalk, and therefore the stalks of these two specimens were identical in structure with those of *Colus Gardneri*.

Twin specimens of *Simblum* are not uncommon. In general they are of two kinds; in one type the "eggs" are adherent, but each develops an independent receptaculum; in the other two eggs are united, without any partition between them, and the receptaculum consists of two distinct stalks with only a single head. I have recently found a third mode of "twinning" which does not appear to have been recorded before. In this specimen the two stalks and the heads are united throughout their whole length. The wall of each stalk is composed of a single layer of cavities, but where they are united there is only a single layer common to both.

When the diameter of the head of *Simblum* exceeds that of the stalk the head appears well defined. The transition from the stalk to the net is coincident with the beginning of the outward curve of the head. In one specimen, however, collected at Peradeniya, the lower part of the inflated head has the same structure as the stalk. The specimen is 14 cms. high, with a stalk 1·9 cm. diameter; the head is ovoid, 3·5 cms. high and 2·8 cms. diameter. The lower part of the head consists of a yellow band, reaching to height of 8 mms. on one side and 14 mms. on the other. This band is partly interrupted on one side by a complete mesh, and it also includes three obsolete meshes closed by a thin yellow membrane.

The volva of *Simblum periphragmoides* is marked internally by yellowish lines and narrow bands of fibres, radiating from the base of the stalk ; in this respect it resembles *Aseroë*.

When yellow specimens of *Simblum periphragmoides* begin to decay they turn red or orange-red, and the same colour is developed when they are placed in alcohol. The red and yellow of *Simblum* would therefore appear to be closely related, and it seems extremely doubtful whether the different forms are worthy of specific rank. *S. periphragmoides* and *S. texense* are yellow, while *S. sphærocephalum* and *S. clathratum* are red. Except in the colour, however, there does not appear to be any marked difference. The size of the meshes, and the breadth of the bars, vary as much within the one species, *e.g.*, *S. periphragmoides*, as they do between *S. clathratum* and *S. sphærocephalum*, as shown in the illustrations of these. I have measured meshes varying from one to nine millimetres in breadth on the same specimen ; and the figure on Pl. XI., Ann. Perad., Vol. IV., shows variation both in the width of the bars and the diameter of the meshes. What separates *S. Texense* from *S. periphragmoides* I am unable to make out. In Lloyd's Synopsis of the Known Phalloids (1909), *Simblum gracile* (*S. periphragmoides*) is figured with the head swelling outwards regularly from the top of the stalk, while *S. Texense* has the head abruptly contracted into the stalk, or, judging from the photograph, the head might be described as umbilicate below. But this is just what happens to *Simblum periphragmoides* after the gleba has disappeared ; the head then " sits down " on the top of the stalk owing to the partial collapse of the bars, and the specimens have then exactly the appearance of *S. Texense*, which, it may be noted, was photographed after the gleba had vanished. But we do not photograph them in that condition, because that is obviously not the perfect form. The case is similar to that of *Dictyophora*, which is usually figured with its net collapsed, or of *Aseroë*, which is generally photographed with its arms twisted and coiled at their extremities. A photograph of a phalloid should exhibit it in the most perfect form possible, and in order to obtain this the " egg " should be procured and allowed to expand under a bell glass, wherever opportunity offers. If it is desired to obtain a photograph of a specimen minus the gleba, the latter should be washed off the fully expanded specimen. If this were done with the different species of *Simblum*, I think that the apparent differences, as shown in the available illustrations, would disappear.

When a sufficiently long series of each species is available, it will most probably be found that the only difference that can be made lies in the colour, some being red and others yellow. Whether that is sufficient to maintain them as species is, in my opinion, more than doubtful.

[Since the above was written, I have received Mycological Notes, No. 34, by C. G. Lloyd. In it he figures a *Simblum* from Mauritius which is "the exact size and shape as the plant recently described as *Simblum Texense* from the United States, and which was supposed to differ from the original Mauritian species (*Simblum periphragmoides*) by its shape and size alone." The figure shows a specimen of *periphragmoides* with the head collapsed. This confirms the view stated above.]

Colus Gardneri (Berk.) Ed. Fischer.

Three more specimens of this species have been found since 1908. After the discovery of the first on May 3, 1909, the locality was inspected every morning during the rains, in the hope that, as with *Simblum*, successive crops of specimens might be obtained. Only two more appeared : the second on May 5 and the third on July 18.

The first specimen was 15 cms. high. Its volva was oval, 4 cms. high and 2·7 cms. diameter. The stalk measured 1·7 cm. in diameter at the volva and diminished to 1·5 cm.

diameter just below the arms. The arms were five in number, and the gaps between them, below the gleba-bearing portion, were somewhat oval, 6 to 7 millimetres in length and 4 millimetres wide. The sporiferous part was 1·7 cm. high, and 1·6 cm. in diameter at the base ; it was thus only slightly wider than the stalk, and it tapered regularly to the apex without any outward swelling. The apex was pointed, not rounded, but the arms were united.

The second specimen was 12·5 cms. high. The stalk was 11 mms. diameter at the volva, and 8 mms. diameter just below the head. It had only four arms, and the gaps between these were alternately long and short, 1 cm. and 6 mms. respectively, with a breadth of about 3 mms. The arms were united at the apex. The gleba-bearing part of the head was wider than the stalk, 1·4 cm. diameter and 1·8 cm. high.

The third specimen was 11 cms. high, with an equal stalk 12 mms. diameter. It had five arms, united at the apex, and the gaps between them, below the gleba-bearing part, were smaller than usual.

I have left this species under Fischer's name for convenience of reference. Lloyd (Synopsis of the Known Phalloids, p. 35) considers that it should bear its original name, *Lysurus Gardneri*, and that the definition of the genus *Lysurus* should be altered to include species with arms "very slightly" united. He very rightly objects that, in the previous communication on this subject, I have altered the definition of the genus *Colus* so as to exclude the original species, *Colus hirudinosus*. There was no intention of doing this ; it was an unpardonable blunder due to too great an abbreviation of the definition of previous authors. I must, however, object to the statement that "Mr. Petch finds the tips of the arms united by a delicate membrane." The arms unite at the apex, but the junction is no more a membrane than the arms themselves. The structure of the arms is simply continued over the apex. When the apex is rounded the arms may be united by a cross bar, but this, like the arms, is hollow. The junction is certainly narrow, but it is not membranous. The use of the word membrane is the more misleading, since in *Colus Gardneri*, and most other Ceylon phalloids, the gleba is covered at first by a fine white membrane which disappears as the fungus expands. If the specimen is placed in alcohol before this membrane has deliquesced, the latter becomes tough and persistent. Any one who had only alcohol specimens at command would therefore be extremely liable to misinterpret the published descriptions, if the junction of the arms were referred to as a membrane.

The question how the differences of opinion have arisen between those who have examined the herbarium specimens of *Colus Gardneri* does not seem to have yet been satisfactorily settled. The photograph of a Kew herbarium specimen given by Lloyd in his "Synopsis of Known Phalloids," fig. 38 *a*, does not resemble the specimens in the Peradeniya herbarium, and could not with any degree of certainty be identified as *Colus Gardneri*. In particular the arms appear to be covered by the gleba down to their junction with the stalk; there seems to be no bare portion, and no corresponding gaps. I still think it probable that there is some confusion of specimens here between *Colus Gardneri* and *Lysurus australiensis*.

Aseroë rubra La Bill.

Further specimens of *Aseroë rubra*, collected at Hakgala, exhibit the following variations in the arrangement of the arms, &c.:—

(*a*) Specimen with sixteen arms, arranged somewhat obscurely in pairs on one side of the disc, but singly on the other side. This specimen has only one really well-marked pair. The disc, without the arms, is 3·3 cms. diameter, while the arms are extremely short, only 5–9 mms. long.

(*b*) Specimen with fourteen arms, distinctly arranged in pairs. One pair is fused almost to the tip, only the last four millimetres being divided. The arms are 3 cms. long and the breadth of the disc is 2·3 cms. This is the specimen illustrated on Pl. V.

(*c*) Specimen with fourteen arms, not arranged in pairs. Length of the arms 3·7 cms.; diameter of disc 3·6 cms.

(*d*) Specimen with sixteen arms, in six well-marked pairs, and *one group of four*. The latter group is 3 cms. long and 1·3 cm. wide at the base; it splits off one arm at a distance of

5 mm. from the base, a second at a distance of 1·2 cm., and the remaining half splits into two at 1·8 cm.

(*e*) Specimen with fourteen arms arranged in pairs. Diameter of disc 2 cms.; length of paired arms 1 cm., dividing at a distance of about 3 mms. from the base.

(*f*) Specimen with sixteen arms, ten single and three well-marked pairs. Diameter of disc 2·3 cms.; length of arms 1·5 cm.

Ceylon examples of *Asceroë rubra* vary in total diameter from 4 cms. to 12 cms. The number of arms is fourteen, sixteen, or eighteen, and these vary in length on different specimens from 4 mms. to 4 cms. Some specimens have the arms quite distinct, while others have them arranged in pairs. But these are not different species or even varieties, for both paired and single arms may occur on the same specimen. The greatest number of arms united into one group that has been observed up to the present is four; this occurred on a specimen on which the remaining arms were distinctly paired.

In a previous paper (Ann. Perad., IV., pt. 4) I described and figured that part of the disc which bears the gleba, as deep red, covered with low, wavy ridges, and being slightly thickened. Further examples have shown that this feature is subject to variation. In some examples the thickening of the disc, *i.e.*, of the upper wall of the chambers which form it, thins away at the margin of the deep red area, and the wall there becomes of ordinary thickness. But in other cases it becomes thicker at the margin, and the thickening layer separates and recurves from the disc there, giving at first sight the impression that the gleba is borne on a circular plate which overlies the disc. Further, the low ridges underlying the gleba, which are little more than lines in some specimens, may be as much as 1·5 mm. high; they are then irregularly curved and bent over sideways, and often broken up into short lengths or projecting tubercles, thus giving the disc a ragged appearance quite different from that previously illustrated (Ann. Perad., IV., Pl. XVI., fig. 12). In some cases these ridges are united above, and thus form, here and there, an additional layer of irregular chambers.

The interesting part about this variation is that the almost smooth disc with low wavy ridges occurs in specimens in which the arms are quite separate, *i.e.*, *Aseroë rubra zeylanica*, while the irregular disc occurs in specimens in which the arms are distinctly paired, *i.e.*, in *Aseroë rubra typica*. (These names were unfortunately interchanged on p. 182 of the previous paper. Fig. 12, as cited above, illustrates the disc of *Aseroë rubra zeylanica*.) It might be supposed that the grouping of the arms in pairs, especially as a pair may be fused almost to the tip, is a case of imperfect development; and that the abnormal and irregular structure of the ridges which underlie the gleba is due to the persistence of parts which would normally disappear during the ripening of the latter.

The photographs of *Aseroë rubra* reproduced herewith were taken on an ordinary plate, and therefore fail to bring out the difference in tone between the gleba and the remainder of the fungus. Prof. C. Bernard's photograph, reproduced by C. G. Lloyd in "Synopsis of the Known Phalloids," shows this difference admirably. But I have thought it worth while to publish them, since they show the somewhat saucer-shaped outline of the disc and arms, and the fact that *the arms when first expanded are straight, not curled up at the tip*. This specimen was developed from the egg, under a bell glass; the arms were quite straight at first, but curling began while the camera was being set up. It will be noted that the arms are in pairs, and that one pair is united almost to the tip.

Protubera maracuja Möller.

A species of *Protubera* is not uncommon in belts of *Acacia decurrens*, and sometimes also in the jungle, at Hakgala (5,600 ft.). It was very common in spinneys of *Acacia* at Nuwara Eliya (6,200 ft.) in September, 1908. It differs in a few minor details from the description of *Protubera maracuja*, but it is evidently the same as Möller's species.

The "eggs" occur in clusters, sometimes in large rings. They are usually half-embedded in the earth and dead leaves, but sometimes lie entirely on the surface. In one instance, the mycelium had spread over a dead log and had produced the eggs at a height of about a foot from the ground. In shape they are spherical or ellipsoidal, in the latter case with the long axis horizontal. They are wholly white, or mottled with reddish-brown, sometimes entirely red-brown on the exposed parts.

The outer wall is thin, but tough. When the specimens are fresh it is even, not areolated as in *Clathrus crispatus ;* but it becomes areolated on drying. Consequently dried specimens may readily be mistaken for " eggs " of *Clathrus crispatus.* As a rule the outer wall is glabrous, but in one specimen from Hakgala it is scaly-tomentose. The largest specimen I have seen was 5·5 cms. long, 4·2 cms. broad, and 3·6 cms. high.

A section of the fungus, before deliquescence has occurred, shows that the interior is filled with a bluish-hyaline jelly. Narrow, almost membranous ridges penetrate radially into the jelly from the outer wall to a depth of three to five millimeters. These ridges or plates form a network on the inner side of the wall, and hence the latter becomes areolated on drying. The gleba is arranged along the edges of the ridges, in masses which are more or less oval and lobed in section. These masses penetrate about half way to the centre ; they are dark green externally, olive internally. From the point of attachment of the mycelium several fibres radiate towards the gleba.

The internal structure of the fungus, especially in the plates or ridges radiating from the exterior, strongly recalls that of *Clathrus.* In *Clathrus*, similar membranous ridges unite the net to the outer wall. *Protubera* is, in appearance, a *Clathrus* without a net. The gleba of *Clathrus*, however, in my specimens of *Clathrus crispatus*, fills the whole of the centre of the egg ; it does not leave a clear space filled with jelly, as in *Protubera.*

The mycelium is white, or purplish, in cords up to 2 mms. in diameter. I have not found sphæro-crystals in it.

The spores in the Nuwara Eliya specimens were narrow-oval, smooth, greenish-hyaline, $4–5 \times 2\mu$; in a tomentose specimen from Hakgala they were oblong with rounded ends, $4–7 \times 2·5\mu$.

My first specimen was kept in damp earth under a bell glass for several weeks, in the expectation that it would expand, or at least rupture in some way ; but nothing of the kind happened. Subsequent experience has shown that the outer wall does not rupture, except by accident. The fungus absorbs moisture and the interior deliquesces into a yellow-brown muddy liquid. The wall remains intact; and on picking up the fungus when in this condition it settles into the same depressed oval or spherical shape, no matter which side is placed uppermost. It resembles a bladder filled with liquid. Apparently the contents are set free only by the decay of the outer wall.

When broken, the ripe fungus has exactly the smell of rotting oranges, such as may be experienced in the sorting yard of an orange warehouse. Möller states that the smell resembles that of the ripe fruit of *Passiflora alata*, which is known in Brazil as *Maracuja*.

According to Ed. Fischer, *Protubera* belongs to the *Hymenogastrineæ*, not to the *Phallineæ*. I have included it in this paper, because most people would mistake it for a phalloid.

EXPLANATION OF PLATES.

Pl. 1 A. *Ithyphallus tenuis.*—A group of "eggs." Natural size.

Pl. 1 B. *Ithyphallus tenuis.*—A group soon after expansion, already beginning to collapse. $\times \frac{1}{2}$.

Pl. 2. *Ithyphallus tenuis.* $\times \frac{2}{3}$.

Pl. 3 A. *Mutinus Fleischeri.*—Specimen bearing gleba. $\times \frac{3}{4}$.

Pl. 3 B. *Mutinus Fleischeri.*—Expanded specimen with the gleba washed away; and an "egg" just beginning to expand. The red tip of the receptaculum is protruding from the latter. Natural size.

Pl. 4, fig. 1. *Mutinus Fleischeri.*—A half expanded specimen; the gleba still covered by a white membrane, which subsequently deliquesces. Natural size.

Pl. 4, fig. 2. *Simblum periphragmoides.*—The form usually styled var. *gracile.* $\times \frac{3}{4}$.

Pl. 4, fig. 3. *Simblum periphragmoides.* A twin specimen. $\times \frac{3}{4}$.

Pl. 4, fig. 4. *Protubera maracuja.* A section through the middle of the fungus, photographed by transmitted and reflected light. $\times \frac{1}{2}$.

Pl. 5 A. *Aseroë rubra* viewed from the side. $\times \frac{2}{3}$.

Pl. 5 B. *Aseroë rubra* viewed obliquely. $\times \frac{2}{3}$.

PLATES

TO ACCOMPANY

VOL. V., PART I., JANUARY, 1911,

OF THE

ANNALS

OF THE

ROYAL BOTANIC GARDENS. PERADENIYA.

ITHYPHALLUS TENUIS

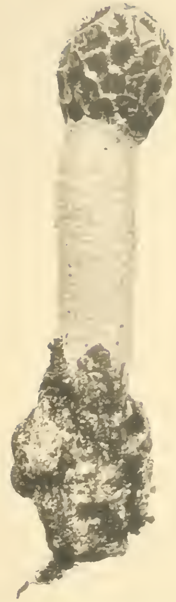
ITHYPHALLUS TENUIS X 1/2

MUTINUS FLEISCHERI

MUTINUS FLEISCHERI X 3/4

1

2



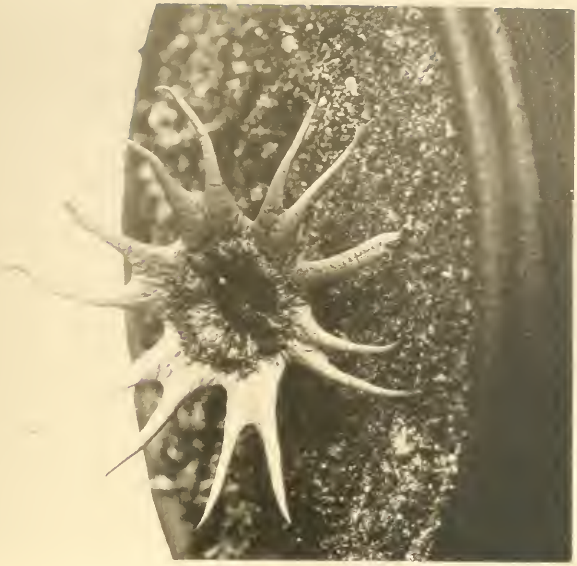
3

4

I. MUTINUS FLEISCHERI   II. SIMBLUM PERIPHRAGMOIDES X

III. SIMBLUM PERIPHRAGMOIDES X 3/4

IV. PROTUBERA MARACUJA X 1



ASEROE RUBRA X 2/3

395. Morinda, L.
 1050. tinctoria, Roxb. *Ahu*, S. *Mancha-vanna*, T. II.354
 1051. citrifolia, L. *Ahu*, S. II.354
 1052. umbellata, L. *Kiri-wel*, *Maha-kiri-wel*, S. II.355

396. Prismatomeris, Thw.
 1053. albidiflora, Thw. II.355
 var. β Fergusonii, Trim.

397. Psychotria, L.
 1054. STENOPHYLLA, Hk. f. II.357
 1055. GLANDULIFERA, Thw. II.357
 1056. GARDNERI, Hk. f. II.358
 1057. Thwaitesii, Hk. f. II.358
 var. β coronata, Hk. f.
 1058. WIGHTIANA, Hk. f. II.358
 var. β affinis, Hk. f.
 1059. elongata, Hk. f. II.359
 1060. sarmentosa, Bl. *Wal-gonika*, S. II.359
 1061. MOONII, Hk. f. II.360
 1062. SORDIDA, Thw. II.360
 1063. LONGEPETIOLATA, Thw. II.361
 1064. PLURIVENIA, Thw. II.361
 1065. FILIPES, Hk. f. II.361
 1066. bisulcata, W. & A. II.362, Pl. LIV.

398. Chasalia, Comm.
 1067. curviflora, Thw. II.362

399. Geophila, Don.
 1068. reniformis, D. Don. *Agukarni*, S. II.363

400. Lasianthus, Jack.
 1069. MOONII, Wight. II.364
 1070. THWAITESII, Hook. f. II.365
 var. β nitidus, Thw.
 1071. RHINOPHYLLUS, Thw. II.365
 1072. WALKERIANUS, Wight. II.365
 1073. GARDNERI, Hk. f. II.366
 1074. OLIGANTHUS, Thw. II.366
 1075. OBLIQUUS, Thw. II.367
 1076. STRIGOSUS, Wight. II.367
 var. β protractus, Hk. f.
 1077. VARIANS, Thw. II.368

401. Saprosma, Bl.
 1078. indicum, Dalz. II.368
 1079. SCABRIDUM, Bedd. II.369
 1080. zeylanicum, Bedd. II.369

402. Hydrophylax, L. f.
1081. maritima. L. f. *Mudu-geta-kola*, S. II.370

403. Spermacoce, L.
1082. stricta, L. f. II.371
1083. ocymoides, Burm. f. II.371
1084. hispida, L. *Hin-geta-kola*, S. *Yar*, *Nat-taichchuri*, T. II.371

404. Rubia, L.
1085. cordifolia, L. *Manda-madini-wel*, *Yogana-wel*, S. II.372

405. Galium, L.
1086. asperifolium, Wall. II.373

68. Valerianaceæ.

406. Valeriana, L.
1087. MOONII, Arn. III.1

69. Dipsacaceæ.

407. Dipsacus, L.
1088. WALKERI, Arn. III.2

70. Compositæ.

408. Vernonia, Schreb.
1089. GARDNERI, Thw. III.6
1090. THWAITESII, Clarke. III.6
1091. ANCEPS, Clarke. III.6
1092. cinerea, Less. *Monara-kudimbiya*, S. *Chitiviyarchenkalainir*, T. III.7
1093. SETIGERA, Arn. III.7
1094. HOOKERIANA, Arn. III.8
1095. SCARIOSA, Arn. III.8
var. β crassa, Thw.
*1096. anthelmintica, Willd. *Sanninayan*, S. *Kadduchchirakam*, T. III.9
1097. NEMORALIS, Thw. III.9
1098. WIGHTIANA, Arn. III.9
1099. ZEYLANICA, Less. *Pupula*, *Hin-botiya*, S. *Kuppilay*, T. III.10
1100. pectiniformis, DC. III.10
1101. arborea, Ham. *Kobomella*, S. III.11

409. Elephantopus, L.
1102. scaber, L. *Et-adi*, S. *Anichovadi*, T. III.12

410. Adenostemma, Forst.
1103. viscosum, Forst. III.13
var. β reticulatum, Clarke.

411. Dichrocephala, DC.
  1104. latifolia, DC. III.14
412. Grangea, Adans:
  1105. maderaspatana, Poiret. III.14
413. Myriactis, Less.
  1106. Wightii, DC. III.15
414. Lagenophora, Cass.
  1107. Billardieri, Cass. III.16, Pl. LV.
415. Erigeron, L.
  1108. asteroides, Roxb. *Narakaramba*, T. III.16
416. Microglossa, DC.
  1109. zeylanica, Clarke. *Pupula*, S. III.17
417. Conyza, Less.
  1110. viscidula, Wall. III.18
418. Blumea, DC.
  1111. amplectens, DC. III.19
  var. β arenaria, Hk. f.
  1112. bifoliata, DC. III.19
  1113. lacera, DC. III.19
  1114. barbata, DC. III.20
  1115. flexuosa, Clarke. III.20
  1116. CRINITA, Arn. III.21
  1117. hieraciifolia, DC. III.21
  1118. membranacea, DC. III.22
  var. β Gardneri, Hk. f
  1119. spectabilis, DC. III.22
  1120. ANGUSTIFOLIA, Thw. III.23, Pl. LVI.
419. Laggera, Schultz-Bip.
  1121. alata, Sch.-Bip. III.23
  1122. aurita, Benth. III.24
420. Epaltes, Cass.
  1123. divaricata, Cass. *Hin-muda-mahana*, S. III.24
421. Sphæranthus, L.
  1124. amaranthoides, Burm. f. *Chiva-charantai*, T. III.25
  1125. indicus, L. *Muda-mahana*, S. III.26
  1126. africanus, L. III.26
422. Blepharispermum, Wight.
  1127. petiolare, DC. III.27
423. Anaphalis, DC.
  1128. cinnamomea, Clarke. III.28
  1129. PELLICULATA, Trim. III.28, Pl. LVII.

1130. FRUTICOSA, Hk. f. III.29
1131. THWAITESII, Clarke. III.29
1132. oblonga, DC. III.30
1133. ZEYLANICA, Clarke. III.30
1134. marcescens, Clarke. III.31
var. β sulphurea, Trim.
1135. brevifolia, DC. III.31

424. Helichrysum, Gærtn.
1136. buddleoides, DC. III.32

425. Vicoa, Cass.
1137. auriculata, Cass. *Ran-hiriya*, S. III.33

426. Chrysogonum, L.
1138. heterophyllum, Clarke. III.34

427. Xanthium, L.
1139. Strumarium, L. III.35

428. Siegesbeckia, L.
1140. orientalis, L. III.36

429. Eclipta, L.
1141. alba, Hassk. *Kikirindi*, S. *Karippan*, T. III.37

430. Blainvillea, Cass.
1142. latifolia, DC. III.37

431. Wedelia, Jacq.
1143. calendulacea, Less. *Ran-wan-kikirindi*, S. III.38
1144. biflora, DC. III.39

432. Spilanthes, Jacq.
1145. Acmella, L. *Akmella*, S. *Toothache plant.* III.40

433. Bidens, L.
*1146. pilosa, L. *Wal-te-kola*, S. *Spanish needle.* III.40
var. β bipinnata, Hk. f.

434. Glossogyne, Cass.
1147. pinnatifida, DC. III.41

435. Centipeda, Lour.
1148. orbicularis, Lour. *Wisaduli*, S. III.42

436. Artemisia, L.
*1149. vulgaris, L. *Wal-kolondu*, S. *Mugwort.* III.43

437. Gynura, Cass.
1150. lycopersicifolia, DC. III.43
1151. ZEYLANICA, Trim. III.44, Pl. LVIII.
1152. HISPIDA, Thw. III.45

438. Emilia, Cass.
  1153. sonchifolia, DC. *Kadupara*, S. III.45
  1154. ZEYLANICA, Clarke. III.46
    var. β Walkeri, Trim.

439. Notonia, DC.
  1155. grandiflora, DC. III.47
  1156. Walkeri, Clarke. III.47

440. Senecio, L.
  1157. gracilis, Arn. III.48
  1158. GARDNERI, Clarke. III.48
  1159. ludens, Clarke. III.49
  1160. Walkeri, Arn. III.49
  1161. corymbosus, Wall. III.50
  1162. scandens, D. Don. III.50

441. Crepis, L.
  1163. japonica, Benth. III.51
  1164. fuscipappa, Clarke. III.51

442. Lactuca, L.
  1165. Heyneana, DC. III.52

443. Launæa, Cass.
  1166. pinnatifida, Cass. III.52

71. Stylidiaceæ.

444. Stylidium, Sw.
  1167. uliginosum, Sw. III.53

72. Goodenoviaceæ.

445. Scævola, L.
  1168. Kœnigii, Vahl. *Takkada*, S. III.54
  1169. Plumieri, Vahl. *Hin-takkada*, S. III.55

73. Campanulaceæ.

446. Lobelia, L.
  1170. zeylanica, L. III.56
    var. β Walkeri, Clarke.
  1171. trigona, Roxb. III.56
  1172. affinis, Wall. III.57
  1173. nicotianæfolia, Heyne. *Rasni*, S. III.57
    var. β trichandra (Wight), Trim.

447. Wahlenbergia, Schrad.
  1174. gracilis, A. DC. *Hare-bell.* III.58

448. Sphenoclea, Gærtn.
  1175. zeylanica, Gærtn. III.59

449. Campanula, L.
 1176. canescens, Wall. III.60
 1177. fulgens, Wall. III.60

74. Vacciniaceæ.

450. Vaccinium, L.
 1178. Leschenaultii, Wight. *Boralu*, S. III.61

75. Ericaceæ.

451. Gaultheria, L.
 1179. fragrantissima, Wall. *Wel-kapuru*, S. III.62
 var. β hirsuta, Gardn.

452. Rhododendron, L.
 1180. arboreum, Sm. *Ma-ratmal*, S. III.63

76. Plumbaginaceæ.

453. Plumbago, L.
 1181. zeylanica, L. *Ela-netul*, S. III.65

77. Primulaceæ.

454. Lysimachia, L.
 1182. ramosa, Wall. III.66
 1183. deltoidea, Wight. III.66

78. Myrsinaceæ.

455. Mæsa, Forsk.
 1184. indica, A. DC. (Perrotetiana, A. DC.)
 Matabimbiya, S. III.67

456. Myrsine, L.
 1185. capitellata, Wall.[1] III.68
 var. β lanceolata, Clarke.
 var. γ sessiliflora, Thw.

457. Embelia, Burm. f.
 1186. Ribes, Burm. f. *Wel-embilla*, S. III.69
 1187. robusta, Roxb. (tsjeriam-cottam, A. DC.) III.70
 1188. viridiflora, Scheff. (basaal, A. DC.) III.70

458. Ardisia, Sw.[2]
 1189. Missionis, Wall. III.71
 1190. WILLISII, Mez. (A. humilis, Trim. pp.)
 Lunu-dan, S. (Gardner, 516, Hügel, 3,581, C. P., 2,829, &c.)

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[1] Mez, in Das Pflanzenreich, splits this into five species, Thwaitesii, ceylanica, robusta, exigua, and rubens, and transfers it to Rapanea.
[2] *Cf.* Mez in Das Pflanzenreich.

1191. humilis, Vahl. (incl. A. elliptica, Thunb.) *Balu-dan*, S. III.72
var. β Wightiana, A. DC.
1192. solanacea, Roxb. III.72
1193. Gardneri, Clarke. III.72
var. β zeylanica, Clarke.
1194. pauciflora, Heyne. III.73
1195. POLYLEPIS, Mez. (last sp. p.p.)
1196. MOONII, Clarke. III.73

459. Ægiceras, Gærtn.
1197. majus, Gærtn. *Hin-kadol*, S. *Vitlikanna*, T. III.74

79. Sapotaceæ.

460. Chrysophyllum, L.
1198. Roxburghii, G. Don. *Lawulu*, S. III.76

461. Sideroxylon, L.
1199. tomentosum, Roxb. *Mul-makil*, T. III.77

462. Isonandra, Wight.
1200. lanceolata, Wight. *Kiri-warala*, *Mol-pedda*, S. III.77
var. β angustata, Thw.
var. γ montana, Thw.
var. δ compta, Thw.
var. ε major, Clarke.

463. Bassia, Kœnig.
1201. longifolia, L. *Mi*, S. *Iluppai*, T. III.79
1202. MOONII, Bedd. III.79
1203. NERIIFOLIA, Moon. *Gan-mi*, S. III.80, Pl. LIX.
1204. MICROPHYLLA, Hook. III.80
1205. FULVA, Bedd. *Wana-mi*, S. III.81

464. Palaquium, Blanco.
1206. PETIOLARE, Engl. *Molpedda*, S. III.82
1207. GRANDE, Engl. *Kirihiriya*, *Mihiriya*, *Kirihembiliya*, *Molpedda*, S. III.82
var. β parvifolium, Clarke.
var. γ angustatum, Trim.
1208. RUBIGINOSUM, Engl. III.83
1209. CANALICULATUM, Engl. III.84
1210. THWAITESII, Trim. III.84
1211. LÆVIFOLIUM, Engl. III.84
1212. PAUCIFLORUM, Engl. III.85

465. Mimusops. L.
 1213. Elengi, L. *Muna-mal*, S. *Makil*, *Mukalai*, *Vilva-padri*, T. III.86
 1214. hexandra, Roxb. *Palu*, S. *Palai*, T. III.86

80. Ebenaceæ.

466. Maba, Forst.
 1215. ACUMINATA, Hiern. III.88
 1216. OVALIFOLIA, Hiern. III.88
 1217. OBLONGIFOLIA, Hiern. III.89
 1218. buxifolia, Pers. *Kalu-habaraliya*, S. *Juvarai*, *Irumpalai*, T. III.89
  var. β microphylla, Thw.
  var. γ Ebenus, Thw.
  var. δ angustifolia, Thw.

467. Diospyros, L.[1]
 1219. ovalifolia, Wight. *Kunumella*, *Habara*, S. *Vedukkanari*, T. III.91
 1220. montana, Roxb. *Mulkarunkali*, *Katukanni*, *Vakkana*, T. III.92
 1221. Embryopteris, Pers. *Timbiri*, S. *Panichchai*, T. III.93
  var. β atrata, Thw.
  var. γ nervosa, Thw.
 1222. Toposia, Ham. *Kahakala*, *Kaluwella*, S. *Vellai Thoveri*, T. III.94
 1223. Ebenum, Kœnig. *Kaluwara*, S. *Karunkali*, T. *Ebony*. III.94
 1224. pruriens, Dalz. III.95
 1225. ATTENUATA, Thw. *Kadumberiya*, S. III.96
 1226. ACUTA, Thw. III.96
 1227. GARDNERI, Thw. *Kadumberiya*, *Kallu*, S. *Bastard ebony*. III.96
 1228. oocarpa, Thw. *Kalu-kadumberiya*, *Etatimbiri*, S. *Vellai-karunkali*. T. III.97
 1229. QUÆSITA, Thw. *Kalumediriya*, S. *Calamander*. III.97
 1230. sylvatica, Roxb. *Sudu-kadumberiya*, S. *Karuppu-thoveri*, T. III.98
 1231. Melanoxylon, Roxb. *Kadumberiya*, S. III.99
 1232. HIRSUTA, L. f. III.99
 1233. insignis, Thw. *Gona*, *Poruwa-mara*, *Wal-mediriya*, S. III.100
 1234. OPPOSITIFOLIA, Thw. *Kalumediriya*, *Kadumberiya*, S. III.100

[1] See Wright, in Ann. Perad. II., 1904, pp. 1–133.

1235. THWAITESII, Bedd. *Kadumberiya*, S. III.101
1236. MOONII, Thw. *Kadumberiya*, *Kaluwella*, S. III.101
1237. affinis, Thw. *Kaluwella*, S. *Semelpanachai*, T. III.102
1238. crumenata, Thw. III.102

81. Styraceæ.

468. Symplocos, L.[1]
1239. spicata, Roxb. *Bombu*, *Wal-bombu*, S. III.104
1240. furcata, Brand. (obtusa, Wall.) III.104
var. β major, Thw.
var. γ obovata, Thw.
var. δ cucullata, Thw.
1241. LÆTA, Thw. III.105
1242. BRACTEALIS, Thw. III.106
1243. VERSICOLOR, Clarke (spicata according to Brand.) III.106
1244. ACUTA, Thw. III.106
1245. CUNEATA, Thw. III.107
1246. HISPIDULA, Thw. III.107
1247. WALKERI, Brand.
1248. JUCUNDA, Thw. III.107
1249. ANGUSTATA, Clarke. III.108
1250. LATIFLORA, Clarke. III.108
1251. ELEGANS, Thw. III.108
1252. MINOR, Clarke. III.109
var. β glabrescens, Thw.
1253. HEBANTHA, Thw. III.109
1254. CORDIFOLIA, Thw. III.110
1255. APICALIS, Thw. III.110
var. β glabrifolia, Thw.
1256. MARGINALIS, Thw. III.111
1257. CORONATA, Thw. III.111
1258. pendula, Wight. (pauciflora, Wight.) III.111

82. Oleaceæ.

469. Jasminum, L.
1259. glabriusculum, Bl. III.113
1260. sessiliflorum, Vahl. III.114
1261. angustifolium, Vahl. *Wal-pichcha*, S. III.114
1262. auriculatum, Vahl. III.115
1263. flexile, Vahl. III.115
1264. humile, L. III.115

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[1] See Brand, in Das Pflanzenreich.

470. Linociera, Sw.
1265. PURPUREA, Vahl. *Geriata*, S. *Katti-muruchan*, T. III.116
1266. albidiflora, Clarke. III.117
var. β rostrata, Clarke.
1267. leprocarpa, Clarke. III.117

471. Olea, L.
1268. glandulifera, Wall. III.118
1269. polygama, Wight. III.118

472. Ligustrum, L.
1270. Walkeri, Dcne. III.119

83. Salvadoraceæ.

473. Salvadora, L.
1271. persica, L. *Uvay*, *Viyay*, T. III.120

474. Azima, Lam.
1272. tetracantha, Lam. *Iyanku*, *Ichanku*, T. III.121

84. Apocynaceæ.

475. Willughbeia, Roxb.
1273. ZEYLANICA, Thw. *Kiri-gedi*, *Kiri-wel*, S. III.123

476. Carissa, L.
1274. Carandas, L. *Maha-karamba*, S. *Perunkila*, T. III.124
1275. spinarum, L. *Hin-karamba*, S. *Chirukila*, *Kilatti*, T. III.125

477. Rauvolfia, L.
1276. serpentina, Hk. f. *Ekaweriya*, *Ratekaweriya*, S. III.126
1277. densiflora, Hk. f. III.126

478. Alyxia, Br.
1278. ZEYLANICA, Wight. *Walkaduru*, S. III.127

479. Hunteria, Roxb.
1279. corymbosa, Roxb. *Mediya*, S. III.128

480. Cerbera, L.
1280. Odollam, Gærtn. *Gon-kaduru*, S. III.128

481. Ochrosia, Juss.
1281. borbonica, Gmel. *Mudu-kaduru*, S. III.129, Pl. LX.

482. Vinca, L.
1282. pusilla, Murr. III.130

483. Holarrhena, Br.
1283. MITIS, Br. *Kiri-walla*, *Kiri-mawara*, S. III.131

484\. Tabernæmontana, L.
1284. dichotoma, Roxb. *Divi-kaduru*, S. *Eve's apple*, *Forbidden fruit*. III.132

485\. Alstonia, Br.
1285. scholaris, Br. *Ruk-attana*, *Elilaippalai*, T. III.133

486\. Parsonsia, Br.
1286. spiralis, Wall. III.134

487\. Vallaris, Burm.
1287. Heynei, Spreng. III.135

488\. Wrightia, Br.
1288. FLAVIDO-ROSEA, Trim. III.136, Pl. LXI.
1289. ANGUSTIFOLIA, Thw. III.136
1290. tomentosa, Rœm. & Sch. *Palmadankai*, T. III.137
1291. ZEYLANICA, Br. *Wal-idda*, *Sudu-idda*, S. III.137

489\. Chonemorpha, G. Don.
1292. macrophylla, G. Don. *Bu-wal-anguna*, S. III.138

490\. Aganosma, G. Don.
1293. cymosa, G. Don. III.139

491\. Baissea, A. DC.
1294. ACUMINATA, Hk. f. III.140

492\. Anodendron, A. DC.
1295. paniculatum, A. DC. *Dul*, *As-wel*, S. III.141
1296. RHINOSPORUM, Thw. III.141

493\. Ichnocarpus, Br.
1297. frutescens, Ait. *Kiri-wel*, S. III.142

85. Asclepiadaceæ.

494\. Hemidesmus, Br.
1298. indicus, Br. *Iramusu*, S. *Nannari*, T. III.144

495\. Cryptolepis, Br.
1299. Buchanani, Rœm. & Sch. *Wel-ruk-attana*, S. III.145

496\. Secamone, Br.
1300. emetica, Br. III.146

497\. Toxocarpus, W. & A.
1301. Kleinii, W. & A. III.146

498\. Oxystelma, Br.
1302. esculentum, Br. *Kulappalai*, T. III.147

499. Calotropis, Br.
  1303. gigantea, Br. *Wara*, S. *Manakkovi*, *Errukalai*, *Urkkovi*, T. III.148

500. Pentatropis, Br.
  1304. microphylla, W. & A. III.149

501. Dæmia, Br.
  1305. extensa, Br. *Medahangu*, S. *Uttamakam*, *Veliparatti*, T. III.150

502. Holostemma. Br.
  1306. Rheedei, Wall. III.150

503. Cynanchum, L.
  1307. pauciflorum, Br. *Kan-kumbala*, S. III.151

504. Sarcostemma, Br.
  1308. Brunonianum, W. & A. *Muwa-kiriya*, S. III.152

505. Gymnema, Br.
  1309. sylvestre, Br. *Mas-bedde*, S. III.153
    var. β zeylanicum, Hk. f.
  1310. ROTUNDATUM, Thw. III.153
  1311. lactiferum, Br. *Kurinnan*, S. and T. III.154
    var. β Thwaitesii, Hk. f.
  1312. pergularioides, Wight. & Gardn. III.154
    var. β Gardneri, Hk. f.
    var. γ stenoloba, Hk. f. (sp.)

506. Marsdenia, Br.
  1313. tenacissima, Moon. *Muruwa-dul*, S. III.155

507. Tylophora, Br.
  1314. fasciculata, Ham. III.156
  1315. Iphisia, Dene. III.157
  1316. MEMBRANIFOLIA, Thw. III.157
  1317. zeylanica, Dene. III.157
  1318. tenuis, Bl. III.158
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  1320. asthmatica, W. & A. *Bin-nuga*, S. *Peypalai*, *Nancharapanchan*, T. *Wild ipecacuanha.* III.158
  1321. FLAVA, Trim. *Mudu-bin-nuga*, S. III.159, Pl. LXII.

508. Cosmostigma, Wight.
  1322. racemosum, Wight. III.160

509. Dregea, E. Meyer.
  1323. volubilis, Benth. *Kiri-anguna*, S. *Kurincha*, T. III.161

510. Dischidia, Br.
  1324. Nummularia, Br. III.161

511. Hoya, Br.
  1325. pauciflora, Wight. III.162
  1326. ovalifolia, W. & A. III.162

512. Heterostemma, W. & A.
  1327. tanjorense, W. & A. III.163

513. Leptadenia, Br.
  1328. reticulata, W. & A. *Palai*, T. (?) III.164

514. Ceropegia, L.
  1329. elegans, Wall. III.165
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  1331. Thwaitesii, Hook. III.166
  1332. Decaisneana, Wight. III.166
  1333. biflora, L. *Wel-mottu*, S. III.167
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515. Caralluma, Br.
  1335. fimbriata, Wall. *Mankalli*, T. III.168
  1336. CAMPANULATA, N. E. Br. III.168

86. Loganiaceæ.

516. Mitrasacme, Lab.
  1337. alsinoides, Br. III.170

517. Fagræa, Thunb.
  1338. zeylanica, Thunb. *Etamburu*, S. III.170
  1339. obovata, Wall. III.171
    var. β Gardneri, Clarke.

518. Strychnos, L.
  1340. MICRANTHA, Thw. *Kachchalkodi*, T. III.172
  1341. colubrina, L. var. zeylanica, Clarke. III.173
  1342. Beddomei, Clarke. III.173
    var. β coriacea, Clarke.
  1343. BENTHAMI, Clarke. III.174
    var. β parvifolia, Benth.
  1344. CINNAMOMIFOLIA, Thw. *Eta-kirindi-wel*, *Wel-beli*, S. III.174
  1345. Nux-vomica, L. *Goda-kaduru*, S. *Eddi*, *Kanchurai*, T. *Nux vomica.* III.175
  1346. potatorum, L. f. *Ingini*, S. *Tetta*, T. *Clearing-nut.* III.176

519. Gærtnera, Lam.
1347. Kœnigii, Wight. *Pera-tambala*, S. III.177
var. β thyrsiflora, Thw.
var. γ divaricata, Clarke.
1348. ROSEA, Thw. III.177
1349. WALKERI, Wight. III.178
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1350. TERNIFOLIA. Thw. III.178, Pl. LXIV.

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1356. sessile, L. (? endemic.) III.183

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1357. fastigiata, Clarke. III.183

522. Canscora, Lam.
1358. diffusa, Br. III.184
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1361. decussata, Rœm. & Schult. III.185

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1363. quadrifaria, Bl. III.186

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1364. japonica, Sieb. & Zucc. var. Championii, Clarke. III.187, Pl. LXV.

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1366. indicum, Thw. *Olu*, *Maha-ambala*, S. III.188
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88. Hydrophyllaceæ.

528. Hydrolea, L.
 1370. zeylanica, Vahl. *Diya-kirilla*, S. III.191

89. Boraginaceæ.

529. Cordia, L.
 1371. Myxa, L. *Lolu*, S. *Naruvili*, *Vidi*, T. *Sebestens.* III.193
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 1372. monoica, Roxb. *Naruvili*, *Pon-naru-vili*, T. III.193
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 1374. OBLONGIFOLIA, Thw. III.194
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 1378. procumbens, L. *Chirupaddi*, T. III.197
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 1379. lycioides, Mart. III.197
533. Tournefortia, L.
 1380. argentea, L. f. *Karan*, S. III.198
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 1383. paniculatum, Br. III.200
 1384. scabrum, Retz. III.200
 1385. indicum, L. *Et-setiya*, *Et-honda*, S. *Dimi-biya*, *Tedkodukku*, T. III.200
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 1386. indicum, Br. *Kavil-tumpai*, T. III.201
 1387. zeylanicum, Br. III.202
536. Cynoglossum, L.
 1388. micranthum, Desf. *Bu-katu-henda*, S. *Forget-me-not.* III.203
  var. β decurrens, Moon.

90. Convolvulaceæ.

537. Erycibe, Roxb.
 1389. paniculata, Roxb. *Eta-miriya*, *Etam-biriya*, S. III.204

538. Rivea, Choisy.
1390. ornata, Choisy. *Muchuddai*, T. III.205

539. Argyreia, Lour.
1391. tiliæfolia, Wight. *Ma-banda*, S. III.206
1392. splendens, Sweet. III.207
1393. POPULIFOLIA, Choisy. *Giri-tilla*, S. III.207
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1394. pomacea, Choisy. var. triflora, Clarke. III.208
1395. Choisyana, Wight. III.208

540. Lettsomia, Roxb.
1396. aggregata, Roxb. var. osyrensis, Clarke. III.209
1397. elliptica, Wight. III.209
1398. HANCORNIÆFOLIA, Clarke. III.210

541. Ipomaea, L.
*1399. digitata, L. *Kiribadu*, S. III.212
*1400. hederacea, Jacq. *Tali*, T. III.212
1401. dissecta, Willd. III.213
*1402. Bona-nox, L. *Alanga*, *Kalu-alanga*, S. *Moon-flower*. III.213
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1406. pileata, Roxb. III.215
1407. Wightii, Choisy. III.216
1408. bracteata, Wight. III.216
1409. Pes-tigridis, L. *Divi-adiya*, *Divi-pahuru*, S. III.216
var. β hepaticifolia, Clarke.
1410. eriocarpa, Br. III.217
1411. angustifolia, Jacq. *Hin-madu*, S. III.217
1412. tridentata, Roth. *Hawari-madu*, S. *Mudiya kundal*, T. III.218
1413. reniformis, Choisy. III.218
1414. chryseides, Ker. *Kaha-tel-kola*, S. III.219
1415. staphylina, Rœm. & Sch. III.219
1416. cymosa, Rœm. & Sch. *Kiri-madu*, *Maha-madu*, S. III.219
1417. sepiaria, Kœnig. *Rasa-tel-kola*, S. *Tali*, T. III.220
var. β stipulacea, Clarke.
1418. obscura, Ker. *Tel-kola*, S. III.220
1419. campanulata, L. III.221
1420. aquatica, Forsk. *Kankun*, S. III.221
var. β parviflora, Trim.
1421. repens, Lam. *Bin-tamburu*, S. III.222

1422. Turpethum, Br. *Trastawalu*, S. III.222
1423. denticulata, Choisy. III.223
1424. biloba, Forsk. *Mudu-bin-tamburu*, S. III.224
1425. vitifolia, Sweet. III.224
1426. palmata, Forsk. III.225
1427. dasysperma, Jacq. III.225

542. Hewittia, W. & A.
1428. bicolor, W. & A. *Wal-trastawalu*, S. III.226

543. Convolvulus, L.
1429. parviflorus, Vahl. III.226

544. Evolvulus, L.
1430. alsinoides, L. *Visnu-kranti*, S. *Vichnu-kiranti*, T. III.227

545. Breweria, Br.
1431. cordata, Bl. III.227

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1432. cretica, L. *Panittanki*, T. III.228

547. Cuscuta, L.
1433. reflexa, Roxb. III.229
1434. chinensis, Lam. *Aga-mula-neti-wel*, S. III.229

91. Solanaceæ.

548. Solanum, L.
1435. nigrum, L. *Kalu-kan-weriya*, S. *Manaltakalli*, T. III.231
1436. læve, Dunal. III.231, Pl. LXVII.
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1437. pubescens, Willd. III.232
1438. verbascifolium, L. *Hekarilla*, S. III.232
1439. giganteum, Jacq. III.233
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1441. torvum, Sw. III.234
1442. indicum, L. *Tibbatu*, S. III.234
1443. xanthocarpum, Schrad. & Wendl. *Elabatu*, S. *Vaddu*, T. III.235
var. β Jacquini, Thw. *Katu-wel-batu*, S. *Kandankattari*, T.
1444. trilobatum, L. *Wal-tibbatu*, S. *Tutuvalai*, T. III.236

549. Physalis, L.
1445. minima, L. *Mottu*, *Hin-mottu*, S. III.236

550. Withania, Pauq.
*1446. somnifera, Dun. *Amukkara*, S. *Amukkirai*, T. III.237

551. Datura, L.
 1447. fastuosa, L. *Attana*, S. *Venumattai*, T. III.238

92. Scrophulariaceæ.

552. Celsia, L.
 1448. coromandeliana, Vahl. III.240

553. Adenosma, Br.
 1449. SUBREPENS, Benth. III.241
 1450. CAMPHORATUM, Hk. f. *Kaha-gona-kola*, S. III.241
 1451. capitatum, Benth. *Nil-gona-kola*, S. III.242

554. Limnophila, Br.
 1452. conferta, Benth. *Amba-wila*, S. III.243
 1453. gratissima, Bl. III.243
 1454. hirsuta, Benth. III.244
 1455. sessiliflora, Bl. III.244
 1456. heterophylla, Benth. III.244
 1457. racemosa, Benth. III.245
 1458. gratioloides, Br. III.245

555. Herpestis, Gærtn. f.
 1459. Monnieria, H. B. K. *Lunu-wila*, S. III.246
 1460. floribunda, Br. III.246

556. Dopatrium, Hamilt.
 1461. nudicaule, Ham. III.247
 1462. lobelioides, Benth. III.247
 1463. junceum, Ham. *Bin-sawan*, S. III.247

557. Artanema, Don.
 1464. sesamoides, Benth. *Gas-kotala*, S. III.248

558. Torenia, L.
 1465. asiatica, L. *Kotala-wel*, S. III.249
 1466. hirtella, Hk. f. III.249

559. Vandellia, L.
 1467. crustacea, Benth. III.250
 1468. hirsuta, Ham. III.250
 1469. scabra, Benth. III.251
 1470. pedunculata, Benth. III.251
 1471. angustifolia, Benth. III.251

560. Ilysanthes, Rafin.
 1472. hyssopioides, Benth. III.252
 1473. rotundifolia, Benth. III.252

561\. Bonnaya, Link & Otto. III.253
   1474. brachiata, Link & Otto. III.253
   1475. veronicæfolia, Spreng. *Wila*, S. III.253
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562\. Microcarpæa, Br.
   1477. muscosa, Br. III.254

563\. Peplidium, Del.
   1478. humifusum, Del. III.255

564\. Striga, Lour.
   1479. orobanchoides, Benth. III.255
   1480. lutea, Lour. III.256
   1481. euphrasioides, Benth. III.256

565\. Sopubia, Ham.
   1482. delphinifolia, G. Don. III.257
   1483. trifida, Ham. III.257

566\. Centranthera, Br.
   1484. procumbens, Benth. *Dutu-satutu*, S III.258, Pl. LXVIII.
   1485. hispida, Br. III.259
   1486. humifusa, Wall. III.259

567\. Pedicularis, L.
   1487. zeylanica, Benth. III.260

93. Orobanchaceæ.

568\. Æginetia, L.
   1488. indica, L. *Kolikara-mal*, S. III.261
   1489. pedunculata, Wall. III.261

569\. Christisonia, Gardn.
   1490. subacaulis, Gardn. III.262
   1491. THWAITESII, Trim. III.263, Pl. LXIX.
   1492. TRICOLOR, Gardn. III.263
      var. β grandiflora, Hk. f.
   1493. bicolor, Gardn. III.264
      var. β pallidiflora, Thw.
      var. γ spectabilis, Trim.
   1494. ALBIDA, Thw. III.265

570\. Campbellia, Wight.
   1495. cytinoides, Wight. III.265

94. Lentibulariaceæ.

571\. Utricularia, L.
   1496. stellaris, L. f. III.267
   1497. flexuosa, Vahl. *Diya-pasi*, S. III.267
   1498. exoleta, Br. III.268

1499. cærulea, L. *Nil-monaressa*, S. III.268
1500. affinis, Wight. III.269
1501. reticulata, Smith. *Nil-monaressa*, S. III.269
var. β stricticaulis, Kœnig.
1502. capillacea, Wall. III.270
1503. bifida, L. III.270
1504. nivea, Vahl. III.270
var. β rosea, Thw.
1505. orbiculata, Wall. III.271

95. Gesneraceæ.

572. Æschynanthus, Jack.
1506. zeylanica, Gardn. III.272
var. β pinguis, Clarke.

573. Didymocarpus, Wall.
1507. HUMBOLDTIANUS, Gardn. III.273
var. β primulæfolius, Trim.
var. γ recedens, Clarke.
1508. FLOCCOSUS, Thw. III.274
1509. ZEYLANICUS, Br. III.274

574. Chirita, Ham.
1510. MOONII, Gardn. III.275
1511. WALKERI, Gardn. III.275
var. β parviflora, Clarke.
1512. ZEYLANICA, Hook. III.276
var. β angusta, Clarke.

575. CHAMPIONIA, Gardn.
1513. RETICULATA, Gardn. III.277

576. Klugia, Schlecht.
1514. Notoniana, A. DC. *Diya-nilla*, S. III.277
var. β glabra, Clarke.
1515. ZEYLANICA, Gardn. III.278

577. Epithema, Bl.
1516. carnosum, Benth. var. zeylanicum, Clarke. III.279

578. Isanthera, Nees.
1517. permollis, Nees. III.280

96. Bignoniaceæ.

579. Oroxylum, Vent.
1518. indicum, Vent. *Totila*, S. III.281

580. Dolichandrone, Seem.
1519. Rheedii, Seem. *Diya-danga*, S. *Vil-padri*, T. III.282

581. Stereospermum, Cham.
 1520. chelonioides, DC. *Lunu-madala*, *Dunu-madala*, S. *Padri*, T. III.283

97. Pedaliaceæ.

582. Pedalium, L.
 1521. Murex, L. *Et-nerenchi*, S. *Peru-nerinchi*, *Anai-nerinchi*, T. III.285
583. Sesamum, L.
 *1522. indicum, L. *Tel-tala*, S. *Ella*, T. *Gingili*, *Gingelly*. III.285

98. Acanthaceæ.

584. Thunbergia, L. f.
 1523. fragrans, Roxb. III.288
  var. β vestita, Nees.
  var. γ parviflora, Trim.
585. Elytraria, Vahl.
 1524. crenata, Vahl. III.289
  var. β lyrata, Vahl.
586. Ebermaiera, Nees.
 1525. zeylanica, Nees. III.290
587. Cardanthera, Ham.
 1526. uliginosa, Ham. III.291
 1527. balsamica, Clarke. III.291
 1528. verticillata, Clarke. III.291
 1529. THWAITESII, Benth. III.292
588. Hygrophila, Br.
 1530. salicifolia, Nees. III.293
 1531. quadrivalvis, Nees. III.293
 1532. spinosa, And. *Katu-ikiri*, S. *Nirmulli*, T. III.293
589. Calophanes, D. Don.
 1533. Nagchana, Nees. *Paduvan*, T. III.294
 1534. littoralis, And. *Paraddai*, T. III.295
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 1535. ringens, L. *Nil-puruk*, S. III.295
 1536. patula, Jacq. III.296
591. Phaylopsis, Willd.
 1537. parviflora, Willd. III.296
592. Dædalacanthus, T. And.
 1538. montanus, And. III.297

593. Stenosiphonium, Nees.
1539. Russellianum, Nees. *Bu-nelu*, S. *Nelu*, T. III.298
var. β subsericeum (Nees.), Trim.
594. Strobilanthes, Bl. *Nelu*, S.
1540. VISCOSUS, And. III.301
var. β digitalis, Clarke.
var. γ argutus, Clarke.
1541. NOCKII, Trim. III.301, Pl. LXX.
1542. STENODON, Clarke. III.302
1543. EXAREOLATUS, Clarke. III.303
1544. RHYTISPERMUS, Clarke. III.303
1545. NIGRESCENS, And. III.303
1546. RHAMNIFOLIUS, And. III.304
1547. DEFLEXUS, And. III.304
1548. LANCEOLATUS, Hook. III.305
1549. WALKERI, Arn. III.305
var. β stenocarpa, Clarke.
1550. THWAITESII, And. III.306
1551. caudatus, And. III.306
var. β laniceps, Clarke.
1552. anceps, Nees. III.307
1553. PUNCTATUS, Nees. III.307
1554. ARNOTTIANUS, Nees. III.308
1555. ASPERRIMUS, Nees. III.308
1556. TRIFIDUS, Nees. III.309
1557. EXSERTUS, Clarke. III.309
var. β integra, Clarke.
1558. GARDNERIANUS, And. III.310
1559. VESTITUS, Nees. III.310
1560. HOOKERI, Nees. III.311
1561. CALYCINUS, Nees. III.311
1562. LAXUS, And. III.312
1563. ZEYLANICUS, And. III.312
1564. sexennis, Nees. III.313
var. β argutus, Clarke.
var. γ hirsutissimus, And.
1565. HELICOIDES, And. III.314
1566. PANICULATUS, And. III.314
1567. PULCHERRIMUS, And. III.315
595. Blepharis, Juss.
1568. boerhaaviæfolia, Pers. III.316
1569. molluginifolia, Pers. III.316
596. Acanthus, L.
1570. ilicifolius, L. *Ikili*, *Katu-ikili*, S. III.317
var. β integrifolius, And.

597. Barleria, L.
  1571. Prionitis, L. *Katu-karandu*, S. III.318
  1572. mysorensis, Roth. *Katu-nelu*, S. *Kiri-mulla, Kikkiri, Ikkiri*, T. III.319
  1573. noctiflora, L. f. III.319
  1574. involucrata, Nees. III.320
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    var. β glabra, Trim.
  1577. NUTANS, Nees. III.321
  1578. nitida, Nees. III.322

598. Crossandra, Salisb.
  1579. undulæfolia, Salisb. III.322
    var. β crocea, Trim.
    var. γ axillaris (Nees.), Trim.

599. Asystasia, Bl.
  1580. coromandeliana, Nees. *Puruk*, S. *Peyp-patchotti*, T. III.323
  1581. chelonioides, Nees. III.324
  1582. variabilis, Trim. III.324

600. Eranthemum, L.
  1583. malabaricum, Clarke. III.325

601. Andrographis, Wall.
  1584. paniculata, Nees. *Hin-bin-kohomba*, S. *Nila-vempu*, T. III.326
    var. β glandulosa, Trim.
  1585. macrobotrys, Nees. III.327
    var. β parvifolia, Clarke.
  1586. alata, Nees. III.327
  1587. echioides, Nees. *Hakan*, S. III.327

602. Gymnostachyum, Nees.
  1588. ZEYLANICUM, Arn. and Nees. III.328
  1589. THWAITESII, And. III.329
  1590. PANICULATUM, And. III.329
  1591. SANGUINOLENTUM, And. III.330
  1592. HIRSUTUM, And. III.330

603. Lepidagathis, Willd.
  1593. hyalina, Nees. var. lophostachyoides, Nees. III.331
  1594. ZEYLANICA, Nees. III.331
  1595. WALKERIANA, Nees. III.332
  1596. fasciculata, Nees. III.332

604. Monothecium, Hochst.
  1597. aristatum, And. III.333

605. Justicia, L.
1598. Betonica, L. *Sudu-puruk*, S. III.334
1599. ZEYLANICA, And. III.334
var. β capitata, And.
1600. tranquebarensis, L. f. III.335
1601. Gendarussa, Burm. f. *Kalu-waraniya*, S. *Karunochchi*, T. III.335
1602. HOOKERIANA, And. III.336
1603. glabra, Kœn. III.336
1604. procumbens, L. *Mayani*, S. III.337
var. β latispica, Clarke.
1605. ROYENIANA, Clarke. III.337
1606. diffusa, Willd. III.338
var. β prostrata, Roxb.

606. Adhatoda, Nees.
1607. Vasica, Nees. *Agaladara*, *Wanepala*, S. *Adatodai*, *Pavettai*, T. *Malabar nut.* III.338

607. Rhinacanthus, Nees.
1608. communis, Nees. *Anitta*, S. *Nagamulli*, T. III.339

608. PTYSSIGLOTTIS, And.
1609. RADICOSA, And. III.340

609. Ecbolium, Medik.
1610. Linneanum, Kurz. III.341

610. Rungia, Nees.
1611. latior, Nees. III.342
1612. parviflora, Nees. III.342
var. β pectinata, Clarke.
1613. repens, Nees. *Sulu-nayi*, S. III.343
1614. apiculata, Bedd. III.343

611. Dicliptera, Juss.
1615. zeylanica, Nees. III.344
var. β Neesii, Trim.

99. Verbenaceæ.

612. Lantana, L.
1616. indica, Roxb. III.346

613. Lippia, L.
1617. nodiflora, Rich. *Heri-mena-detta*, S. *Podutalai*, T. III.347

614. Bouchea, Cham.
1618. hydorabadensis, Walp. III.348

615. Stachytarpheta, Vahl.
*1619. indica, Vahl. *Bala-nakuta*, S. *Nai-oringi*, T. III.348
var. β jamaicensis, Trim.

616. Priva, Adans.
1620. leptostachya, Juss. III.349

617. Callicarpa, L.
1621. lanata, L. *Illa*, S. III.350

618. Premna, L.
1622. PURPURASCENS, Thw. III.351, Pl. LXXII.
1623. corymbosa, Rottl. III.351
1624. serratifolia, L. *Midi*, S. *Erumaimullai*, T. III.352
1625. tomentosa, Willd. *Bu-seru*, S. *Koluk-kutti*, T. III.352
1626. THWAITESII, Clarke. III.353
1627. latifolia, Roxb. *Maha-midi*, S. *Pachu-mullai*, T. III.353
*1628. procumbens, Moon. *Mullai*, T. III.354

619. Gmelina, L.
1629. arborea, Roxb. *Et-demata*, S. III.355
1630. asiatica, L. *Demata*, S. *Kumil*, T. III.355

620. Vitex, L.
1631. trifolia, L. *Nochchi*, T. III.356
1632. Negundo, L. *Nika*, *Nil-nika*, *Sudu-nika*, S. *Vennochchi*, T. III.357
1633. altissima, L. f. *Milla*, *Miyan-milla*, *Sapu-milla*, S. *Kadamanakku*, T. III.357
var. β zeylanica, Clarke.
var. γ alata, Trim.
1634. Leucoxylon, L. f. *Nebedda*, S. *Kaddu-nochchi*, *Nir-nochchi*, T. III.358

621. Clerodendron, L.
1635. inerme, Gærtn. *Wal-gurenda*, S. *Pin-chil*, *Pinari*, T. III.359
1636. Phlomidis, L. f. *Vatamadakki*, T. III.360
1637. serratum, Spreng. *Ken-henda*, S. *Vata-madakki*, T. III.360
1638. infortunatum, L. *Gas-pinna*, S. III.361

622. Glossocarya, Wall.
1639. SCANDENS, Trim. III.362, Pl. LXXIII.

623. Symphorema, Roxb.
1640. involucratum, Roxb. III.363

624. Avicennia, L.
1641. officinalis. L. *Kanna*, T. *White mangrove.* III.363

100. Labiatæ.

625. Ocimum, L. III.365
1642. canum, Sims. *Hin-tala*, S. *Kanchan-korai*, T. III.365
1643. sanctum, L. *Maduru-tala*. S. III.366
1644. adscendens, Willd. III.366
*1645. gratissimum, L. *Gas-tala*, *Otala*, S. III.367
var. β suave. Hk. f.

626. Geniosporum. Wall.
1646. elongatum, Benth. III.368
1647. prostratum, Benth. III.368
var. β gracile, Thw.

627. Moschosma, Rchb.
1648. polystachyum, Benth. III.369

628. Orthosiphon, Benth.
1649. glabratus, Benth. III.369

629. Plectranthus, L'Herit.
1650. NIGRESCENS, Benth. III.370
1651. Walkeri, Arn. III.371
1652. GARDNERI, Thw. III.371
1653. coleoides, Benth. III.372
1654. CAPILLIPES, Benth. III.372
1655. menthoides, Benth. III.372

630. Coleus, Lour.
1656. barbatus, Benth. *Wal-kapura-walliya*, S. III.373
1657. malabaricus, Benth. III.374
var. β leptostachys, Hk. f.
1658. INFLATUS, Benth. III.375
1659. ELONGATUS, Trim. III.375, Pl. LXXIV.

631. Anisochilus, Wall.
1660. carnosus, Wall. *Gal-kapura-walliya*, S. III.376
1661. paniculatus, Benth. III.377, Pl. LXXV.
1662. VELUTINUS, Trim. *Bolvila*, *Bolila*, S. III.377

632. Pogostemon, Desf.
1663. Heyneanus, Benth. *Gan-kollan-kola*, S. III.378
1664. RUPESTRIS, Benth. III.379
1665. HIRSUTUS, Benth. III.379
1666. REFLEXUS. Benth. III.379

633. Dysophylla, Bl.
1667. auricularia, Bl. *Hemanilla*, S. III.380
1668. verticillata, Benth. III.380

634. Mentha, L.
1669. javanica, Bl. *Odu-talan*, S. III.381

635. Calamintha, Mœnch.
1670. umbrosa, Benth. III.381

636. Scutellaria, L.
1671. violacea, Heyne. III.382
var. β glabra, Trim.
1672. robusta, Benth. III.383
1673. OBLONGA, Benth. III.383

637. Anisomeles, Br.
1674. ovata, Br. *Yak-wanassa*, S. III.384
1675. malabarica, Br. *Pey-maruddi*, T. III.384

638. Leucas, Br.
1676. mollissima, Wall. III.385
1677. marrubioides, Desf. *Sudu-tumba*, S. III.385
1678. angularis, Benth. III.385
1679. biflora, Br. *Geta-tumba*, S. *Peyt-tumpai*, T. III.386
1680. longifolia, Benth. III.386
1681. zeylanica, Br. *Geta-tumba*, *Mudi-tumpai*, T. III.387
var. β Walkeri, Hk. f.

639. Leonotis, Br.
1682. nepetæfolia, Br. *Maha-yak-wanassa*, S. *Kasitumpai*, T. III.387

640. Teucrium, L.
1683. tomentosum, Heyne. III.388

101. Plantaginaceæ.

641. Plantago, L.
1684. major, L. var. asiatica, Dcne. III.389

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102. Nyctaginaceæ.

642. Boerhaavia, L.
1685. diffusa, L. *Pita-sudu-pala*, S. *Muk-karaichchi*, *Karichcharanai*, T. III.390
1686. repanda, Willd. III.390

643. Pisonia, L.
1687. aculeata, L. III.391

103. Amarantaceæ.

644. Celosia, L.
 1688. argentea, L. *Kiri-henda*, S. III.393
 1689. pulchella, Moq. III.393
 1690. polygonoides, Retz. III.394

645. Allmania, Br.
 1691. nodiflora, Br. *Kumatiya*, S. III.394
 var. β longepedunculata, Trim.

646. Digera, Forsk.
 1692. arvensis, Forsk. *Toggil*, T. III.395

647. Amarantus, L.
 1693. spinosus, L. *Katu-tampala*, S. *Mud-kirai*, T. III.396
 *1694. gangeticus, L. *Sudu-tampala*, S. *Chiru-kirai*, *Araikkirai*, T. III.396
 1695. mangostanus, L. III.397
 1696. viridis, L. *Kura-tampala*, S. III.397
 1697. polygonoides, L. *Araikkirai*, T. III.397

648. Cyathula, Lour.
 1698. ZEYLANICA, Hk. f. III.398
 1699. prostrata, Bl. *Bin-karal-heba*, S. III.398

649. Pupalia, Juss.
 1700. atropurpurea, Moq. *Wel-karal-heba*, S. III.399
 1701. orbiculata, Wight. *Kumiddil*, *Pichu-kodiya*, T. III.400

650. Psilotrichum, Bl.
 1702. SCLERANTHUM, Thw. III.400
 1703. calceolatum, Moq. III.400

651. Nothosærua, Wight.
 1704. brachiata, Wight. *Tampala*, S. *Chiru-pilai*, T. III.401

652. Ærua, Forsk.
 1705. javanica, Juss. III.402
 1706. lanata, Juss. *Pol-kudu-pala*, S. III.402
 1707. Monsoniæ, Mart. III.403

653. Achyranthes, L.
 1708. aquatica, Br. III.403
 1709. aspera, L. *Gas-karal-heba*, S. *Nayuruvi*, T. III.404
 var. β argentea, Hk. f.
 1710. bidentata, Bl. III.404
 1711. DIANDRA, Roxb. III.405

654. Alternanthera, Forsk.
1712. triandra, Lam. *Mukunu-wenna*, S. *Pon-nankani*, T. III.405

104. Chenopodiaceæ.

655. Atriplex, L.
1713. repens, Roth. *Elichchevi*, T. III.406
656. Arthrocnemum, Moq.
1714. indicum, Moq. *Kotanai*, T. III.407
657. Salicornia, L.
1715. brachiata, Roxb. III.408
658. Suæda, Forsk.
1716. monoica, Forsk. III.408
1717. maritima, Dumort. III.409
1718. nudiflora, Moq. *Umiri*, T. III.409
659. Basella, L.
1719. rubra, L. *Niviti*, S. *Pasalai*, T. III.410

105. Polygonaceæ.

660. Polygonum, L.
1720. tomentosum, Willd. *Sudu-kimbulwenna*, S. III.411
1721. glabrum, Willd. III.412
1722. minus, Huds. III.412
1723. barbatum, L. *Ratu-kimbulwenna*, S. III.412
1724. serrulatum, Lagasca. III.413
1725. punctatum, Ham. III.413
1726. chinense, L. III.413
1727. strigosum, Br. III.414
1728. prætermissum, Hk. f. III.414
1729. pedunculare, Wall. III.415

106. Podostemaceæ.[1]

661. Lawia, Griff.
1730. zeylanica, Tul. III.416
var. β Gardneriana, Willis.
var. γ Parkiniana, Willis.
662. Dicrea (Du Pet Th.), Tul.
1731. ELONGATA, Tul. (Podostemon elongatus, Gardn.) III.417
1732. stylosa, Wight. III.417
var. α fucoides, Willis. (P. algæformis, Trim.)
var. β laciniata, Willis.

[1] See Willis, A Revision of the Podost. of India and Ceylon, Ann. Perad., I., p. 181. 1902.

663. Podostemon. Tul.
1733. subulatus, Gardn. var. mavceliæ, Willis. III.418

664. Hydrobryum. Endl.
1734. olivaceum, Tul. var. zeylanicum, Willis. III.418
1735. lichenoides, Kurz. var. kelense, Willis.

665. Farmeria, Willis.
1736. METZGERIOIDES, Willis. III.419, Pl. LXXVI.

107. Nepenthaceæ.

666. Nepenthes. L.
1737. DISTILLATORIA. L. *Bandura-wel*, S. *Pitcher-plant.* III.420

108. Aristolochiaceæ.

667. Bragantia. Lour.
1738. Wallichii, Br. III.421
var. β latifolia, Duchart.
var. γ brachycarpa, Hk. f.

668. Aristolochia. L.
1739. bracteata, Retz. *Adutin-tappalai*, T. III.422
1740. indica, L. *Sap-sanda*, S. *Perumarundu*, T. III.423

109. Piperaceæ.

669. Piper, L.
*1741. longum, L. *Tippili*, S. and T. *Long pepper.* III.424
*1742. Betle. L. *Bulat*, *Bulat-wel*, S. *Vettilai*, T. *Betel pepper.* III.425
var. β Siriboa, Trim. *Rata-bulat-wel*, *Siri-bo*, S.
1743. THWAITESII, Cas. DC. III.426, Pl. LXXVII.
1744. nigrum, L. *Miris*, *Gam-miris-wel*, S. *Milaku*, T. *Black pepper.* III.427
1745. ZEYLANICUM, Miq. III.427
1746. TRINEURON, Miq. III.428
var. β laxiflorum, Trim.
1747. argyrophyllum, Miq. *Wal-gam-miris-wel*, S. III.428
var. β Walkeri, Trim.
1748. sylvestre, Lam. *Wal-gam-miris-wel*, *Mala-miris-wel*, S. III.429
1749. subpeltatum, Willd. *Mala-labu*, S. III.429

670. Peperomia, Ruiz. & Pav.
1750. PSEUDO-RHOMBEA, Cas. DC. III.430
var. β tenuis, Trim.
1751. Wightiana, Miq. III.431
var. β Ritigalensis, Willis.
1752. CONFUSA, Hk. f. III.431
1753. dindigulensis, Miq. III.431
var. β hirsuta, Trim.
1754. reflexa, A. Dietr. III.432

110. Chloranthaceæ.

671. Chloranthus, Swartz.
1755. brachystachys, Bl. III.433

111. Myristicaceæ.

672. Myristica, L.
1756. laurifolia, Hk. f. & Th. *Malaboda*, S. *Palmanikam*, T. III.434
1757. ZEYLANICA, A. DC. III.434
1758. HORSFIELDIA, Bl. *Ruk*, S. III.435
1759. Irya, Gærtn. *Iriya*, S. III.435

112. Monimiaceæ.

673. HORTONIA, Wight.
1760. FLORIBUNDA, Wight. *Wawiya*, S. III.436
var. β ovalifolia, Hk. f. & Th.
1761. ANGUSTIFOLIA, Trim. III.437, Pl. LXXVIII.

113. Lauraceæ.

674. Cryptocarya, Br
1762. Wightiana, Thw. *Gal-mora*, S. III.439
1763. MEMBRANACEA, Thw. *Tawenna*, S. III.439

675. Beilschmiedia, Nees.
1764. ZEYLANICA, Trim. III.440

676. Cinnamomum, Bl.
1765. zeylanicum, Bl. *Kurundu*, S. *Karuva*, T. *Cinnamon*. III.440
1766. MULTIFLORUM, Wight. *Wal-kurundu*, S. III.441
1767. OVALIFOLIUM, Wight. III.442
1768. LITSEÆFOLIUM, Thw. *Kudu-kurundu*, S. III.442
1769. CITRIODORUM, Thw. *Pengiri-kurundu*, S. III.443

677. Machilus, Nees.
1770. macrantha, Nees. *Ululu*, S. III.443

678. Alseodaphne, Nees.
1771. semecarpifolia, Nees. *Wewarani*, S. *Ranai*, *Yavaranai*, T. III.444

679. Actinodaphne, Nees.
1772. MOLOCHINA, Nees. III.445
var. β Moonii, Hk. f.
1773. STENOPHYLLA, Thw. III.446
1774. ELEGANS. Thw. III.446
1775. GLAUCA, Nees. III.446
1776. PISIFERA. Hk. f. III.447
1777. AMBIGUA. Hk. f. III.447
var. β orbicularis, Trim.
1778. SPECIOSA, Nees. *Elephants' ears.* III.448
var. β Candolleana, Hk. f.

680. Litsea, Lam.
1779. tomentosa, Heyne. *Kosbada, Landittan*, S. III.449
1780. chinensis, Lam. *Bomi, Bombi,* S. *Elumpurukki*. T. III.449
1781. UNDULATA, Hk. f. III.450
1782. CAULIFLORA. Trim. *Rat-keliya*, S. III.450
1783. HOOKERIANA, Meissn. III.451
1784. NEMORALIS, Thw. III.451
1785. OVALIFOLIA, Thw. III.451
1786. GLABERRIMA, Thw. III.452
1787. ITEODAPHNE, Thw. III.452
var. β angustata, Meissn.
1788. GARDNERI, Thw. III.453
1789. FUSCATA, Thw. III.453
1790. zeylanica, Nees. *Dawul-kurundu, Kududawula*, S. *Wild cinnamon.*
var. β rubrinervia, Meissn.

681. Lindera, Thunb.
1791. LANCIFOLIA, Thw. III.454

682. Cassytha, L.
1792. filiformis, L. III.455
1793. capillaris, Meissn. III.455

683. Hernandia, L.
1794. peltata, Meissn. *Palatu*, S. III.456

114. Proteaceæ.

684. Helicia, Lour.
1795. ZEYLANICA, Gardn. III.457, Pl. LXXIX.

115. Thymelæaceæ.

685. Wikstrœmia, Endl.
1796. canescens, Meissn. III.458

686. Lasiosiphon, Fresen.
1797. eriocephalus, Dcne. *Naha*, S. III.459
var. β zeylanicus, Meissn.

687. Phaleria, Jack.
1798. CAULIFLORA, Bedd. III.459

688. Gyrinops, Gærtn.
1799. WALLA, Gærtn. *Walla*, *Patta-walla*, S. III.460

116. Elæagnaceæ.

689. Elæagnus, L.
1800. latifolia, L. *Wel-embilla*, *Katu-embilla*, S. III.461
var. β Thwaitesii, Trim.

117. Loranthaceæ.

690. Loranthus, L. *Pilila*, S. *Kuruvichchai*, T.
1801. NODIFLORUS, Thw. III.463
1802. MABÆOIDES, Trim. III.463
1803. ENSIFOLIUS, Thw. III.464
1804. Hookerianus, W. & A. III.464
1805. Scurrula, L. III.465
1806. cordifolius, Wall. III.465
1807. tomentosus, Heyne. III.465
var. β incanus, Trim.
1808. cuneatus, Heyne. III.466
1809. SCLEROPHYLLUS, Thw. III.466
1810. LIGULATUS, Thw. III.467
1811. SUBORBICULARIS, Thw. III.467
1812. longiflorus, Desrouss. III.468
var. β amplexifolius, Thw.
1813. LONCHIPHYLLUS, Thw. III.468
1814. neelgherrensis, W. & A. III.468
1815. GARDNERI, Thw. III.469
1816. loniceroides, L. III.469
1817. capitellatus, W. & A. III.470

691. Viscum, L. *Pilila*, S. *Kuruvichchai*, T.
1818. orientale, Willd. III.471
1819. monoicum, Roxb. III.471
1820. capitellatum, Sm. III.471
1821. ramosissimum, Wall. III.472
1822. articulatum, Burm. III.472
1823. japonicum, Thunb. III.472

692. Notothixos, Oliv.
1824. FLOCCOSUS, Oliv. III.473, Pl. LXXX.

693. Ginalloa, Korth.
1825. SPATHULIFOLIA, Oliv. III.473

118. Santalaceæ.

694. Osyris, L.
1826. arborea, Wall. III.474

695. Scleropyrum, Arn.
1827. Wallichianum, Arn. III.475

119. Balanophoraceæ.

696. Balanophora, Forst.
1828. indica, Wall. III.476
1829. THWAITESII, Eichl. III.477, Pl. LXXXI.

120. Euphorbiaceæ.

697. Euphorbia, L.
1830. Antiquorum, L. *Daluk*, S. *Chatura-kalli*, T. IV.4
1831. tortilis, Rottl. *Sinuk*, S. IV.5
1832. Atoto, Forst. IV.6
1833. rosea, Retz. *Mudu-dada-kiriya*, S. IV.6
1834. cristata, Heyne. IV.6
1835. hypericifolia, L. *Ela-dada-kiriya*, S. IV.7
1836. hirta, L. *Bu-dada-kiriya*, S. *Palavi*, T. IV.7
1837. thymifolia, L. *Bin-dada-kiriya*, S. *Chittira-palavi*, T. IV.8
1838. Rothiana, Spreng. IV.8

698. Sarcococca, Lindl.
1839. pruniformis, Lindl. IV.9
var. β zeylanica, Hk. f.
var. γ brevifolia, Muell. Arg.

699. Bridelia, Willd.
1840. retusa, Spreng. *Keta-kala*, S. *Mul-venkai*, T. IV.10
1841. MOONII, Thw. *Pat-kala*, S. IV.11
1842. scandens, Willd. IV.11

700. Cleistanthus, Hk. f.
1843. collinus, Benth. *Madara*, S. IV.12
1844. ACUMINATUS, Muell. Arg. IV.12
1845. ROBUSTUS, Muell. Arg. IV.13
1846. patulus, Muell. Arg. IV.13
1847. PALLIDUS, Muell. Arg. *Visa*, T. IV.13
var. β subglauca, Trim.
1848. FERRUGINEUS, Muell. Arg. IV.14

701. Actephila, Bl.
1849. neilgherrensis, Wight. IV.14

702. Agyneia, Vent.
1850. bacciformis, A. Juss. *Et-pitawakka*, S. IV.15

703. Sauropus, Bl.
1851. albicans, Bl. *Mella-dum-kola*, S. IV.16
1852. RETROVERSUS, Wight. IV.16
1853. ASSIMILIS, Thw. IV.17
1854. RIGIDUS, Thw. IV.17

704. Phyllanthus, L.
1855. THWAITESIANUS, Muell. Arg. IV.18
1856. reticulatus, Poir. *Wel-kayila*, S. *Pula, Pullanti, Mipullanti*, T. IV.19
1857. Emblica, L. *Nelli*, S. *Topu-nelli*, T. IV.19
1858. polyphyllus, Willd. IV.20
1859. maderaspatensis, L. IV.20
1860. Rheedii, Wight. IV.21
1861. Urinaria, L. *Rat-pitawakka*, S. IV.21
1862. MYRTIFOLIUS, Moon. IV.22
1863. simplex, Retz. IV.22
var. β Gardnerianus, Muell. Arg.
1864. Niruri, L. *Pitawakka*, S. *Kilkaynelli*, T. IV.23
1865. rotundifolius, Klein. IV.23
1866. BAILLONIANUS, Muell. Arg. IV.23
1867. ANABAPTIZATUS, Muell. Arg. IV.24
1868. OREOPHILUS, Muell, Arg. IV.24
1869. longiflorus, Heyne. IV.25
1870. HAKGALENSIS, Thw. IV.25
1871. CINEREUS, Muell. Arg. IV.26
1872. AFFINIS, Muell. Arg. IV.26
1873. indicus, Muell. Arg. *Karawu*, S. IV.27
1874. CYANOSPERMUS, Muell. Arg. *Sudu-liyan, Kulu-liyan*, S. IV.27

705. Glochidion, Forst.
1875. zeylanicum, A. Juss. *Hunu-kirilla*, S. IV.28
var. β tomentosum, Trim.
1876. BRACHYLOBUM, Muell. Arg. IV.29
1877. PYCNOCARPUM, Bedd. IV.29
var. β elliptica, Hk. f.
1878. RIGIDUM, Muell. Arg. IV.30
1879. sp. nov. (Ritigala).[1]
1880. CORIACEUM, Thw. IV.30
1881. NEMORALE, Thw. IV.31
1882. GARDNERI, Thw. IV.31
var. β acuminata, Trim.
1883. MONTANUM, Thw. IV.31
1884. MOONII, Thw. *Bu-hunu-kirilla*, S. IV.32

[1] Willis, The Flora of Ritigala, Ann. Perad., III., p. 285, 1906.

706. Flueggea, Willd.
1885. leucopyrus, Willd. *Hin-katu-pila*, S. *Mudpulanti*, T. IV.33

707. Breynia, Forst.
1886. patens, Hk. f. *Wal-murunga*, S. IV.33
1887. rhamnoides, Muell. Arg. *Gas-kayila*, S. *Manipulnati*, T. IV.34

708. Putranjiva, Wall.
1888. Roxburghii, Wall. *Vitchurunai*, *Karip-palai*, T. IV.35
1889. ZEYLANICA, Muell. Arg. *Pelan*, S. IV.35

709. Hemicyclia, W. & A.
1890. sepiaria, W. & A. *Wira*, S. *Virai*, T. IV.36
1891. LANCEOLATA, Thw. IV.37
1892. GARDNERI, Thw. *Gal-wira*, *Eta-wira*, S. IV.37, Pl. LXXXII.

710. Cyclostemon, Bl.
1893. macrophyllus, Bl. IV.38

711. Mischodon, Thw.
1894. zeylanicus, Thw. *Tammanna*, S. *Tam-panai*, T. IV.38

712. Aporosa, Bl.
1895. LATIFOLIA, Thw. *Mapat-kebella*, *Kam-potta*, *Pepiliya*, S. IV.39
1896. Lindleyana, Baill. *Kebella*, *Barawa-embilla*, S. IV.40
1897. LANCEOLATA, Thw. *Hin-kebella*, S. IV.40
1898. acuminata, Thw. IV.41
1899. FUSIFORMIS, Thw. IV.41

713. Daphniphyllum, Bl.
1900. glaucescens, Bl. IV.42

714. Antidesma, L.
1901. Ghaesembilla, Gærtn. *Bu-embilla*, S. IV.43
1902. Bunius, Spreng. *Karawala-kebella*, S. IV.43
var. β Thwaitesianum, Trim.
1903. zeylanicum, Lam. *Hin-embilla*, S. IV.44
1904. diandrum, Roth. IV.44
1905. PYRIFOLIUM, Muell. Arg. IV.45

715. Jatropha, L.
*1906. glandulifera, Roxb. *Atalai*, T. IV.45

716. Croton, L.
1907. reticulatus, Heyne. IV.47
1908. oblongifolius, Roxb. *Milla-kunari*, T. IV.47

1909. aromaticus, L. *Wel-keppitiya*, S. *Tep-paddi*, T. IV.47
var. β lacciferus, Trim. *Keppitiya*, *Gas-keppitiya*, S.
1910. caudatus, Geisel. IV.48
1911. MOONII, Thw. IV.49
1912. Klotzschianus, Thw. IV.49
1913. NIGRO-VIRIDIS, Thw. IV.49

717. Givotia, Griff.
1914. rottleriformis, Griff. *Puttalai*, T. IV.50

718. Trigonostemon, Bl.
1915. DIPLOPETALUS, Thw. IV.51, Pl. LXXXIII.
1916. nemoralis, Thw. IV.51

719. Ostodes, Bl.
1917. zeylanica, Muell. Arg. *Wal-kekuna*, *Olupetta*, S. IV.52
var. β minor, Thw.

720. Blachia, Baill.
1918. umbellata, Baill. *Kosatta*, S. IV.53

721. Dimorphocalyx, Thw.
1919. glabellus, Thw. *Weli-wenna*, S. *Ten-tukki*, T. IV.54, Pl. LXXXIV.

722. Agrostistachys, Dalz.
1920. indica, Dalz. IV.55
1921. HOOKERI, Benth. *Maha-beru*, *Diya-beru*, S. IV.55
1922. longifolia, Benth. *Beru*, S. IV.56

723. Chrozophora, Neck.
1923. plicata, A. Juss. IV.56

724. Acalypha, L.
1924. paniculata, Miq. IV.57
1925. fruticosa, Forsk. IV.58
1926. indica, L. *Kuppa-meniya*, S. *Kuppa-meni*, *Punairananki*, T. IV.58
1927. brachystachya, Hornem. IV.59
1928. lanceolata, Willd. IV.59
1929. ciliata, Forsk. IV.59

725. Adenochlæna, Boiv.
1930. ZEYLANICA, Thw.[1] IV.60, Pl. LXXXV.

[1] Probably worthy of rank as an endemic genus (Centrostylis, Baill), according to Hooker.

726. Trewia, L.
 1931. nudiflora, L. IV.61

727. Tragia, L.
 1932. involucrata, L. *Wel-kahambiliya*, S. IV.61
 var. β cordata, Muell. Arg.
 var. γ cannabina, Hk. f.

728. PODADENIA, Thw.
 1933. SAPIDA, Thw. IV.62

729. Claoxylon, A. Juss.
 1934. Mercurialis, Thw. IV.63
 1935. OLIGANDRUM, Muell. Arg. IV.64

730. Mallotus, Lour.
 1936. albus, Muell. Arg. *Bu-kenda*, S. IV.64
 1937. ERIOCARPUS, Muell. Arg. IV.65
 1938. WALKERÆ, Hk. f. IV.66
 1939. rhamnifolius, Muell. Arg. *Marai-tinni*, T. IV.66
 var. β ovalifolius, Hk. f.
 1940. FUSCESCENS, Muell. Arg. IV.67
 1941. distans, Muell. Arg. IV.67
 1942. repandus, Muell. Arg. IV.67
 1943. philippinensis, Muell. Arg. *Hamparila*, S. *Kapila*, T. IV.68

731. Cleidion, Bl.
 1944. javanicum, Bl. *Okuru*, S. IV.69
 1945. nitidum, Thw. IV.69

732. Macaranga, Thou.
 1946. indica, Wight. *Vattakanni*, T. IV.70
 1947. tomentosa, Wight. *Kenda*, *Pat-kenda*, S. IV.70
 1948. DIGYNA, Muell. Arg. *Ota*, *Gal-ota*, S. IV.71

733. Homonoia, Lour.
 1949. riparia, Lour. IV.72

734. Dalechampia, L.
 1950. indica, Wight. IV.72

735. Gelonium, Roxb.
 1951. lanceolatum, Willd. *Kakkaipalai*, *Varittulai*, *Potpattai*, T. IV.73

736. Chætocarpus, Thw.
 1952. castanocarpus, Thw. *Hedoka*, *Hedawaka*, S. IV.74
 1953. PUBESCENS, Hk. f. IV.74
 1954. CORIACEUS, Thw. *Hedoka*, *Hedawaka*, S. IV.75

737. Sapium, P. Br.
1955. indicum, Willd. *Kiri-makulu*, S. IV.75
1956. insigne, Trim. *Tel-kaduru*, S. *Tilai*, T. IV.76

738. Excœcaria, L.
1957. Agallocha, L. *Tela-kiriya*, S. IV.77
1958. crenulata, Wight. IV.77

739. Sebastiania, Spreng.
1959. Chamælea, Muell. Arg. *Rat-pitawakka*, S. IV.78

121. Urticaceæ.

740. Holoptelea, Planch.
1960. integrifolia, Planch. *Goda-kirilla*, S. *Ayil*, *Velayil*, *Kanchia*, T. *Indian elm*. IV.80

741. Celtis, L.
1961. cinnamomea, Lindl. *Gurenda*, S. IV.81, Pl. LXXXVI.
1962. Wightii, Planch. *Meditella*, S. IV.81

742. Trema, Lour.
1963. orientalis, Bl. *Gedumba*, S. *Charcoal tree*. IV.82

743. Gironniera, Gaudich.
1964. subæqualis, Planch. var. zeylanica, Thw. *Akmediya*, S. IV.83
1965. reticulata, Thw. *Wal-munamal*, S. IV.83

744. Ficus, L.
1966. parasitica, Kœn. *Gas-netul*, *Wel-ehetu*, S. IV.85
*1967. benghalensis, L. *Maha-nuga*, S. *Al*, T. *Banyan*. IV.86
1968. mysorensis, Heyne. *Bu-nuga*, S. IV.86
1969. tomentosa, Roxb. *Wel-aralu*, S. IV.87
1970. altissima, Bl. var. Fergusoni, King. *Nuga*, *Kosgona*, S. IV.87
1971. Trimeni, King. IV.88
1972. CAUDICULATA, Trim. IV.88
1973. retusa, L. *Panu-nuga*, S. *Itti*, T. IV.89
1974. nervosa, Heyne. *Kalumaduwa*, S. IV.89
1975. Arnottiana, Miq. *Kaudu-bo*, S. IV.90
1976. MOONIANA, King. IV.91
1977. Tsjakela, Burm. *Kiri-pella*, S. IV.91
1978. Tsiela, Roxb. *Ela-nuga*, *Ehetu*, S. *Kalatti*, T. IV.92
1979. infectoria, Roxb. IV.92
var. β Lambertiana, King. *Kalaha*, S.

1980. callosa, Willd. *Wal-gona*, S. IV.93
1981. heterophylla, L. f. *Wal-chetu*, S. IV.93
1982. asperrima, Roxb. *Sewana-mediya*, S. *Furniture leaf*. IV.94
1983. hispida, L. f. *Kota-dimbula*, S. IV.94
1984. THWAITESII, Miq. IV.95
1985. lævis, Bl. var. dasyphylla, King. IV.95
1986. glomerata, Roxb. *Attikka*, S. *Atti*, T. IV.96

745. Antiaris, Leschen.
1987. toxicaria, Leschen. *Riti*, S. *Netavil*, T. *Upas tree*. IV.97

746. Cudrania, Trec.
1988. javanensis, Trec. IV.98

747. Artocarpus, Forst.
1989. NOBILIS, Thw. *Del*, *Bedi-del*, S. IV.98
1990. Lakoocha, Roxb. *Kana-gona*, S. IV.99
var. β Gomeziana, Wall. (sp.)

748. Taxotrophis, Bl.
1991. zeylanica, Thw. IV.100

749. Phyllochlamys, Bureau.
1992. spinosa, Bureau. *Gon-gotu*, S. IV.101

750. Streblus, Lour.
1993. asper, Lour. *Geta-netul*, S. *Patpirai*, *Pirasu*, T. IV.101

751. Dorstenia, L.
1994. indica, Wall. IV.102

752. Allæanthus, Thw.
1995. ZEYLANICUS, Thw. *Alandu*, S. IV.103

753. Plecospermum, Trecul.
1996. spinosum, Trec. *Katu-timbol*, S. IV.103

754. Fleurya, Gaudich.
1997. interrupta, Gaudich. *Wal-kahambiliya*, S. IV.104

755. Laportea, Gaudich.
1998. terminalis, Wight. IV.105
1999. crenulata, Gaudich. *Maussa*, S. *Devil-nettle*, *Fever-nettle*. IV.105

756. Girardinia, Gaudich.
2000. heterophylla, Dcne. *Gas-kahambiliya*, S. *Nilgiri-nettle*. IV.106
var. β palmata, Hk. f.

757. Pilea, Lindl.
 2001. Wightii, Wedd. IV.107
 2002. stipulosa, Miq. IV.107
 2003. trinervia, Wight. IV.108
758. Lecanthus, Wedd.
 2004. Wightii, Wedd. IV.108
759. Pellionia, Gaudich.
 2005. Heyneana, Wedd. IV.109
760. Elatostema, Forst.
 2006. WALKERÆ, Hk. f. IV.110
 2007. acuminatum, Brongn. IV.110
 2008. lineolatum, Wight. IV.110
  var. β lineare, Wedd.
  var. γ bidentatum, Hk. f.
  var. δ falcigerum, Wedd.
  var. ε petiolare, Thw.
 2009. surculosum, Wight. IV.111
  var. β rigidiusculum, Thw.
761. Procris, Juss.
 2010. lævigata, Bl. IV.112
762. Bœhmeria, Jacq.
 2011. malabarica, Wedd. *Maha-diya-dul*, S. IV.113
 2012. platyphylla, Don. IV.114
763. Chamabainia, Wight.
 2013. cuspidata, Wight. IV.114
764. Pouzolzia, Gaudich.
 2014. indica, Gaudich. IV.115
  var. β alienata, Wedd.
 2015. auriculata, Wight. IV.116
  var. β bicuspidata, Hk. f.
 2016. WALKERIANA, Wight. IV.116
 2017. Bennettiana, Wight. IV.117
  var. β Gardneri, Wedd.
 2018. parvifolia, Wight. IV.117
765. Villebrunea, Gaudich.
 2019. integrifolia, Gaudich. var. sylvatica, Hk. f. IV.118
766. Debregeasia, Gaudich.
 2020. velutina, Gaudich, *Gas-dul*, S. *Wild rhea.* IV.119
 2021. ZEYLANICA, Hk. f. IV.119

122. Ceratophyllaceæ.

767. Ceratophyllum, L.
 2022. verticillatum, Roxb. IV.120

GYMNOSPERMÆ.

123. Cycadaceæ.

768. Cycas, L.
 2023. circinalis, L. *Madu*, S. IV.121
 *2024. Rumphii, Miq. *Maha-madu*, S. IV.122

MONOCOTYLEDONS.

124. Hydrocharitaceæ.

769. Hydrilla, Rich.
 2025. ovalifolia, Rich. IV 123
770. Lagarosiphon, Harv.
 2026. Roxburghii, Benth. IV.124
771. Blyxa, Thou.
 2027. ZEYLANICA, Hk. f. *Diyahawari*, S. IV.125
772. Ottelia, Pers.
 2028. alismoides, Pers. IV.125
773. Enhalus, Rich.
 2029. Kœnigii, Rich. IV.126
774. Thalassia, Soland.
 2030. Hemprichii, Aschers. *Chatelai*, T. IV.127
775. Halophila, Thou.
 2031. ovata, Gaudich. IV.128
 2032. sp. nov. (Chilaw).[1] IV.129
 2033. Beccarii, Aschers. IV.129

125. Burmanniaceæ.

776. Burmannia, L.
 2034. disticha, L. *Mediya-jawala*, S. IV.130
 2035. cœlestis, Don. IV.131
 var. β pusilla, Trim.
 2036. CHAMPIONII, Thw. IV.131, Pl. LXXXVII.
777. Thismia, Griff.
 2037. GARDNERIANA, Hk. f. IV.132

126. Orchidaceæ.

778. Oberonia, Lindl.
 2038. TRUNCATA, Lindl. IV.136
 2039. recurva, Lindl. IV.137
 2040. THWAITESII, Hk. f. IV.137
 2041. LONGIBRACTEATA, Lindl. IV.138

[1] *Cf.* Hooker in Trimen's Flora, IV., p. 129.

2042. ZEYLANICA, Hk. f. IV.138
2043. TENUIS, Lindl. IV.138
2044. FORCIPATA, Lindl. IV.139
2045. Wightiana, Lindl. IV.139
2046. SCYLLÆ, Lindl. IV.139

779. Microstylis, Nutt.
2047. PURPUREA, Lindl. (?? also Java.) IV.140
2048. DISCOLOR, Lindl. IV.141
2049. congesta, Rchb. f. IV.141
2050. Rheedii, Wight. IV.141
2051. versicolor, Wight. IV.142
2052. LANCIFOLIA, Thw. IV.142

780. Liparis, Rich.
2053. THWAITESII, Hk. f. IV.143
2054. Wightiana, Thw. IV.144
2055. TRIMENII, Ridley. IV.144
2056. BARBATA, Lindl. IV.145
2057. nervosa, Lindl. IV.145
2058. Walkeriæ, Graham. IV.146
2059. atropurpurea, Lindl. IV.146
2060. BRACHYGLOTTIS, Rchb. f. IV.147
2061. OBSCURA, Hk. f. IV.147
2062. longipes, Lindl. IV.147
2063. viridiflora, Lindl. IV.148
2064. disticha, Lindl. IV.148

781. Dendrobium, Swartz.
2065. Macræi, Lindl. *Jata-makuta*, S. IV.150
2066. PANDURATUM, Lindl. IV.150
2067. DIODON, Rchb. f. IV.151
2068. crumenatum, Sw. *Sudu-pareyi-mal*, S. *White dove orchid.* IV.151
2069. nutans, Lindl. IV.152
2070. macrostachyum, Lindl. IV.152
2071. hæmoglossum, Thw. IV.152
2072. MACARTHIÆ, Thw. *Wesak-mal*, S. IV.153
2073. heterocarpum, Wall. *Primrose orchid.* IV.154

782. Bulbophyllum, Thou.
2074. CRASSIFOLIUM, Thw. IV.155
2075. PETIOLARE, Thw. IV.155
2076. PURPUREUM, Thw. IV.155
2077. ELEGANS, Gardn. IV.156, Pl. LXXXVIII.
2078. SP. NOV. (Ritigala).[1]

[1] Willis, Flora of Ritigala, Ann. Perad., III., p. 287.

783. Cirrhopetalum, Lindl.		
	2079. GRANDIFLORUM, Wight.	IV.157
	2080. WIGHTII, Thw.	IV.157
	2081. TRIMENI, Hk. f.	IV.158
	2082. MACRÆI, Lindl.	IV.158
	2083. THWAITESII, Rchb. f.	IV.159
784. Cœlogyne, Lindl.		
	2084. BREVISCAPA, Lindl.	IV.160
	2085. odoratissima, Lindl.	IV.160, Pl. LXXXIX.
	2086. ZEYLANICA, Hk. f.	IV.161
785. ADRORHIZON, Hk. f.		
	2087. PURPURASCENS, Hk. f.	IV.161
786. Pholidota, Lindl.		
	2088. imbricata, Lindl.	IV.162
787. Chrysoglossum, Bl.		
	2089. MACULATUM, Hk. f.	IV.163
788. Acanthephippium, Bl.		
	2090. BICOLOR, Lindl.	IV.164
789. Eria, Lindl.		
	2091. BRACCATA, Lindl.	IV.165
	2092. muscicola, Lindl. var. β oblonga, Trim.	IV.165
	2093. BICOLOR, Lindl. *Lily of the valley orchid.*	IV.166
	2094. TRICOLOR, Thw.	IV.166
	2095. LINDLEYI, Thw.	IV.167
	2096. THWAITESII, Trim.	IV.167
790. ALVISIA, Lindl.		
	2097. TENUIS, Lindl.	IV.168
791. Tainia, Bl.		
	2098. bicornis, Trim.	IV.169
792. Arundina, Bl.		
	2099. MINOR, Lindl.	IV.170
793. Agrostophyllum, Bl.		
	2100. ZEYLANICUM, Hk. f.	IV.171
794. Ipsea, Lindl.		
	2101. SPECIOSA, Lindl. *Daffodil orchid.*	IV.171
795. Phaius, Lour.		
	2102. WALLICHII, Lindl.	IV.172
	2103. LURIDUS, Thw.	IV.173
796. Calanthe, Br.		
	2104. PURPUREA, Lindl.	IV.174
	2105. veratrifolia, Br. var. β discolor, Lindl.	IV.174

797. Eulophia, Br.
 2106. virens, Br. IV.175
 2107. graminea, Lindl. IV.176
 2108. macrostachya, Lindl. IV.176
 2109. nuda, Lindl. IV.177
 2110. sanguinea, Hk. f. IV.177

798. Geodorum, Jacks.
 2111. dilatatum, Br. IV.178

799. Cymbidium, Swartz.
 2112. bicolor, Lindl. IV.179
 2113. ensifolium, Sw. var. hæmatodes, Trim. IV.180, Pl. XC.

800. Josephia, Wight.
 2114. lanceolata, Wight. IV.182
 2115. latifolia, Wight. IV.182

801. Polystachya, Hk.
 2116. ZEYLANICA, Lindl. IV.183

802. Sarcochilus, Br.
 2117. Wightii, Hk. f. IV.184
 2118. VIRIDIFLORUS, Hk. f. IV.184
 2119. PULCHELLUS, Trim. IV.185
 2120. PUGIONIFOLIUS, Hk. f. IV.185
 2121. COMPLANATUS, Hk. f. IV.186

803. Rhynchostylis, Bl.
 2122. retusa, Bl. *Fox-tail orchid, Batticaloa orchid.* IV.187

804. Doritis, Lindl.
 2123. Wightii, Benth. IV.188

805. Ærides, Lour.
 2124. cylindricum, Lindl. IV.189
 2125. lineare, Hk. f. IV.189

806. Luisia, Gaudich.
 2126. teretifolia, Gaudich. IV.190
 2127. tenuifolia, Bl. IV.191

807. Vanda, Br.
 2128. parviflora, Lindl. IV.192
 2129. Roxburghii, Br. IV.192
 2130. THWAITESII, Hk. f. IV.193
 2131. spathulata, Spreng. IV.193

808. Diplocentrum, Lindl.
 2132. recurvum, Lindl. IV.194

809\. Saccolabium, Bl.

2133\. NIVEUM, Lindl. IV.195
2134\. filiforme, Lindl. IV.196
2135\. GRACILE, Lindl. IV.196
2136\. BREVIFOLIUM, Lindl. IV.196
2137\. ROSEUM, Lindl. IV.197
2138\. ochraceum, Lindl. IV.197
2139\. ACAULE, Hk. f. IV.198
2140\. longifolium, Hk. f. IV.198
2141\. Wightianum, Hk. f. IV.199

810\. Sarcanthus, Lindl.

2142\. peninsularis, Dalz. IV.200

811\. Cleisostoma, Bl.

2143\. MACULOSUM, Lindl. IV.200
2144\. tenerum, Hk. f. IV.201
2145\. DECIPIENS, Lindl. IV.201

812\. Mystacidium, Lindl.

2146\. ZEYLANICUM, Trim. IV.202

813\. Cottonia, Wight.

2147\. macrostachya, Wight. IV.203

814\. Tæniophyllum, Bl.

2148\. ALWISII, Lindl. IV.203

815\. Diploprora, Hk. f.

2149\. Championii, Hk. f. IV.204

816\. Podochilus, Bl.

2150\. FALCATUS, Lindl. IV.205
2151\. malabaricus, Wight. IV.206
2152\. SAXATILIS, Lindl. IV.206

817\. Phreatia, Lindl.

2153\. elegans, Lindl. IV.207

818\. OCTARRHENA, Thw.

2154\. PARVULA, Thw. IV.208

819\. Cryptostylis, Br.

2155\. Arachnites, Bl. IV.209

820\. Hetæria, Bl.

2156\. GARDNERI, Benth. IV.209
2157\. elongata, Lindl. IV.210

821\. Cheirostylis, Bl.

2158\. PARVIFOLIA, Lindl. IV.211
2159\. flabellata, Wight. IV.211

822\. Physurus, Rich.

2160\. Blumei, Lindl. IV.212

823. Anæctochilus, Bl.
    2161. REGALIS, Bl. *Wana-raja*, S. IV.213

824. Goodyera, Br.
    2162. procera, Hk. f. IV.214
    2163. fumata, Thw. IV.214

825. Zeuxine, Lindl.
    2164. sulcata, Lindl. IV.215
    2165. longilabris, Benth. IV.216
    2166. REGIA, Benth. *Iru-raja*, S. IV.216
    2167. flava, Benth. IV.217

826. Spiranthes, Rich.
    2168. australis, Lindl. IV.217

827. Corymbis, Thou.
    2169. veratrifolia, Bl. IV.218

828. Tropidia, Lindl.
    2170. THWAITESII, Hk. f. IV.219
        var. β major, Hk. f.
    2171. BAMBUSIFOLIA, Trim. IV.220

829. Vanilla, Sw.
    2172. Walkeriæ, Wight. IV.220
    2173. MOONII, Thw. IV.221, Pl. XCI.

830. Gastrodia, Br.
    2174. javanica, Lindl. IV.221

831. Epipogum, Gmel.
    2175. nutans, Lindl. IV.222

832. Galeola, Lour.
    2176. javanica, Benth. IV.223

833. Aphyllorchis, Bl.
    2177. montana, Rchb. f. IV.224

834. Pogonia, Griff.
    2178. juliana, Wall. (?) IV.225

835. Habenaria, Willd.
    2179. barbata, Wight. IV.226
    2180. ACUMINATA, Trim. IV.227
    2181. macrostachya, Lindl. IV.227
    2182. DOLICHOSTACHYA, Thw. IV.228
    2183. DICHOPETALA, Thw. IV.228
    2184. plantaginea, Lindl. *Pigeon orchid.* IV.229
    2185. crinifera, Lindl. IV.229
    2186. PTEROCARPA, Thw. IV.230
    2187. RHYNCOCARPA, Trim. IV.230
    2188. viridiflora, Br. IV.231
    2189. BREVILOBA, Trim. IV.232

2190. Wightii, Trim. IV.232
2191. aristata, Trim. IV.233
2192. TRIMENI, Hk. f. IV.233
2193. torta, Hk. f. IV.234
2194. GARDNERI, Hk. f. IV.234
var. β latifolia, Hk. f.
2195. cubitalis, Br. IV.235

836. Disperis, Sw.
2196. zeylanica, Trim. IV.236

837. Satyrium, Sw.
2197. nepalense, Don. *Hyacinth orchid.* IV.237

838. Apostasia, Bl.
2198. Wallichii, Br. IV.238

127. Scitamineæ.

839. Globba, L.
2199. bulbifera, Roxb. IV.240

840. Curcuma, L.
2200. aromatica, Salisb. *Dada-kaha, Wal-kaha*, S. IV.241
*2201. Zedoaria, Roscoe. *Haran-kaha*, S. IV.241
2202. OLIGANTHA, Trim. IV.242, Pl. XCII.
2203. ALBIFLORA, Thw. IV.242

841. Kæmpferia, L.
*2204. pandurata, Roxb. *Amba-kaha*, S. IV.243
*2205. rotunda, L. *Yawakenda, Laukenda*, S. IV.244

842. Hedychium, Kœn.
2206. coronarium, Kœn. *Ela-mal*, S. IV.245
2207. flavescens, Carey. IV.245
2208. coccineum, Ham. IV.246

843. Costus, L.
2209. speciosus, Sm. *Tebu*, S. IV.246

844. Alpinia, L.
2210. Allughas, Rosc. *Alu, Alu-gas, Alan, Keleniya*, S. IV.247
2211. nutans, Rosc. var. sericea, Moon. *Rankiriya*, S. IV.248
2212. RUFESCENS (Thw.). K. Schum. IV.256

845. Amomum, L.
2213. FLORIBUNDUM, Trim. IV.250
2214. INVOLUCRATUM, Trim. IV.250
2215. NEMORALE, Trim. IV.251
2216. ACUMINATUM, Thw. IV.251
2217. FULVICEPS, Thw. IV.252

2218. MASTICATORIUM, Thw. IV.252
2219. GRAMINIFOLIUM, Thw. IV.253
2220. CILIATUM, Baker. IV.253
2221. hypoleucum, Thw. IV.254
2222. PTEROCARPUM, Thw. IV.254
2223. ECHINATUM, Willd. (? Malaya.) IV.255
2224. BENTHAMIANUM, Trim. IV.255

846. Zingiber, Adans.
2225. Wightianum, Thw. IV.257
2226. CYLINDRICUM, Moon. IV.257
*2227. Cassumunar, Roxb. IV.258
*2228. Zerumbet, Smith. *Walinguru*, S. IV.259

847. CYPHOSTIGMA, Benth.
2229. PULCHELLUM, Benth.[1] IV.260

848. Elettaria, Maton.
2230. Cardamomum, Maton. var. major, Smith. *Ensal*, S. *Cardamom.* IV.261

849. Clinogyne, Salisb.
2231. virgata, Benth. *Geta-oluwa*, S. IV.262

850. Phrynium, Willd.
2232. ZEYLANICUM, Benth. *Hulan-kiriya*, S. IV.263
2233. capitatum, Willd. *Et-bemi-kiriya*, S. IV.263

851. Canna, L.
2234. indica, L. *But-sarana*, S. *Indian shot.* IV.264

852. Musa, L.
2235. paradisiaca, L. *Kehel*, *Gal-kehel*, S. *Wild plantain.* IV.265

128. Hæmodoraceæ.

853. Ophiopogon, Ker.
2236. intermedius, Don. IV.267

854. Sansevieria, Thunb.
2237. zeylanica, Willd. *Niyanda*, S. *Maral*, T. IV.267

129. Amaryllidaceæ.

855. Curculigo, Gærtn.
2238. Finlaysoniana, Wall. *Ma-bin-tal*, S. IV.269
var. β linearifolia, Thw.
2239. orchioides, Gærtn. *Hin-bin-tal*, S. *Nilappanai*, T. IV.269

[1] A new sp., pedicellatum, K. Schum., split off from this in Das Pflanzenreich.

856. Crinum, L.
 2240. asiaticum, L. *Tolabo*, S. *Vichamunkil*, T. IV.270
 2241. defixum, Ker. *Hin-tolabo*, S. IV.271
 2242. latifolium, L. *Tolabo*, S. *Vichamunkil*, T. IV.271
 var. β zeylanicum, Hk. f.

857. Pancratium, L.
 2243. zeylanicum, L. *Wal-lunu*, S. IV.272

130. Taccaceæ.

858. Tacca, Forst.
 2244. pinnatifida, J. & G. Forst. *Garandi-kidaran*, S. IV.274

131. Dioscoreaceæ.

859. Dioscorea, L.
 2245. tomentosa, Heyne. *Uyala*, S. IV.275
 2246. pentaphylla, L. *Katuwala*, S. *Allai*, T. IV.276
 2247. oppositifolia, L. *Hiritala*, S. IV.276
 2248. INTERMEDIA, Thw. IV.277
 2249. spicata, Roth. *Gon-ala*, S. IV.277, Pl. XCIII.
 2250. sativa, L. *Panu-kondol*, S. IV.278

860. Trichopus, Gærtn.
 2251. zeylanicus, Gærtn. *Bim-pol*, S. IV.280

132. Roxburghiaceæ.

861. Stemona, Lour.
 2252. minor, Hk. f. IV.281

133. Liliaceæ.

862. Smilax, L.
 2253. aspera, L. IV.283
 2254. zeylanica, L. *Kabarasa*, *Hin-kabarasa*, S. IV.283
 2255. prolifera, Roxb. *Maha-kabarasa*, S. IV.283

863. Asparagus, L.
 2256. racemosus, Willd. *Hatawariya*, S. *Chattavari*, T. IV.285
 2257. ZEYLANICUS, Hk. f. IV.285
 2258. falcatus, L. *Hatawariya*, S. IV.285
 2259. gonoclados, Baker. IV.286

864. Dracæna, L.
 2260. Thwaitesii, Regel. IV.287

865. Dianella, Lam.
 2261. ensifolia, Redouté. *Monara-petan*, S. IV.288

866. Disporum, Salisb.
  2262. Leschenaultianum, D. Don. IV.289
867. Chlorophytum, Ker.
  2263. Heyneanum, Wall. IV.289
  2264. laxum, Br. IV.290
868. Allium, L.
  2265. Hookeri, Thw. IV.291
869. Dipcadi, Medic.
  2266. montanum, Baker. IV.291
870. Urginea, Steinheil.
  2267. RUPICOLA, Trim. IV.292
871. Scilla, L.
  2268. indica, Baker. IV.293
872. Iphigenia, Kunth.
  2269. indica, A. Gray. IV.293
873. Gloriosa, L.
  2270. superba, L. *Niyangala*, S. *Karttikai-kilanku*, *Ventonti*, T. IV.294

134. Pontederiaceæ.

874. Monochoria, Presl.
  2271. hastæfolia, Presl. *Diya-habarala*, S. IV.295
  2272. vaginalis, Presl. IV.295
    var. β plantaginea, Solms.

135. Xyridaceæ.

875. Xyris, L.
  2273. indica, L. *Ran-motu*, S. IV.297
  2274. anceps, Lam. IV.297
  2275. schœnoides, Mart. IV.297
  2276. pauciflora, Willd. IV.298

136. Commelinaceæ.

876. Pollia, Thunb.
  2277. sorzogonensis, Endl. IV.299
877. Commelina, L.
  2278. nudiflora, L. *Girapala*, S. IV.300
  2279. benghalensis, L. *Diya-meneriya*, S. IV.301
  2280. clavata, Clarke. *Girapala*, S. IV.301
  2281. persicariæfolia, Wight. IV.302
  2282. THWAITESII, Hk. f. IV.302
  2283. attenuata, Vahl. IV.303
  2284. obliqua, Ham. IV.303

2285. Kurzii, Clarke. IV.304
2286. ensifolia, Br. IV.304
2287. appendiculata, Clarke. IV.304

878. Aneilema, Br.
2288. glaucum, Thw. IV.305
2289. esculentum, Wall. IV.306
2290. zeylanicum, Clarke. IV.306
2291. dimorphum, Dalz. IV.307
2292. spiratum, Br. IV.307
2293. nudiflorum, Br. IV.308
var. β terminale, Clarke.
2294. giganteum, Br. IV.308
2295. vaginatum, Br. IV.309
2296. montanum, Wight. IV.309
2297. protensum, Wall. IV.310

879. Cyanotis, Don.
2298. cristata, Schultes f. *Bol-hinda*, S. IV.311
2299. OBTUSA, Trim. IV.312, Pl. XCIV.
2300. tuberosa, Schultes f. var. adscendens, Clarke IV.312
2301. ZEYLANICA, Hassk. IV.313
2302. villosa, Schultes f. IV.313
2303. fasciculata, Schultes f. IV.314
2304. pilosa, Schultes f. IV.314
2305. axillaris, Schultes f. IV.315

880. Floscopa, Lour.
2306. scandens, Lour. IV.316

137. Flagellariaceæ.

881. Flagellaria, L.
2307. indica, L. *Goyi-wel*, S. IV.317

882. Susum, Bl.
2308. anthelminticum, Bl. *Induru*, S. IV.317

138. Juncaceæ.

883. Juncus, L.
2309. effusus, L. IV.318
2310. prismatocarpus, Br. IV.319

139. Palmaceæ.

884. Areca, L.
2311. Catechu, L. *Puwak*, S. *Kamukai*, T. *Arecanut palm*. IV.321
2312. CONCINNA, Thw. *Len-teri*, S. IV.322

885. Loxococcus, Wendl. & Drude.
2313. RUPICOLA, Wendl. & Drude. *Dotalu*, S. IV.322

886. Oncosperma, Bl.
2314. FASCICULATUM, Thw. *Katu-kitul*, S. IV.323

887. Caryota, L.
2315. urens, L. *Kitul*, S. *Tippilipana*, T. *Toddy palm.* IV.324

888. Nipa, Wurmb.
2316. fruticans, Wurmb. *Gin-pol*, S. IV.325

889. Phœnix, L.
2317. ZEYLANICA, Trim. *Indi*, S. IV.326, Pl. XCV.
2318. pusilla, Gærtn. *Inchu*, T. IV.327

890. Corypha, L.
2319. umbraculifera, L. *Tala*, S. *Talipot.* IV.328

891. Calamus, L.
2320. Thwaitesii, Becc. IV.330
2321. pseudo-tenuis, Becc. IV.330
2322. Rotang, L. *Wewel*, S. *Priampu*, T. IV.331
2323. RIVALIS, Thw. *Ela-wel*, S. IV.332
2324. DELICATULUS, Thw. *Nara-wel*, S. IV.332
2325. RADIATUS, Thw. *Kukula-wel*, S. IV.333
2326. PACHYSTEMONUS, Thw. IV.333
2327. DIGITATUS, Becc. *Kukula-wel*, S. IV.334
2328. ZEYLANICUS, Becc. *Ma-wewel*, *Wanderu-wel*, S. IV.335
2329. OVOIDEUS, Thw. *Tambutu-wel*, S. IV.335

892 Borassus, L.
*2330. flabellifer, L. *Tal*, S. *Panai*, T. *Palmyra palm.* IV.336

893. Cocos, L.
*2331. nucifera, L. *Pol*, S. *Tennai*, T. *Coconut palm.* IV.337

140. Pandanaceæ.

894. Pandanus, L. f.
2332. odoratissimus, L. f. *Mudu-keyiya*, S. *Talai*, T. *Screw-pine.* IV.339
2333. ZEYLANICUS, Solms. *O-keyiya*, S. IV.339
2334. fœtidus, Roxb. var. racemosus, Kurz. *Dunu-keyiya*, S. IV.340

895. Freycinetia, Gaudich.
2335. PYCNOPHYLLA, Solms. IV.341
2336. WALKERI, Solms. IV.342

141. Typhaceæ.

896. Typha, L.
2337. javanica, Schnitzl. *Hambu-pan*, S. IV.343

142. Araceæ.

897. Pistia, L.
2338. Stratiotes, L. *Diya-parandella*, S. *Water lettuce.* IV.345

898. Cryptocoryne, Fisch.
2339. spiralis, Fisch. IV.346
2340. THWAITESII, Schott. IV.346
2341. NEVILLII, Trim. IV.346
2342. WALKERI, Schott. IV.347
2343. BECKETTII, Thw. IV.347

899. Lagenandra, Dalz.
2344. THWAITESII, Engl. IV.348
2345. LANCIFOLIA, Thw. *Ati-udayan*, S. IV.348
2346. toxicaria, Dalz. *Vetala*, S. IV.349
2347. KŒNIGII, Thw. IV.349
2348. INSIGNIS, Trim. IV.350

900. Arisæma, Mart.
2349. neglectum, Schott. *Wal-kidaran*, S. IV.351
2350. FILICAUDATUM, N. E. Br. IV.351
2351. Leschenaultii, Bl. *Wal-kidaran*, S. IV.352

901. Typhonium, Schott.
2352. trilobatum, Schott. *Panu-ala*, S. IV.353
2353. Roxburghii, Schott. *Polon-ala*, S. IV.353
2354. cuspidatum, Dcne. IV.354

902. Theriophonum, Bl.
2355. CRENATUM, Bl. IV.355

903. Amorphophallus, Bl.
2356. campanulatus, Bl. *Kidaran*, S. IV.355
2357. DUBIUS, Bl. IV.356

904. Synantherias, Schott.
2358. sylvatica, Schott. IV.357

905. Remusatia, Schott.
2359. vivipara, Schott. IV.358

906. Colocasia, L.
2360. Antiquorum, Schott. *Gahala*, S. *Taro.* IV.359

907. Alocasia, Schott.
*2361. cucullata, Schott. *Pannu-habarala*, S. IV.360
*2362. macrorrhiza, Schott. *Habarala*, S. IV.360

908. Raphidophora, Schott.
 2363. pertusa, Schott. IV.361
 2364. decursiva, Schott. *Dada-kehel*, S. IV.362

909. Lasia, Lour.
 2365. aculeata, Lour. *Kohila*, S. IV.363

910. Pothos, L.
 2366. CEYLANICUS, Engl.
 2367. scandens, L. *Pota-wel*, S. IV.364
 2368. HOOKERI, Schott. IV.364
 2369. REMOTIFLORUS, Hk. IV.364
 var. β macrophylla, Hk. f.

911. Acorus, L.
 *2370. Calamus, L. *Wada-kaha*, S. *Sweet flag*. IV.365

143. Lemnaceæ.

912. Lemna, L.
 2371. paucicostata, Hegelm. *Diya-panshi*, S. IV.366
 2372. polyrrhiza, L. IV.367

913. Wolffia, Heckel.
 2373. Michelii, Schleid. (arrhiza, Wimm.) IV.367

144. Triuridaceæ.

914. Sciaphila, Bl.
 2374. ERUBESCENS, Miers. IV.368
 2375. SECUNDIFLORA, Thw. IV.368
 2376. janthina, Thw. IV.369

145. Alismaceæ.

915. Alisma, L.
 2377. oligococcum, F. Muell. IV.370

916. Limnophytum, Miq.
 2378. obtusifolium, Miq. IV.370

146. Naiadaceæ.

917. Aponogeton, L. f.
 2379. natans, Engl. & Krause (monostachyon, L. f.). *Koddi*, T. IV.372
 2380. CRISPUM, Thunb. *Kekatiya*, S. IV.372

918. Potamogeton, L.
 2381. indicus, Roxb. IV.373
 2382. pectinatus, L. IV.374

919. Ruppia, L.
 2383. maritima, L. var. rostellata, Græbn. IV.374

920. Najas, L.

2384. marina, L. (major, All.)	IV.375
2385. graminea, Del.	IV.375
2386. minor, All.	IV.376

921. Cymodocea, Kœn.

2387. serrulata, Aschers. & Magn.	IV.376
2388. isœtifolia, Aschers.	IV.377

922. Diplanthera, Thou.

2389. uninervis, Aschers. (Cymodocea australis, Trim.)	IV.377

147. Eriocaulonaceæ.

923. Eriocaulon, L.[1]

2390. setaceum, L. *Penda*, S.	V.2
2391. Capillus-naiadis, Hk. f.	V.2
2392. CAULESCENS, Hk. f. & Th.	V.3
2393. ZEYLANICUM, Kœrn.	V.3
2394. LONGICUSPIS, Hk. f.	V.4
2395. ATRATUM, Kœrn.	V.4
2396. sexangulare, L. *Kokmota*, S.	V.5
2397. Thwaitesii, Kœrn.	V.6
2398. Brownianum, Mart.	V.6
2399. luzulæfolium, Mart.	V.7
2400. truncatum, Ham.	V.7
2401. TRIMENI, Hk. f.	V.8
2402. Wightianum, Mart.	V.8
2403. WALKERI, Hk. f.	V.9
2404. quinquangulare, L. *Hin-kokmota*, S.	V.9
2405. collinum, Hk. f.	V.10
2406. Sieboldianum, Sieb. & Zucc.	V.10
2407. FLUVIATILE, Trim.	V.11

148. Cyperaceæ.

924. Cyperus, L.[2]

2408. Cephalotes, Vahl.	V.17
2409. Iria, L. *Wel-hiri*, S.	V.18
2410. pygmæus, Rottb.	V.18
2411. stramineus, Nees.	V.19
2412. pumilus, L. *Go-hiri*, S.	V.19

[1] *Cf.* Ruhland in Das Pflanzenreich, who makes new spp. and re-arranges these. I have preferred Hooker's arrangement however.

[2] I follow Trimen here for convenience sake, though Pycreus at any rate should, I think, be separated from Cyperus.

2413. hyalinus, Vahl. V.19
2414. sanguinolentus, Vahl. V.20
2415. polystachyus, Rottb. V.20
2416. puncticulatus, Vahl. V.21
2417. globosus, Allioni. V.21
2418. bulbosus, Vahl. *Chilanti-arichi*, T. V.22
2419. conglomeratus, Rottb. V.23
var. β pachyrhizus, Trim.
2420. arenarius, Retz. *Mudu-kalanduru*, S. V.23
2421. aristatus, Rottb. V.24
2422. platystylis, Br. V.24
2423. difformis, L. V.25
2424. castaneus, Willd. V.25
2425. cuspidatus, H. B. K. V.26
2426. Haspan, L. *Halpan*, S. V.26
2427. flavidus, Retz. V.27
2428. pulcherrimus, Willd. V.27
2429. diffusus, Vahl. V.28
var. β pubisquama, Hk. f.
2430. articulatus, L. V.29
2431. corymbosus, Rottb. *Gal-ehi*, S. V.29
2432 dehiscens, Nees *Hewan-pan*, S. V.30
2433. distans, L. f. V.30
2434. nutans, Vahl. V.31
2435. pilosus, Vahl. V.32
2436 exaltatus, Retz. V.32
var. β amœnus, Clarke.
2437. tuberosus, Rottb. V.33
2438. compressus, L. V.33
2439. procerus, Rottb. V.34
2440. Zollingeri, Steud. V.35
2441. rotundus, L. *Kalanduru*, S. *Korai*, T. V.35
2442. stoloniferus, Retz. V.36
2443. digitatus, Roxb. V.36
var. β Hookeri, Clarke.
2444. eleusinoides, Kunth. V.37
2445. platyphyllus, Rœm. & Sch. V.38
2446. alopecuroides, Rottb. V.38
2447. SP. NOV. (Ritigala).[1]

925. Mariscus, Vahl.
2448. Dregeanus, Kunth. V.39
2449. albescens, Gaudich. *Ramba*, S. *Iram-pai*, T. V.40
2450. microcephalus, Presl. V.41

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[1] Willis, Flora of Ritigala, Ann. Perad., II., p. 289.

2451. paniceus, Vahl. V.41
var. β Roxburghiana, Clarke.
2452. cyperinus, Vahl. V.42
2453. Sieberianus, Nees. V.42
2454. tenuifolius, Schrad. V.43

926. Kyllinga, Rottb.
2455. cylindrica, Nees. V.44
2456. monocephala, Rottb. *Mottu-tana*, S. V.44
2457. triceps, Rottb. V.45
2458. brevifolia, Rottb. V.45
2459. melanosperma, Nees. V.45

927. Fimbristylis, Vahl.
2460. tetragona, Br. V.48
2461. acuminata, Vahl. V.48
2462. nutans, Vahl. V.48
2463. polytrichoides, Vahl. V.49
2464. schœnoides, Vahl. V.49
var. β bispicata, Trim.
2465. dichotoma, Vahl. V.50
2466. ÆSTIVALIS, Vahl. V.51
2467. TRIMENI, Hk. f. V.52
2468. argentea, Vahl. V.52
2469. ferruginea, Vahl. V.53
var. β tenuissima, Clarke.
2470. diphylla, Vahl. V.53
var. β major, Thw.
var. γ ovalis, Hk. f.
2471. spathacea, Roth. V.54
2472. compressa, Bœck. V.55
2473. quinquangularis, Kunth. V.55
2474. miliacea, Vahl. *Mudu-halpan*, S. V.56
var. β congesta, Trim.
2475. globulosa, Kunth. *Halpan*, S. V.57
2476. insignis, Thw. V.57
2477. leptoclada, Benth. V.58
2478. asperrima, Bœck. V.58
2479. tristachya, Thw. V.59
2480. monostachya, Hassk. V.59
2481. pentaptera, Kunth. V.60
2482. monticola, Steud. V.60
2483. cinnamometorum, Kunth. V.61
2484. FULVESCENS, Thw. V.62
2485. nigrobrunnea, Thw. V.62
2486. complanata, Link. V.63
2487. Kraussiana, Hochst. V.63
2488. junciformis, Kunth. V.64

928. Echinolytrum, Desv.
   2489. dipsaceum, Desv. V.65

929. Bulbostylis, Kunth.
   2490. puberula, Kunth. V.66
   2491. barbata, Kunth. *Uru-hiri*, S. V.66
      var. β pulchella. Clarke.
   2492. capillaris, Kunth. var. trifida. Clarke. V.67

930. Eleocharis, R. Br.
   2493. plantaginea, Br. *Boru-pan*, S. V.68
   2494. equisetina, Presl. V.69
   2495. variegata, Kunth. var. laxiflora, Clarke. V.69
   2496. fistulosa, Schultes. V.70
   2497. spiralis, R. Br. V.70
   2498. Chætaria, Rœm. & Sch. V.71
   2499. atropurpurea, Kunth. V.71
   2500. capitata, R. Br. V.72
   2501. congesta, D. Don. V.72
   2502. tetraquetra, Nees. V.72

931. Scirpus, L.
   2503. fluitans, L. V.73
   2504. squarrosus, L. V.74
   2505. supinus, L. V.74
   2506. erectus, Poir. V.75
   2507. articulatus, L. *Maha-geta-pan*, S. V.75
   2508. mucronatus, L. V.76
   2509. subcapitatus, Thw. V.76
   2510. grossus, L. f. V.77
   2511. littoralis, Schrad. V.77

932. Websteria, S. H. Wright.
   2512. limnophila, S. H. Wright. V.78

933. Fuirena, Rottb.
   2513. glomerata, Lam. V.79
   2514. uncinata, Kunth. V.79
   2515. umbellata, Rottb. V.80

934. Lipocarpha, Br.
   2516. argentea, Br. V.81
   2517. triceps, Ness. V.81

935. Actinoschœnus, Benth.
   2518. filiformis, Benth. V.82

936. Rhyncospora, Vahl.
   2519. Wallichiana, Kunth. V.83
   2520. aurea, Vahl. V.83
   2521. triflora, Vahl. V.84

2522. gracillima, Thw. V.85
2523. glauca, Vahl. V.85
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937. Cladium, P. Br.
2524. undulatum, Thw. V.86
2525. riparium. Benth. var. crassum, Clarke. V.87

938. Remirea, Aubl.
2526. maritima, Aubl. V.87

939. Lepironia, L. C. Rich.
2527. mucronata, Rich. *Eta-pan*, S. V.88

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941. Mapania, Aubl.
2530. zeylanica, Benth. V.91
2531. IMMERSA, Benth. V.91

942. Scirpodendron, Zipp.
2532. costatum, Kurz. *Hin-keyiya*, S. V.92, Pl. XCVII.

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2533. Neesii, Kunth. *Baka-munu-tana*, S. V.94
2534. pergracilis, Kunth. *Mehi-wal*, S. V.94
2535. corymbosa, Roxb. V.95
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2540. elata, Thw. V.97
2541. chinensis, Kunth. var. biauriculata, Clarke. V.98
2542. tessellata, Willd. V.98
2543. hebecarpa, Nees. *Goda-karawu*, S. V.99
2544. biflora, Roxb. V.99
2545. oryzoides, Presl. *Potu-pan*, *Potu-kola*, S. V.99
2546. lævis, Retz. V.100

944. Diplacrum, Br.
2547. caricinum, Br. V.101

945. Carex, L.
2548. nubigena, D. Don. V.102
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2553. ARNOTTIANA, Nees. V.105
2554. rara, Boott. V.105
2555. Walkeri, Arn. V.106
2556. SPICIGERA, Nees. V.106
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var. γ rubella, Clarke.
var. δ rostrata, Bœck.
2557. leucantha, Arn. V.107
2558. baccans, Nees. V.107
2559. indica, L. var. latebrunnea, Clarke. V.108
2560. Lindleyana, Nees. V.109
2561. ZEYLANICA, Bœck. V.109
2562. filicina, Nees. V.110
2563. maculata, Boott. V.110
2564. BREVISCAPA, Clarke. V.111
2565. hebecarpa, C. A. Mey (ligulata, Nees.) V.111
2566. Jackiana, Boott. V.112
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2567. lateralis, Kukenth.
2568. LOBULIROSTRIS, Drejer. V.113

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946. Paspalum, L.
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*2570. conjugatum, Berg.[1] V.122
2571. sanguinale, Lamk. *Guruwal*, S. V.123
2572. longiflorum, Retz. V.124
2753. Royleanum, Nees. V.125
2547. Perrottetii, Hk. f. V.125
947. Eriochloa, H. B. K.
2575. polystachya, H. B. K. V.126
948. Isachne, Br.
2576. Kunthiana, W. & A. V.127
2577. ELATIOR, Hk. f. V.127
2578. MULTIFLORA, Trim. V.127
2579. australis, R. Br. V.128
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2580. miliacea, Roth. V.128
2581. Walkeri, W. & A. V.129
2582. Gardneri, Benth. V.130
949. Panicum, L.
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2584. flavidum, Retz. V.133
2585. punctatum, Burm. V.134
2586. fluitans, Retz. V.135

[1] This and the two next usually placed in Panicum.

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var. γ stagninum, Trim.
2588. colonum, L. V.136
2589. ambiguum, Trin. V.137
2590. oryzoides, Sw. V.138
2591. prostratum, Lamk. V.138
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2594 ramosum, L. V.140
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2602. auritum, Presl. V.145
2603. Myurus, H. B. K. V.146
2604. interruptum, Willd. V.147
2605. indicum, L. V.147
var. β brachiatum, Hk. f.
2606. myosuroides, Br. V.148
2607. curvatum, L. V.148
2608. ovalifolium, Poir. V.149
*2609. miliaceum, L. *Wal-meneri*, S. *Kadai*, *Kannai*, T. V.150
*2610. miliare, Lamk. *Meneri*, S. *Chamai*, T. V.150
2611. cæsium, Nees. V.151
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- 2626. glauca, Beauv. *Kawalu*, S. V.162
- 2627. verticillata, Beauv. V.163
- 2628. intermedia, Rœm. & Sch. V.163
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952. Chamæraphis, Br.
- 2630. spinescens, Poir. V.165
  - var. β aspera, Hk. f.
  - var. γ subglabra, Thw.
  - var. δ depauperata, Hk. f.

953. Axonopus, Beauv.
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- 2632. semialatus, Hk. f. V.167

954. Oplismenus, Beauv.
- 2633. compositus, Beauv. V.168
- 2634. Burmannii, Beauv. V.169
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- *2636. typhoideum, Rich. *Kumba*, T. *Bulrush millet.* V.170
- 2637. orientale, Rich. V.171

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- 2638. complanatum, Schrank. V.172

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- 2639. sarmentosa, Pers. V.173

958. Spinifex, L.
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- 2647. BLEPHARIPHYLLA, Trim. V.180
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	2655. racemosus, Scop.	V.187
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	2658. latifolia, Ait.	V.189
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	2660. COCHLEATA, Thw.	V.191
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	2661. Lachryma-jobi, L. *Kikirindi*, S.	V.192
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	2662. barbata, Stapf.	V.194
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	2663. pusilla, Thw.	V.195
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	2665. Lehmanni, Hack.	V.196
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	2666. THWAITESII, Hack.	V.197
	2667. fuscescens, Trin.	V.198
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	2668. TRIMENI, Hk. f.	V.198
	2669. gracilis, Nees.	V.199
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	2670. arundinacea, Cyrill. *Iluk*, S.	V.200
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	2671. spontaneum, L.	V.201
	2672. arundinaceum, Retz. *Rambuk*, S. *Pey-karumu*, T.	V.202
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	2673. THWAITESII, Hack.	V.203
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    2680. granularis, L. f. V.209
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    2681. lævis, Kunth. V.210
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    2682. aristatum, L. V.211
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    2683. rugosum, Salisb. V.212
    *2684. semisagittatum, Roxb. V.213
    2685. commutatum, Hack. V.214
    2686. muticum, L. V.215
    2687. ciliare, Retz. *Rat-tana*, S. V.216
    2688. RIVALE, Hack. V.217
    2689. timorense, Kunth. V.218
    2690. laxum, Br. V.219
979. Eremochloa, Buse.
    2691. muricata, Hack. V.220
    2692. ZEYLANICA, Hack. V.221
980. Pogonatherum, Beauv.
    2693. crinitum, Kunth. V.222
981. Apocopis, Nees.
    2694. Wightii, Nees. V.223
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982. Arthraxon, Beauv.
    2695. rudis, Hochst. V.224
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    2705. zeylanicus, Nees. V.235
    2706. monticola, Schult. V.236
    2707. caricosus, L. V.237

[1] *Cf.* Stapf in Kew Bulletin, 1906, p. 297.

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2709. contortus, L. *Itana*, S. V.238
2710. triticeus, Br. V.239
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2713. venustus (Thw.), Willis. V.233

986. Cymbopogon, Spreng.[1]
2714. Schœnanthus, Spreng (A. Schœnanthus, L.). V.241
2715. Nardus, Rendle (A. Nardus, L.). *Lenabatu*, S. *Citronella grass.* V.242
2716. Winterianus, Jowitt. *Maha-pengiri*, S. *Winter's citronella grass*
2717. confertiflorus, Stapf. *Mana*, S.
2718. citratus, Stapf. *Lemon grass.*
2719. polyneuros, Stapf.
2720. THWAITESII (Hk. f.), Willis. V.243
2721. lividus (Thw.), Willis. V.244
2722. filipendulus (Hochst.), Willis. V.245

987. Pseudanthistiria, Hk. f.
2723. umbellata, Hk. f. V.247

988. Anthistiria, L.
2724. imberbis, Retz. V.248
2725. cymbaria, Roxb. *Karawata-mana*, S. V.249
2726. tremula, Nees. *Pini-baru-tana*, S. V.249
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989. Iseilema, Anderss.
2727. laxum, Hack. V.251

990. Aristida, L.
2728. Adscensionis, L. *Teli-tana*, S. V.252
2729. setacea, Retz. *Et-tuttiri*, S. V.253

991. Garnotia, Brongn.
2730. THWAITESII, Stapf. V.254
2731. TECTORUM, Hk. f. V.254
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2733. FERGUSONII, Trim. V.255
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2734. MICRANTHA, Thw. V.256
2735. courtallensis, Thw. V.257
2736. PANICOIDES, Trim. V.257

[1] Cf. Stapf in Kew Bulletin, 1906, p. 297.

992. Sphærocaryum, Nees.
 2737. elegans, Nees. V.258

993. Polypogon, Desf.
 2738. monspeliensis, Desf. V.259

994. Sporobolus, Br.
 2739. diander, Beauv. V.260
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 2740. indicus, Br. V.261
 2741. Wallichii, Munro. V.261
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 2744. orientalis, Kunth. V.263
 2745. coromandelianus, Kunth. V.264

995. Calamagrostis, Adans.
 2746. pilosula, Hk. f. V.264

996. Avena, L.
 2747. aspera, Munro. V.265

997. Eriachne, Br.
 2748. triseta, Nees. *Pini-tuttiri*, S. V.266

998. Zenkeria, Trin.
 2749. OBTUSIFLORA, Benth. V.267
 2750. elegans, Trin. V.268

999. Cœlachne, Br.
 2751. pulchella, Br. var. simpliciuscula, Hk. f. V.269
 2752. PERPUSILLA, Thw. V.270
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 2753. Thomæum, Trin. V.271

1001. Enteropogon, Nees.
 2754. melicoides, Nees. V.272

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 2755. bromoides, Roth. V.273

1003. Cynodon, Pers.
 2756. Dactylon, Pers. *Arugam-pillu*, T. *Bermuda grass, Doob grass.* V.274

1004. Chloris, Sw.
 2757. incompleta, Roth. V.275
 2758. barbata, Sw. *Mayuru-tana*, S. V.275
 2759. montana, Roxb. V.276
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2760. indica, Gærtn. *Wal-kurakkan*, S.		V.277
2761. verticillata, Roxb.		V.277
2762. brevifolia, Br.		V.278
2763. ægyptiaca, Desf.		V.279
1006. Dinebra, Jacq.		
*2764. arabica, Jacq.		V.280
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2765. Wightii, Nees.		V.281
1008. Leptochloa, Beauv.		
2766. uniflora, Hochst.		V.282
2767. polystachya, Benth.		V.282
2768. filiformis, Beauv.		V.283
2769. chinensis, Nees.		V.283
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2770. nutans, Kœn.		V.284
1010. Pommereulla, L. f.		
2771. Cornucopiæ, L. f.		V.286
1011. Phragmites, Trin.		
2772. Karka, Trin. *Nala-gas*, S.		V.287
1012. Elytrophorus, Beauv.		
2773. articulatus, Beauv.		V.288
1013. Myriostachya, Hk. f.		
2774. Wightiana, Hk. f.		V.288
1014. Eragrostis, Host.		
2775. tenella, Rœm. & Sch.		V.290
	var. β plumosa, Stapf.	
	var. γ contracta, Hk. f.	
	var. δ riparia, Stapf.	
	var. ε viscosa, Stapf.	
	var. ς densiflora, Hk. f.	
2776. interrupta, Beauv.		V.292
	var. β diplachnoides, Stapf.	
	var. γ Kœnigii, Stapf.	
	var. δ tenuissima, Stapf.	
2777. amabilis, W. & A.		V.293
2778. gangetica, Steud. *Ela-kuru-tana*, S.		V.293
2779. stenophylla, Hochst.		V.294
2780. elongata, Jacq. *Mal-etora-tana*, S.		V.295
2781. nigra, Nees.		V.295
2782. pilosa, Beauv.		V.296
2783. Willdenoviana, Nees.		V.296

2784. major, Host. V.297
2785. coromandeliana, Trin. V.298
2786. SECUNDA, Nees. V.298
2787. WALKERI, Stapf. V.298

1015. Halopyrum, Stapf.
2788. mucronatum, Stapf. V.299

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2789. fusca, Beauv. V.300

1017. Streptogyne, Beauv.
2790. gerontogæa, Hk. f. V.301

1018. Lophatherum, Brongn.
2791. gracile, Brongn. V.302
2792. ZEYLANICUM, Hk. f. V.303

1019. Centotheca, Desv.
2793. lappacea, Desv. V.304

1020. Æluropus, Trin.
2794. villosus, Trin. V.304

1021. Poa, L.
*2795. annua. L. V.305

1022. Brachypodium, Beauv.
2796. sylvaticum, Beauv. V.306

1023. Lepturus, Br.
2797. repens, Br. V.307

1024. Arundinaria, Mich.
2798. Walkeriana, Munro. V.309
2799. Wightiana, Nees. V.309
2800. FLORIBUNDA, Thw. V.310
2801. DEBILIS, Thw. V.311
2802. densifolia. Munro. V.312

1025. Bambusa, Schreb.
2803. arundinacea, Willd. *Katu-una*, S. *Moongil*, T. *Spiny bamboo.* V.313
2804. vulgaris, Schrad. *Una*, S. *Bamboo.* V.314
*2805. nana, Roxb. *Dwarf or Chinese bamboo.* V.315

1026. Oxytenanthera, Munro.
2806. Thwaitesii, Munro. V.316

1027. Teinostachyum, Munro.
2807. ATTENUATUM, Munro. V.317

1028. Ochlandra, Thw.
2808. STRIDULA, Thw. *Bata-li*, S. V.318
var. β maculata, Gamble.

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2810. CEYLANICUM, Spreng.	11
2811. serratum, Thunb.	12
2812. setaceum, Ham.	14
2813. squarrosum, Forst. (Hookeri, Wall.) *Kuda-hedaya*, S.	18
2814. Phlegmaria, L. *Maha-hedaya*, S.	22
2815. Phyllanthum, Hook. & Arn.	22
2816. cernuum, L. *Wanassa, Badal-wanassa*. S.	23
2817. clavatum, L.	26
2818. carolinianum, L.	28
2819. Wightianum, Wall.	28
2820. complanatum, L.	28

150. Psilotaceae.[1]

1030. Psilotum, Sw.

2821. triquetrum, Sw.	30

152. Selaginellaceæ.[1]

1031. Selaginella, Spring.

2822. rupestris, Spring.	35
2823. plumosa, Baker.	50
2824. INTEGERRIMA, Spring.	66
2825. cochleata, Spring.	76
2826. caulescens, Spring.	94
2827. latifolia, Spring.	98
2828. CILIARIS, Spring. (?)	105
2829. proniflora, Baker.	108
2830. ZEYLANICA, Baker.	111
2831. brachystachya, Spring.	113
2832. CRASSIPES, Spring.	117
2833. tenera, Spring.	118

153. Isœtaceæ.[1]

1032. Isœtes, L.

2834. coromandelina, L. f.	132

154. Equisetaceæ.[1]

1033. Equisetum, L.

2835. debile, Roxb.	5

[1] Following Baker, Handbook of the Fern allies, to which the pages quoted refer.

155. Salviniaceæ.[1]

1034. Azolla, Lam.
  2836. pinnata, R. Br. 138

156. Marsileaceæ.[1]

1035. Marsilea, L.
  2837. quadrifolia, L. *Diya-embul-embiliya*, S. *Ara-kiri*, T. 139
  2838. minuta, L. 140

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  2840. WALLII, Thw.
  2841. exiguum, Baker. 37
  2842. bimarginatum, v. d. B. (neilgherrense, Bedd.) 37
  2843. parvulum, Poir. 39
  2844. proliferum, Bl. 39
  2845. digitatum, Sw. 39
  2846. intramarginale, Hk. & Grev. 41
  2847. pallidum, Bl. 41
  2848. bipunctatum, Poir. 41
  2849. pyxidiferum, L. 42
  2850. rigidum, Sw. 44
  2851. sp. nov. (Ritigala).[3]

1037. Hymenophyllum, Sm.
  2852. tenellum, Kuhn. 30
  2853. exsertum, Wall. 30
  2854. polyanthos, Sw. 30
  2855. Blumeanum, Spreng. 32
  2856. australe, Willd. (javanicum, Spreng.)
  2857. aculeatum, Racib. (Neesii, Hk. p. p.) 35

158. Cyatheaceæ.

1038. Cyathea, Sm.
  2858. SINUATA, Hk. & Grev. 5
  2859. HOOKERI, Thw. 6

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[1] Following Baker, Handbook of the Fern-allies, to which the pages quoted refer.

[2] The ferns are arranged according to Christensen's Index Filicum: the number references are to the pages of Beddome's Handbook of the Ferns of British India, Ceylon, &c.

[3] Willis, Flora of Ritigala, Ann. Perad., III., 1906, p. 290.

1039. Hemitelia. R. Br.
2860. WALKERÆ, Pr. (Amphicosmia Walkeræ, Moore.) 8

1040. Alsophila. R. Br.
2861. glabra, Hk. 14
2862. crinita, Hk. 16

159. Polypodiaceæ.

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A Catalogue of the Chief Introduced and Naturalized Species found in Ceylon.

To complete the preceding catalogue, we have made the following, in which we have included all the species we know to be *regularly* cultivated in the Colony, or to have escaped and established themselves as weeds therein. Its length will surprise many people, as also the fact that it includes nearly all of our useful plants.

It is very difficult to make a list like this accurate or complete. New weeds may any day make their appearance, or old ones may disappear, and new cultivations may begin. We have excluded the purely decorative garden plants, unless, as in the case of Cosmos, they have spread into the country and established themselves, or are used in hedges or in similar ways.

The orders are numbered as in Durand's Index Generum Phanerogamorum, and marked with an asterisk to indicate that they belong to the Supplement. Page references, when given, refer to Trimen's Flora.

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† Cultivated only.

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† Cultivated only.

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† Cultivated only.

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† Cultivated only.

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†*65.* odorata, Lour. China. I.247

52. Swietenia, L.

†*66.* Mahagoni, L. *Mahogany.* Trop. America.

†*67.* macrophylla. *Large-leafed mahogany.* Trop. America.

53. Cedrela, L.

†*68.* Toona, Roxb. *Red cedar*, *Indian mahogany.* India. I.252

†*69.* serrata, Royle. *Red toon.* Himalaya. I.252

54.* Ampelidaceæ.

54. Vitis, L.

†*70.* vinifera, L. *Grape.* Medit., N. W. India.

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† Cultivated only.

55.* Sapindaceæ.

55. Dittelasma, Hk. f.
71. Rarak, Hk. f. *Penela*, S. Java, Malacca. I.300

56. Litchi, Sonnerat.
†*72.* chinensis, Sonnerat. *Litchi*, *Leechee*. China.

57. Nephelium, L.
†*73.* lappaceum, L. *Rambutan*. Malaya.

61.* Anacardiaceæ.

58. Mangifera, L.
†*74.* indica, L. *Amba*, S. *Mango*. India. I.318

59. Anacardium, Rottb.
75. occidentale, L. *Caju*, S. *Cashew*. Trop. America. I.317

60. Spondias, L.
†*76.* dulcis, Forst. f. Cosmop. trop.

63.* Moringaceæ.

61. Moringa, Juss.
77. pterygosperma, Gærtn. *Murunga*, S. *Horse-radish tree*. N. India. I.327

65.* Leguminosæ.

62. Crotalaria, L.
78. Willdenowiana, DC. S. Africa. II.18
79. incana, L. Trop. America. II.18

63. Ulex, L.
80. europæus, L. *Gorse*, *Furze*, *Whin*. Europe. II.7

64. Melilotus, Juss.
81. parviflora, Desf. N. temp. zone. II.21

65. Trifolium, L.
82. repens, L. *White clover*, *Dutch clover*. N. temp. zone. II.20
83. minus, Sm. N. temp. zone. II.20
84. arvense, L. *Hare's foot trefoil*. N. temp. zone. II.20

66. Indigofera, L.
85. Anil, L. *Indigo*. America. II.27

67. Gliricidia, H. B. K.
†*86.* maculata, H. B. K. Guatemala.

† Cultivated only.

68. Sesbania, Pers.
87. grandiflora, Pers. *Katuru-murunga*, S. *Akatti*, T. Trop. Asia. II.35

69. Arachis, L.
†*88.* hypogæa, L. *Rata-kaju*, S. *Groundnut*, *Peanut*, *Monkey-nut*. Brazil.

70. Desmodium, Desv.
89. diffusum, DC. India. II.52

71. Uraria, Desv.
†*90.* crinita, Desv. Trop. Asia. II.42

72. Lourea, Neck.
91. Vespertilionis, Desv. Tropics generally.

73. Cicer, L.
†*92.* Arietinum, L. *Kadala*, S. *Chicken pea*. Medit.

74. Pisum, L.
93. sativum, L. *Pea*. Medit.

75. Centrosema, DC.
94. Plumieri, Benth. Trop. America. II.75

76. Periandra, Mart.
95. Berteriana. W. Indies.

77. Erythrina, L.
†*96.* lithosperma, Bl. *Dadap*. Java. II.64
†*97.* umbrosa, H. B. K. *Madre de cacao*. Trop. America. II.64
†*98.* velutina, Willd. W. Indies. II.64

78. Phaseolus, L.
†*99.* lunatus, L. *Bonchi*, *Damala*, S. *Curry bean*, *Lima bean*. Cosmop. trop. cult. II.69
†*100.* vulgaris, L. *Potu-bonchi*, S. *French bean*, *Kidney bean*. Cosmop. trop. cult. II.69

79. Psophocarpus, Neck.
†*101.* tetragonolobus. *Daradamala*, S. Burma.

80. Vigna, Savi.
†*102.* Catiang, Endl. *Nil-me*, S. *Kodippayuru*, T. Cosmop. trop. cult. II.74
var. sinensis, Endl. *Me-karal*, *Wanduru-me*, S. *Cherry bean*.

81. Dolichos, L.
†*103.* biflorus, L. *Kollu*, *Madras gram*, *Horse gram*. India. II.7

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† Cultivated only.

82. Cajanus, DC.
†*104*. indicus, Spreng. *Rata-tora*, S. *Thavarai*, T. *Dhal*, *Pigeon pea*. E. Indies. II.80

83. Dalbergia, L. f.
105. latifolia, Roxb. *Blackwood*, *East Indian rosewood*. India. II.88

84. Pterocarpus, L.
106. indicus, Willd. (?) Burma.

85. Cæsalpinia, L.
107. Sappan, L. *Patangi*, S. *Sappan*. India, Malaya. II.99
†*108*. pulcherrima, Sw. *Peacock flower*. Cosmop. trop. cul.
†*109*. coriaria, Thunb. *Vanni*, T. *Divi-divi*. Trop. America. II.101

86. Poinciana, L.
†*110*. regia, Boj. *Flamboyante*, *Gold mohur*. Madagascar.

87. Parkinsonia, L.
111. aculeata, L. Trop. America. II.102

88. Cassia, L.
†*112*. nodosa, Ham. Bengal, Malaya.
†*113*. grandis, L. f. *Horse cassia*. Trop. America.
114. tomentosa, L. Trop. America. II.106
115. hirsuta, L. Trop. America. II.106
116. lævigata, Willd. Trop. America. II.106
117. alata, L. *Rata-tora*, S. Tropics generally. II.108
†*118*. glauca, Lam. India, &c. II.109
†*119*. multijuga, Rich. Trop. America.

89. Bauhinia, L.
†*120*. acuminata, L. India, &c. II.116
†*121*. purpurea, L. India, &c. II.117

90. Amherstia, Wall.
†*122*. nobilis, Wall. Burma.

91. Tamarindus, L.
†*123*. indica, L. *Siyambala*, S. *Puli*, T. *Tamarind*. Trop. Africa. II.114

92. Cynometra, L.
†*124*. cauliflora, L. *Nam-nam*. India, Malaya.

93. Parkia, R. Br.
†*125*. Roxburghii, G. Don. Assam to Malaya.

† Cultivated only.

94. Neptunia, Lour.
126. plena, Benth. Trop. America. II.119

95. Desmanthus, Willd. Trop. America.
127. virgatus, Willd. Trop. America. II.122

96. Mimosa, L.
128. pudica, L. *Nidi-kumba*, S. *Sensitive plant.* Brazil. II.122

97. Leucæna, Benth.
129. glauca, Benth. Trop. America. II.122

98. Acacia, Willd.
†*130.* decurrens, Willd. *Black wattle.* Australia.
†*131.* dealbata, Link. *Silver wattle.* Australia.
†*132.* melanoxylon, R. Br. *Australian black-wood*, Australia.
†*133.* longifolia, Willd. Australia.

99. Albizzia, Durazz.
†*134.* moluccana, Miq. Malay Is. II.131

100. Pithecolobium, Mart.
†*135.* dulce, Benth. *Madras thorn.* Trop. America. II.131
†*136.* Saman, Benth. *Guango, Rain tree.* Trop. America. II.132

66.* Rosaceæ.

101. Prunus, L.
†*137.* persica, Stokes. *Peach.* Europe.

102. Spiræa, L.
138. salicifolia, L. Northern tropics.

103. Fragaria, L.
139. vesca, L. *Strawberry.* N. temp. zone. II.138

104. Rosa, L.
†*140.* centifolia, L. *Cabbage rose.* Caucasus.
†*141.* indica, L. *Indian or tea rose.* India, China.

105. Pyrus, L.
†*142.* communis, L. *Pear.* Europe, N. Asia.

67.* Saxifragaceæ.

106. Bauera, Banks.
143. rubioides, Andr. Australia.

† Cultivated only.

68.* Crassulaceæ.

107. Bryophyllum, Salisb.
144 calycinum, Salisb. *Akkapana*, *Rata-gowa*, S. Trop. Africa. II.145

74.* Combretaceæ.

108. Terminalia, L.
†*145.* Catappa. L. *Kottamba*, S. *Country almond.* Malaya. II.159

109. Quisqualis, L.
†*146.* indica, L. India, Malaya.

75.* Myrtaceæ.

110. Eucalyptus, L'Her. II.166
†*147.* Globulus, *Labill.* *Blue gum.* Australia. II.166
†*148.* diversicolor, F. Muell. Australia. II.166
†*149* Leucoxylon, F. Muell. *Ironbark.* Australia. II.166
†*150.* robusta, Sm. *Swamp mahogany.* Australia. II.166
†*151.* marginata, Sm. *Jarrah.* Australia. II.166

111. Psidium, L.
152. Guajava, L. *Pera*, S. *Guava.* Trop. America. II.167

112. Eugenia, L.
†*153.* malaccensis, L. *Malay apple.* Malaya. II.170
†*154.* Jambos, L. *Jambu*, S. *Rose apple.* Malaya. II.170
†*155.* Michelii, Lam. *Rata-jambu*, S. *Brazil cherry.* Trop. America. II.188
†*156.* caryophyllata, Thunb. *Clove.* Moluccas.

76.* Melastomaceæ.

113. Tibouchina, Aubl.
†*157.* semidecandra, Cogn. Brazil. (Pleroma macranthum, Hk. f.)

77.* Lythraceæ.

114. Punica, L.
†*158.* granatum, L. *Delun*, S. *Madalankai*, T. *Pomegranate.* N. W. India, Persia, &c.

† Cultivated only.

78.* Onagraceæ.

115. Œnothera, L.
159. fruticosa, L. N. America. II.235
160. odorata, Jacq. (?) Chili.
161. speciosa, Nutt. N. America.

81.* Turneraceæ.

116. Turnera, L.
162. ulmifolia, L. Trop. America. II.239

82.* Passifloraceæ.

117. Passiflora, L.
163. suberosa, L. W. Indies. II.241
164. quadrangularis, L. *Granadilla.* Trop. America.
165. fœtida, L. Trop. America. II.242
166. edulis, Sims. *Sweet cup, Passion fruit.* Brazil. II.242
167. stipulata, Aubl. Trop. America. II.242
168. laurifolia, L. *Water lemon.* Trop. America.

118. Carica, L.
†*169.* Papaya, L. *Pepol*, S. *Pappali*, T. *Papaw.* Trop. America.
†*170.* candamarcensis, Hk. f. *Mountain papaw.* Ecuador.

83.* Cucurbitaceæ.

119. Trichosanthes, L.
†*171.* Anguina, L. *Patola*, S. *Podivilanga*, T. *Snake gourd.* Trop. Asia. II.245

120. Lagenaria, Ser.
†*172.* vulgaris, Ser. *Diya-labu*, S. *Churai*, T. *Bottle gourd*, *Calabash cucumber.* Tropics. II.247

121. Cucumis, L.
†*173.* sativus, L. *Rata-kekiri*, S. *Cucumber.* India.

122. Citrullus, Neck.
†*174.* vulgaris, Schrad. *Komadu*, S. *Water melon.* Trop. Africa. II.253

123. Benincasa, Savi.
†*175.* cerifera, Savi. *Alu-puhul*, S. *Puchini*, T. *Ash pumpkin.* E. tropical cult. II.252

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† Cultivated only.

124. Cucurbita, L.

†*176.* maxima, Duch *Gourd, Pumpkin.* Tropics generally.

†*177.* moschata, Duch. *Rata-labu*, S. Origin unknown.

†*178.* Pepo, L. *Pumpkin, Vegetable marrow.* N. America.

125. Sechium, P. Browne.

†*179.* edule, Sw. *Chocho, Chayote.* Trop. America.

86.* Cactaceæ.

126. Opuntia, Mill.

180. Dillenii, Haw. Mexico. II.267

88.* Umbelliferæ.

127. Apium, L.

†*181.* graveolens, L. *Celery.* Europe, N. W. Asia.

128. Carum, L.

182. Roxburghianum, Benth. & Hk f. Indo-Malaya. II.278

183. Petroselinum, B. & Hk. f. *Parsley.* Medit.

129. Peucedanum, L.

†*184.* sativum, B. & Hk. f. *Parsnip.* N. temp. zone.

130. Coriandrum, L.

†*185.* sativum, L. *Coriander.* Medit.

131. Daucus, L.

†*186.* Carota, L. *Carrot.* N. temp. zone. Old World.

89.* Araliaceæ.

132. Panax, L.

†*187.* fruticosum, L. Malaya. II.282

133. Fatsia, Dene. & Pl.

188. papyrifera, B. & Hk f. *Rice paper tree.* China.

† Cultivated only

GAMOPETALÆ.

92.* Rubiaceæ.

134. Cinchona, L.
- †*189.* Calisaya, Wedd. *Yellow bark, Crown bark.* Trop. S. America.
- †*190.* succirubra, Pav. *Red bark.* Trop. S. America.
- †*191.* officinalis, L. *Crown bark, Brown bark.* Trop. S. America.

135. Oldenlandia, L.
- *192.* crystallina, Roxb. India. II.315

136. Coffea, L.
- †*193.* arabica, L. *Kopi,* S. and T. *Arabian coffee.* Trop. Africa. II.353
- †*194.* liberica, Hiern. *Liberian coffee.* Trop. Africa.

96.* Compositæ.

137. Ageratum, L.
- *195.* conyzoides, L. *Hulan-tala,* S. *Pum-pulla,* T. *White weed, Goat weed.* Trop. America. III.13

138. Mikania, Willd.
- *196.* scandens, Willd. India, trop. America.

139. Erigeron, L.
- *197.* linifolius, Willd. W. temp. Asia. III.17

140. Gnaphalium, L.
- *198.* indicum, L. (multicaule, Willd.). *Wild mignonette.* Tropics generally. III.32

141. Helichrysum, Gærtn.
- *199.* bracteatum, Willd. Australia. III.33

142. Carpesium, L.
- *200.* cernuum, L. Temp. Asia. III.34

143. Lagascea, Cav.
- *201.* mollis, Cav. Trop. America. III.34

144. Melampodium, L.
- *202.* paludosum, H. B. K. (divaricatum. DC.). *Ran-manissa.* S. America.

145. Tithonia, Desf.
- *203.* diversifolia, A. Gray. *Wild sunflower.* Mexico, &c. III.39

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† Cultivated only.

146. Helianthus, L.
204. annuus, L. *Sunflower*. N. America.
205. tuberosus, L. *Jerusalem artichoke*. N. America.

147. Synedrella, Gærtn.
206. nodiflora, Gærtn. Mexico. III.40

148. Cosmos, Cav.
207. bipinnatus, Cav. Mexico. III.40
208. sulphureus, Cav. Mexico. III.40

149. Galinsoga, Ruiz. & Pav.
209. parviflora, Cav. Peru III.42

150. Tridax, L.
210. procumbens, L. S. America. III.42

151. Tagetes, L.
211. erecta, L. Mexico. III.42
212. patula, L. Mexico. III.42

152. Cotula, L.
213. australis, Hk. f. Australia. III.42

153. Artemisia, L.
214. Roxburghiana, Bess. Himalaya.

154. Cynara, L.
†*215*. Cardunculus, L. *Artichoke*. Medit.

155. Taraxacum, L.
216. officinale, Wigg. *Dandelion*. Temp. zone. III.51

156. Lactuca, L.
†*217*. Scariola, L. *Lettuce*. Europe, N. W. Asia.

157. Sonchus, L.
218. asper, Vill. *Sow thistle*. N. temp. zone. III.52
219. oleraceus, L. *Sow thistle*. N. temp. zone. III.52

99.* Lobeliaceæ.

158. Isotoma, Lindl.
220. longiflora, Presl. W. Indies. III.58

107.* Plumbaginaceæ.

159. Plumbago, L.
†*221*. rosea, L. *Rat-netul*, S. India. III.65

† Cultivated only.

108.* Primulaceæ.

160. Anagallis, L.
222. arvensis, L. var. cœrulea, Lam. *Pimpernel, Poor man's weather glass.* N. temp. zone, Old World. III.66

109.* Myrsinaceæ.

161. Ardisia, Sw.
†*223.* solanacea, Roxb. *Balu-dan,* S. Trop. Asia cult. III.74

110. Sapotaceæ.

162. Achras, L.
†*224.* Sapota, L. *Sapodilla plum.* Trop. America.

113.* Oleaceæ.

163. Jasminum, L.
†*225.* Sambac, Ait. *Pichcha, Geta-pichcha,* S. *Arabian jasmine.* Trop. Asia. III.113
†*226.* pubescens, Willd. Trop. Asia. III.113
227. laurifolium, Roxb. N. E. India. III.114

164. Nyctanthes, L.
†*228.* arbor-tristis, L. *Sepala, Sepalika,* S. India. III.116

115.* Apocynaceæ.

165. Allamanda, L.
229. Cathartica, L. *Wal-ruk-attana,* S. Brazil. III.124

166. Landolphia, Beauv.
†*230.* Kirkii, Dyer. *African rubber.* Trop. Africa.

167. Vinca, L.
231. rosea, L. *Madagascar periwinkle.* Cosmop. trop. III.130
232. major, L. *Periwinkle.* Medit.

168. Plumeria, L.
†*233.* acutifolia, Poir. *Alariya,* S. *Temple tree.* III.130

169. Alstonia, R. Br.
234. macrophylla, Wall. Malaya.

† Cultivated only.

170. Tabernæmontana, L.
†*235.* Coronaria, Br. Origin unknown. III.133

171. Vallaris, Burm.
†*236.* Pergulana, Burm. Malaya. III.155

172. Nerium, L.
237. Oleander, L. *Oleander.* Medit. to Japan.

116.* Asclepiadaceæ.

173. Cryptostegia, R. Br.
238. grandiflora, Br. Trop. Africa. III.145

174. Gomphocarpus, R. Br.
239. fruticosus, R. Br. Africa.

175. Asclepias, L.
240. curassavica, L. *Wild ipecacuanha.* W. Indies. III.149

122.* Convolvulaceæ.

176. Argyreia, Lour.
241. speciosa, Sweet. *Maha-dumudu*, S. Bengal. III.207

177. Ipomæa, L.
242. cissoides, Griseb. Trop. America. III.212
243. Batatas, Lam. *Batala*, S. *Sweet potato.* Trop. America. III.212
†*244.* muricata, Jacq. India. III.214
245. tuberosa, L. W. Indies. III.224
246. sidæfolia, Choisy. Trop. America. III.220
247. coccinea, L. Trop. America. III.215
248. Quamoclit, L. *Rata-pamba*, S. Trop. America. III.215

178. Porana, Burm.
†*249.* paniculata, Roxb. India, Java. III.227

123. Solanaceæ.

179. Lycopersicum, Mill.
†*250.* esculentum, Mill. *Rata-batu*, S. *Takkali*, S. and T. *Tomato, Love apple.*

180. Solanum, L.
†*251.* tuberosum, L. *Potato.* S. America.
252. ciliatum, Lam. Brazil. III.234
†*253.* macranthum, Dun. *Potato tree.* Brazil.
†*254.* melongena, L. *Wambatu*, S. *Brinjal*, *Egg plant.* III.235

† Cultivated only.

181. Cyphomandra, Sendtn.
†*255.* betacea, Sendtn. *Tree tomato.* S. America.

182. Physalis, L.
256. angulata, L. Tropics generally. III.237
257. peruviana, L. *Cape gooseberry, Strawberry,* or *Gooseberry tomato.* Trop. America. III.237

183. Capsicum, L.
258. minimum, Roxb. *Nayi-miris. Bird pepper.* Tropics generally. III.238
†*259.* annuum, L. *Chilly, Red pepper.* Tropics generally.

184. Nicandra, Adans.
260. physaloides, Gærtn. Peru. III.238

185. Datura, L.
261. Stramonium, L. *Thorn apple.* Cosmopolitan. III.239
†*262.* suaveolens, H. & B. *Rata-attana,* S. *Trumpet flower.* Mexico. III.239

186. Cestrum, L.
†*263.* fasciculatum, Miers. Mexico.

187. Nicotiana, L.
†*264.* Tabacum, L. *Tobacco.* S. America.

188. Browallia, L.
265. viscosa, H. B. K. S. America.

189. Brunfelsia, L.
266. uniflora, D. Don. Origin unknown.

124.* Scrophulariaceæ.

190. Verbascum, L.
267. Thapsus, L. *Mullein.* Old World, N. temp. zone. III.241

191. Calceolaria, L.
268. chelidonioides, H. B. K. Mexico. III.241

192. Maurandia, Ort.
269. scandens, A. Gray. Mexico.

193. Stemodia, L.
270. parviflora, Ait. Trop. America. III.242

194. Scoparia, L.
271. dulcis, L. Trop. America. III.255

† Cultivated only.

195. Veronica, L.
272. didyma, Tenore. (polita, Fries.) *Speedwell.* N. temp. zone, Old World. III.255

128.* Gesneraceæ.

196. Rhynchoglossum, Bl.
273. zeylanicum, Hook. India. III.279

129.* Bignoniaceæ.

197. Millingtonia, L. f.
†*274.* hortensis, L. f. *Indian cork tree.* Burma. III.282

198. Spathodea, P. Br.
†*275.* campanulata, Beauv. Trop. Africa. III.282

199. Stereospermum, Cham.
†*276.* suaveolens, DC. *Palol, Ela-palol,* S. India. III.284

130.* Pedaliaceæ.

200. Martynia, L.
277. diandra, Glox. *Naka-tali,* T. *Tigers' claws.* Mexico. III.285

201. Sesamum, L.
278. occidentale, Heer & Regel. Origin unknown. III.286

131.* Acanthaceæ.

202. Thunbergia, L. f.
279. alata, Boj. Trop. Africa. III.289
280. laurifolia, Lindl. Malaya.

203. Barleria, L.
†*281.* cristata, L. India, Burma. III.321

134.* Verbenaceæ.

204. Lantana, L.
282. trifolia, L. Trop. America. III.346
283. aculeata, L. *Rata-hinguru, Gandapana,* S. *Lantana.* III.346

205. Stachytarpheta, Vahl.
†*284.* mutabilis, Vahl. Trop. America.

206. Verbena, L.
285. venosa, Gill & Hook. Brazil. III.349

† Cultivated only.

207. Duranta, L.
†*286.* Plumieri, Jacq. Trop. America.

208. Tectona, L. f.
†*287.* grandis, L. f. *Teak.* India, Burma.

209. Clerodendron, L.
288. Siphonanthus, Br. India. III.361

135.* Labiatæ.

210. Ocimum, L.
†*289.* basilicum, L. *Suvandu-tala*, S. *Sweet basil.* Trop. Asia. III.366

211. Plectranthus, L'Her.
†*290.* zeylanicus, Benth. *Iri-weriya*, S. Trop. Asia. III.371

212. Coleus, Lour.
†*291.* parviflorus, Benth. (Plectranthus tuberosus, Bl.) *Innala*, S. *Country potato.* India. III.374
292. aromaticus, Benth. *Kapuru-walliya*, S. India. III.374

213. Mentha, L.
293. sylvestris, L. var. crispa, Benth. *Mint.* Europe. III 381

214. Salvia, L.
294. coccinea, L. Trop. America.

136.* Plantaginaceæ.

215. Plantago, L.
295. lanceolata, L. *Plantain.* N. temp. Eur., Asia. III.389

INCOMPLETÆ.

137.* Nyctaginaceæ.

216. Mirabilis, L.
296. Jalapa, L. *Sendrikka*, S. *Marvel of Peru, False jalap.* Peru. III.391

217. Bougainvillæa, Comm.
297. spectabilis, Willd. Brazil.

† Cultivated only.

218. Pisonia, L.
298. morindæfolia, Br. *Lechchaikedda. Chandi.* T. *Lettuce tree.* (*Wata-banga-kola.*) Malaya, Polynesia, &c. III.392

139.* Amarantaceæ.

219. Amarantus, L.
299. caudatus, L. *Love-lies-bleeding.* Medit. to India. III.396
300. hypochondriacus, L. *Prince of Wales's feather.* N. America. III.396
301. paniculatus, L. (frumentaceus, Ham.) *Ranatampala*, S. N. America. III.396
†*302.* oleraceus. *Tampala*, S. Egypt, India.

220. Gomphrena, L.
†*303.* globosa, L. *Globe amaranth.* Tropical America.

140.* Chenopodiaceæ.

221. Chenopodium, L.
304. murale, L. Temp. zone. III.407
305. ambrosioides, L. *Wormseed.* Temp. and trop. III.407
306. opulifolium, Schrad. N. temp. zone. III.407

222. Beta, L.
†*307.* vulgaris, L. *Beetroot.* Europe.

141.* Phytolaccaceæ.

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† Cultivated only.

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† Cultivated only.

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† Cultivated only.

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†*354.* arundinacea, L. *Arrowroot.* S. America.

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† Cultivated only.
‡ This and Musaceæ are combined into Scitamineæ in the Flora proper.

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259. Ananas, Tourn.
355. sativus, Schult. *Annasi*, S. *Pineapple.* Trop. America.

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260. Crocosmia, Planch.
356. aurea, Planch. (Tritonia aurea, Pappe.) Trop. and S. Africa.

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†*358.* americana, L. *Century plant, American aloe.* Trop. America.

263. Furcrea, Vent.
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265. Phormium, Forst.
364. tenax, Forst. *New Zealand flax.* New Zealand.

266. Aloe, L.
365. vera, L. var. littoralis, Kœn. N. Africa. IV.211

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† Cultivated only.

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†*368.* Porrum, L. *Leek.* Europe.
†*369.* sativum, L. *Garlic.* Europe.

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375. indica, Schott. *Rata-ala, Desa-ala,* S. India, Malaya.

202.* Naiadaceæ.

275. Aponogeton, Thunb.
376. distachyum, Thunb. *Cape pond-weed.* S. Africa.

207. Gramineæ.

276. Zea, L.
†*377.* Mays, L. *Iringu,* S. *Maize, Indian corn.* Trop. America.

277. Saccharum, L.
†*378.* officinarum, L. *Sugar cane.* Tropical.

---

† Cultivated only.

278. Sorghum.
379. vulgare, Pers. *Karal-iringu*, T. *Cholam*, *Guinea corn*. *Millet*. Tropical and subtropical.

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†*387.* macrocarpa, Hartn. *Monterey cypress*. California.

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† Cultivated only.

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EDITED BY

J. C. WILLIS, Sc.D., F.L.S.

DIRECTOR.

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BY M. WILLIS.

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SINHALESE NAMES.

A number of prefixes, &c., occur constantly throughout this list, and the translations are given here for reference :—

Alu	ash	Katu	thorny
Amba	mango	Kiri	milk
Bata	reed	Kudu	dust
Bin	ground	Lunu	salt
Bu	woolly	Ma, Maha	large
Dada	ringworm	Mal	flower
Divi	tiger	Mediya	frog
Diya	water	Mudu	sea
Dodan	orange	Nil	blue, green
Dunu	bow	Panu	worm
Ela	pale	Peni	sweet
Et	great	Pini	dew
Eta	seed	Potu	bark
Gal	rock	Rana	golden
Gan	river	Rata	foreign
Gas	tree	Rat, ratu	red
Geta	joint	Sudu	white
Goda	land	Tel	oil
Gon	bullock	Titta	bitter
Hal	rice	Uru	pig
Hin	small	Wal	wild
Kaha	yellow	Wel	climber
Kalu	black	Weli	sand
Kara	rough	Yak	devil

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EDITED BY

J. C. WILLIS, Sc.D., F.L.S.

DIRECTOR.

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A Species of Polycarpæa new to Ceylon.

BY

J. C. WILLIS.

ON December 8, 1903, the Hon. Mr. J. P. Lewis, C.M.G., then Government Agent of Jaffna, forwarded to me a small piece of a plant which he had found upon one of the islands off the coast of Jaffna, in the straits between India and Ceylon.

On examination this turns out to be *Polycarpœa spicata* W. & A., which is new to Ceylon, though recorded from Tuticorin. It also occurs in Sindh, and in Egypt, Arabia, and North Australia.

This species must therefore be entered in the Flora List as No. 141A.

Note on certain Seedlings of Cymbopogon raised and examined by Mr. J. F. Jowitt.

BY

R. H. LOCK.

In October, 1908, Mr. Jowitt published in these Annals a note containing a criticism of Dr. Stapf's nomenclature of *Cymbopogon nardus* Rendle and *C. confertiflorus* Stapf. In this note exception was taken to the inclusion of the variety of citronella grass known locally as Maha-pengiri in the species *C. nardus*, and Mr. Jowitt brought forward strong evidence to show that this variety is more distinct from either *C. nardus* or *C. confertiflorus* than these two aggregations of types are from one another.

In the same note Mr. Jowitt put forward the suggestion that the variety Lena-batu-pengiri may be a hybrid between Maha-pengiri and one of the many wild varieties of mana grass included in *C. confertiflorus.* A full account of the characteristics of Maha-pengiri and Lena-batu is given in the note in question.

In order if possible to throw further light upon the nature of these varieties, Mr. Jowitt has at my suggestion raised and examined a number of seedling plants derived from two strains of Lena-batu-pengiri, which were grown on his experimental plots at Craig estate, Bandarawela, at an elevation of 4,500 feet. The seeds were sown on January 7, 1909, and the seedlings transplanted on October 21 in the same year. The accompanying table shows the result of Mr. Jowitt's examination of all the plants, which flowered before the close of 1910. These amounted to 31 out of a total of 56.

Mr. Jowitt writes that both Maha-pengiri and Lena-batu flower freely at the elevation of Craig. That Lena-batu ripens its seeds, sparsely however, is vouched for by the observations here recorded. Mr. Jowitt cannot affirm the same of Maha-pengiri, for owing to accidents and climatic conditions he has never succeeded in collecting the seed of this variety.

The behaviour of the seedling plants derived from Lena-batu-pengiri is fully consistent with the view that this plant is a hybrid between Maha-pengiri and *Cymbopogon confertiflorus*. In view of the fact that the pollination was uncontrolled, it is not necessary to lay much stress upon the numerical proportions of the characters observed in the supposed hybrid progeny (F2). The number of plants available (30) is also scarcely sufficient to afford a basis for quantitative conclusions. Nevertheless, the actual results are of considerable interest: and when the difficulty of distinguishing the several characters is borne in mind, together with the fact that these distinctions were drawn by an observer quite unbiased by any special theory of inheritance, it seems well worth while to place on record a succinct statement of the characteristics of these seedling plants.

The results are here summed up in language based upon the supposition that Lena-batu is an actual hybrid between Maha-pengiri and *Cymbopogon confertiflorus*. On this supposition the behaviour of the characters, presence, and absence of awns shows some approximation to that of a simple pair of Mendelian allelomorphs. Awns are present in *C. confertiflorus*. They are always absent in Maha-pengiri, but exceptionally present in Lena-batu. In accordance with the supposition that absence of awns is a dominant character, we find in F2, 5 awned plants to 23 awnless; whilst on 3 plants, both awned or slightly awned and awnless spikelets were found—a phenomenon which rarely, if ever, occurs in Lena-batu.

The proportion found renders it not unlikely that the majority of the flowers of Lena-batu from which these seedlings were derived were fertilized by their own pollen or by that of sister plants.

The mucronate character of Glumes II., III., and IV. also shows evidence of segregation. On the assumption already made, the mucronate character of Maha-pengiri is dominant over the non-mucronate character of *C. confertiflorus* in the case of all three glumes. Without further evidence one might have been inclined to hazard a guess that the character of all three glumes would prove to be influenced by a common factor. Out of 31 F2 plants, however, only 3 showed the complete mucronate character in all three glumes, whilst 3 plants were non-mucronate in all three glumes. The remaining plants showed various combinations of mucronate, non-mucronate, and intermediate glumes. The possibility presents itself that the ratio found—3 : 25 : 3—may represent an actual ratio of 1 : 14 : 1, such as would indicate the presence of two pairs of segregating characters.

The result is complicated by the fact that Glumes III. and IV. of the seedlings show a tendency to be less mucronate than Glume II.

Leaves erect or drooping :—

	Erect.	Half Erect.	Drooping.
No. 4 ..	7 ..	2 ..	3
No. 12 ..	8 ..	5 ..	3
Total ..	$\underbrace{15 \quad\quad 7}_{22}$		6

Leaves rough or smooth :—

	Rough.	Half Rough.	Smooth.
No. 4 ..	6 ..	2 ..	4
No. 12 ..	7 ..	5 ..	6
Total ..	$\underbrace{13 \quad\quad 7}_{20}$		10

Lena-batu has rough leaves intermediate in droop.

The two last-named characters exhibit a notable example of coupling :—

12 plants had rough erect leaves.
5 plants had smooth drooping leaves.
2 plants were classified by Mr. Jowitt as intermediate in both respects.
5 plants had leaves smooth and intermediate in droop.
3 plants had erect leaves of intermediate texture.
1 plant had drooping leaves of intermediate texture.

No plants were classified either with smooth erect leaves or rough drooping leaves.

Before the above point was noticed Mr. Jowitt had written: "The valuations of the vegetative characters were difficult, as the plants are crowded together ; this chiefly refers to erect or drooping." It is possible, therefore, to suppose that there is practically complete correlation between the character, roughness, and the erect habit of the leaves. The word "erect" in this case denotes that the leaf droops for less than one-third of its length, as opposed to a two-thirds droop, which is characteristic of Maha-pengiri.

So far nothing has been found which is obviously inconsistent with Mendelian theory. The remaining characters, however, show results which cannot easily be fitted into any existing Mendelian scheme. It is tentatively suggested that the former set of characters have more in common with what would commonly be called varietal characters; whilst the latter are more of the sort upon which specific differences are usually founded by systematists. In other words, the results so far as they go lend some support to the opinion of De Vries, as expressed in the "Mutationstheore," that specific and varietal characters are distinct in kind.

Thus, Glume I. is winged in *Cymbopogon confertiflorus*, wingless in Maha-pengiri, and usually wingless or intermediate in Lena-batu. The seedlings show :—

	Winged.	Intermediate.
No. 4 ..	8 ..	5
No. 12 ..	10 ..	9

No explanation of these figures in terms of Mendelian theory is apparent.

Glume II. is keeled in *C. confertiflorus*, not keeled in Maha-pengiri, slightly keeled in Lena-batu. Seedlings :—

	Keeled.	Slightly keeled.	Not keeled.
No. 4 ..	8 ..	5 ..	0
No. 12 ..	7 ..	9 ..	3

To suppose the keeled character dominant with intensification of this character in the second generation seems to exceed the legitimate use of hypothesis.

The spikelets are dissimilar in *C. confertiflorus*; in Maha-pengiri and Lena-batu they are similar. In the seedlings :—

	Similar.	Nearly.	Dissimilar.
No. 4 ..	1 ..	1 ..	8
No. 12 ..	3 ..	3 ..	13

Attention may be specially directed to the fact that in the case of the offspring of No. 4 there is the closest possible correlation or coupling between the presence of wings to Glume I., the presence of a keel to Glume II., and a want of similarity between the spikelets. In the case of the offspring of No. 12 this association, though not perfect, is still close.

In the opinion of the writer the facts above recorded go very far towards proving the hybrid nature of Lena-batu-pengiri.

Specimens of the seedlings described are preserved in Mr. Jowitt's collection of grasses deposited with the Secretary of the Ceylon Agricultural Society, Colombo.

In the following table, in which the characters of the seedlings dealt with are indicated, the symbol + represents the presence of a particular character, O its absence, whilst ⊕ denotes an intermediate state, or the presence of the character in a less marked degree. When two symbols are given, this indicates that both conditions were found on the same plant.

	Awned +, Awnless O.	Mucronate Character of Glume. II.	III.	IV.	Erect +, Drooping O.	Rough +, Smooth O.	Glume I. winged + or not.	Glume II. keeled or not.	Spikelets similar or not.
No. 4 D	O	⊕	⊕	O	+	+	+	+	O
E ..	+	O	O	O	+	+	+	+	O
F ..	O	+	+	O	—	—	⊕	⊕	+
H ..	O	⊕	⊕	O	+	+	+	+	O
I ..	O	+	+	+	O	O	⊕	⊕	⊕
O ..	+	⊕	O	O	+	+	+	+	O
P ..	O	+	+	+	O	O	⊕	⊕	⊕
S ..	O	⊕	⊕	O	⊕	⊕	+	+	O
U ..	O	+	+	⊕	O	O	⊕	⊕	⊕
W ..	⊕ O	+	O	O	⊕	O	+	+	O
X ..	O	+	+	O	+	⊕	⊕	⊕	⊕
1 ..	O	+	⊕	O	+	+	+	+	O
2 ..	+	O	O	O	+	+	+	+	O
No. 12 A ..	O	+	+	+	+	⊕	+	⊕	O
C ..	O	+	O	+	+	+	+	+	O
D ..	O	+	O +	+	⊕	O	+	+	O
E ..	O	+	+	⊕	+	+	⊕	O	O
G ..	+ O	+ O	O	O	O	⊕	+	+	O
I ..	O	+	⊕	⊕	+	⊕	⊕	O	+
J ..	O	+	⊕	+	⊕.	O	⊕	⊕	+
M ..	O	+	+	O	+	+	⊕	⊕	O
O ..	+	+	O	O	⊕	⊕	+	+	O
P ..	+	⊕	O	O	+	+	⊕	⊕	O
S ..	O	+	O	+	O	O	⊕	O	+
T ..	O	+	O	O	—	—	+	⊕	O
U ..	O	+	O	O	⊕	O	⊕	+	⊕
V ..	+ O	O	+	+	+	+	+	⊕	O
W ..	O	O	O	O	+	+	+	+	O
Y ..	O	+	⊕	+	—	+	+	⊕	⊕
1 ..	O	+	+	+	⊕	O	⊕	⊕	O
3 ..	O	+	⊕	⊕	O	O	⊕	⊕	⊕
Maha-pengiri	O	+	+	+	O	O	O	O	+
Lena-batu ..	O	+	+	+	+	+	⊕ O	⊕	+
C. nardus ..	O	O	O	O	+	+	+	+	O
C. confertiflorus	+	O	O	O	+	+	+	+	O

Corrections and Additions to Trimen's "Flora of Ceylon," 1893-1911.

BY

J. C. WILLIS

AND

A. M. SMITH,

Principal of the Essex County Laboratories ; late Scientific Assistant, Peradeniya.

AN interleaved copy of Trimen's Flora is kept at Peradeniya, and as each new specimen is added to the herbarium from a fresh locality, or as any error is discovered, note is made therein, and it is from these notes that we have made up the present Paper, which brings the Flora up to date.

The notes are arranged in the order of the Flora, references being made to the pages of that work.

A number of Additions and Corrections have already been given in Part V., page 383.

Practically the whole of the new localities and times of flowering given are supported by specimens in the Peradeniya herbarium. Dates of flowering are always additional to those given by Trimen.

Dr. Trimen left in the interleaved copy the following dedication :—

To the Memory of
my Predecessors at Peradeniya,

MOON,
GARDNER,
THWAITES,

I dedicate this Book, which owes so much to their labours.

HENRY TRIMEN.

Annals of the Royal Botanic Gardens, Peradeniya, Vol. V., Part III., Dec., 1911.
6(13)11

The following are among the most important, more or less systematic, Papers that have appeared in recent years bearing on the Ceylon Flora :—

Engler : Das Pflanzenreich (in progress).

Willis : A revision of the Podostemaceæ of India and Ceylon. Ann. Perad. I., 1902, p. 181.

Giesenhagen : Die Farngattung Niphobolus. Jena, 1901.

Willis : Studies in the Morphology and Ecology of the Podostemaceæ of Ceylon and India. Ann. Perad. I., 1902, p. 267.

Wright : The Genus Diospyros in Ceylon : its Morphology, Anatomy, and Taxonomy. Ann. Perad. II., 1904, pp. 1–133.

Svedelius : On the Life-history of Enalus acoroides. Ditto, 267.

Wright : Foliar Periodicity of Endemic and Indigenous Trees in Ceylon. Ann. Perad. II., 1905, p. 415.

Prain : The Dalbergias of S. E. Asia. Ann. R. B. G., Calcutta, X., 1904, p. 1.

Bargagli-Petrucci : Le specie di Pisonia della Regione dei monsoni. Lavori R. D. B. Firenze I., 1901, p. 73.

Pearson and Parkin : The Botany of Ceylon Patanas. Journal Linn. Soc. XXXIV., 1899, p. 300 ; XXXV., 1903, p. 430.

Lewis : A Descriptive Catalogue of the more useful Trees and Flowering Plants of the Western and Sabaragamuwa Provinces of Ceylon. Journal, R. A. S., Ceylon Branch, XVII., 1903, pp. 89.

Treub : L'Apogamie de l'Elatostema acuminatum. Ann. Jard. Buit., 2 V., p. 141.

Willis : The Flora of Ritigala : a Study in Endemism. Ann. Perad. III., 1906, p. 271.

Jowitt : Note on Apluda varia. Ann. Perad. IV., 1907, p. 85.

Willis : Hill Top Floras of Ceylon. Ann. Perad. IV., 1908, p. 131.

Jowitt : Note on Dr. Otto Stapf's Nomenclature of Cymbopogon Nardus. Ann. Perad. IV., 1908, p. 185.

Willis : A Revised Catalogue of the Flowering Plants and Ferns of Ceylon. Ann. Perad. IV., 1910, p. 467 *et seq.*

King : Anonaceæ of British India. Ann. R. B. G., Calcutta, IV., 1893.

Baker : Handbook of the Fern Allies.

Christensen : Index Filicum.

Stapf : Oil Grasses of India and Ceylon. Kew Bull., 1906, p. 297.

I.—Ranunculaceæ.

1. **Clematis.** *C. Gouriana* (Trimen I., p. 2). Upper leaflets sometimes entire ; leaflets often simply acute, not caudate, and not always unequal. Hakgala, 5,800 ft.

2. **Naravelia.** *N. zeylanica* (I.2). Petals cylindrical, fleshy. Flowers have a faint sweet musky odour.

5. **Ranunculus.** *R. sagittifolius* (I.4) ; *read* sagittæfolius. Ambawela !

R. Wallichianus (I.4). Craig, Bandarawela ! Fl. Jan., Mar., Oct.

II.—Dilleniaceæ.

1. **Delima.** *D. sarmentosa* (I.5). Puttalam, Gardner ; Kurunegala, Thwaites.

III.—Magnoliaceæ.

2. **Kadsura.** *K. Wightiana* (I.16). In description, line 5, *for* base, *read* ends.

IV.—Anonaceæ.

Add See King, Anonaceæ of British India (Annals R. Bot. Gdn., Calcutta, IV., 1894), and enter references under each species.

1. **Uvaria.** *U. zeylanica.* Karu-veppal, T. Madampe, Trimen.

2. **Cyathocalyyx.** *C. zeylanicus* (I.20). Line 2 on page 21, *for* green *read* pale yellow.

3. **Artabotrys.** *A. zeylanicus* (I.22). Bandarawela ! Passara !

5. **Polyalthia.** *P. longifolia* (I.24). Padivil Tank !

P. acuminata (I.25). Singhe Raja forest ! Fl. April !

P. Korinti (I.25). Summit of Ritigala!

7. **Xylopia.** *X. parvifolia* (I.28). Chidavintai, T. Mullaittivu!

8. **Goniothalamus.** *G. reticulatus* (I.31). Locality given by Trimen as Nillowe, but the specimen is marked by Thwaites "between Mininpittiya and Dellowe."

10. **Bocagea.** King does not keep this genus for any species, considering it entirely American. He restores Sageroea.

V.—Menispermaceæ.

1. **Tinospora.** *T. malabarica* (I.38). Var. β has the stem hairy. Anuradhapura!

3. **Coscinium.** *C. fenestratum* (I.41). P. 42 in brackets, *add* D. Hanbury in Pharm. Journ., 1851, p. 321.

4. **Tiliacora.** *T. racemosa* (I.42). Pelagama, Lagalla district! Atakalan korale!

5. **Limacia.** *L. cuspidata* (I.42). Hantane!

7. **Pachygone.** *P. ovata* (I.45). Haragama!

8. **Stephania.** The fl. sometimes have all the parts doubled in number.

S. hernandifolia (I.45). Hakgala, 5,500 ft.! Horton Plains, 7,000 ft.! Hewaheta! Bintenna!

9. **Cissampelos.** *C. Pareira* (I.46). Hakgala, 5,500 ft.! Fort Macdonald valley, 4,600 ft.!

10. **Cyclea.** *C. Burmanni* (I.47). See Dioscorea peltata Juss. in Pers. Syn. II., 621. Leaves sometimes rather hairy above, with ciliate margins, occasionally nearly glabrous below, only finely pubescent along the veins.

Summit of Ritigala! Haputale, 4,800 ft!

VIII.—Cruciferæ.

1. **Nasturtium.** *N. indicum* (I.52). Kalawewa!

2. **Cardamine.** *C. africana* (I.53). Naminakuli, 4,000 ft.!

C. subumbellata (I.53). Craig, Bandarawela!

IX.—Capparidaceæ.

On p. 55, line 3, *for* "no species occurs" *read* "Capparis Moonii extends into."

1. **Cleome.** *C. monophylla* (I.55). Badulla! Dambulla!

C. Chelidonii (I.56). Kalawewa, abundant!

5. Cadaba. *C. trifoliata* (I.59). Mayaladikkuruntu, T. Arippu!

C. indica (I.60). Analativu I.! Kokotaduwa appears to be Kokkotodavai, near Kokkelai lagoon.

6. Capparis. In Key, section 9, *for* supra-tomatose *read* rufous tomentose.

C. zeylanica (I.61). Fl. Feb.

C. Moonii (I.62). To 5,000 feet. Pundaluoya! Welimada! Fort Macdonald valley! Summit of Ritigala!

C. pedunculosa (I.63). Karunchurai, T. Var. β, at Nalande!

C. sepiaria (I.64). Var. β, at Lagalla!

C. horrida (I.64). See Paramignya monophylla, p. 224 (Sinh. name).

C. tener (I.65). Narangama, in Lagalla district! Bibile!

X.—Violaceæ.

1. Viola. *V. Patrinii* (I.66). Fl. bright violet, spur white; rarely produced, the plant being usually cleistogamic.

V. serpens (I.67). Naminakuli!

XI.—Bixaceæ.

P. 70, after Key *read* "one Scolopia and one Aberia."

1. Scolopia. *S. crassipes* (I.71). Hakgala! Naminakuli!

3. Flacourtia. *F. Ramontchi* (I.73). Kurumurukki, T. Colombo! Below Hakgala, 5,000 ft.!

6. Hydnocarpus. *H. alpina* (I.76). Lagalla district!

XII.—Pittosporaceæ.

1. Pittosporum. *P. tetraspermum* (I.78). Naminakuli!

P. zeylanicum (I.78). Bandarawela!

XIII.—Polygalaceæ.

Polygala. *P. arillata* (I.79). Horton Plains! Naminakuli!

P. glaucoides (I.80). Var. γ *cf. P. hypoglauca* Hassk.

P. chinensis (I.81). Palagama, Lagalla district!

P. rosmarinifolia (I.82). Found at 5,600 ft. Pearson.

P. telephioides (I.82). Bintenne! Found at 3,500, 3,800, 4,400 ft. Pearson.

2. Salomonia. *S. oblongifolia* (I.83). Nilgala! Wellassa!

XIV.—CAROPHYLLACEÆ.

3. **Drymaria.** *D. cordata* (I.87). *Read* An annual, with many erect or procumbent branches. Sepals 3-nerved, the central nerve strongest, and glandular-pilose. Haputale, 4,800 ft.! Said to be purgative to cattle and disliked by them.

5. **Polycarpæa.** *P. corymbosa* (I.88). Fort Macdonald valley, opposite Hakgala, 4,800 ft.! Elephant Plains!

XV.—PORTULACACEÆ.

1. **Portulaca.** *P. tuberosa* (I.90). Elephant Pass!

XVI.—TAMARISCINEÆ.

1. **Tamarix.** *T. gallica* (I.91). Umbiri, S. Kirai, Tim, T. Mannar! Elephant Pass! Negombo!

XIX.—GUTTIERÆ.

Line 9, after *Calophyllum* read *trapezifolium*.

1. **Garcinia.** *G. Morella* (I.96). Localities, *for* 2,000 *read* 4,000 ft. Maskeliya! Bandarawela! Flrs. also in March.

G. terpnophylla (I.97). Avisawella!

2. **Calophyllum.** *C. spectabile* (I.99). Mapatkina, S.

C. Walkeri (I.104). Naminakuli!

XX.—TERNSTRŒMIACEÆ.

3. **Eurya.** *E. acuminata* (I.110). 3,800 ft. Pearson.

XXI.—DIPTEROCARPACEÆ.

2. **Shorea.** *S. lissophylla* (I.117). Fruit almost wingless. Commonest Dipterocarp on banks of Bentota river. Also called Yakahalu in Southern Province.

3. **Doona.** *D. cordifolia* (I.122). Pasdun korale.

D. ovalifolia (I.123). Seeds eaten after boiling.

6. **Vatica.** *V. obscura* (I.129). Line 4, *for* "paler beneath," &c., *read* "veinlets minutely reticulate, pellucid, with free dilated ends," petiole, &c. Fl. sweet scented.

XXII.—MALVACEÆ.

1. **Sida.** *S. humilis* (I.141). Palampasi, T.

S. mysorensis (I.142). Fort Macdonald valley, 4,800 ft.

S. rhombifolia (I.143). Extends into upper montane zone.

2. **Abutilon.** The Key is unsatisfactory: new one proposed.

Carpels usually 15 or more.	
Fl. 2 in. diameter.	
Leaves hairy above	1. A. asiaticum.
Leaves densely velvety above	2. A. muticum.
Fl. $1\frac{1}{4}$ in., stems hairy	4. A. graveolens.
Fl. 1 in., stems nearly glabrous	3. A. indicum.
Carpels about 12; fl. $\frac{1}{2}$ in.	5. A. crispum.

A. graveolens (I.145). Maturata! Fl. Oct. Scented at Anuradhapura.

3. **Wissadula.** *W. zeylanica* (I.146). Nuwara Eliya, Gardner (perhaps an error); Maturata, Thwaites!

6. **Julostylis.** *J. angustifolia* (I.150). Avisawella!

8. **Hibiscus.** *H. collinus* (I.152). Parutti, T.

H. panduræformis (I.154). Tissamaharama! Fl. Feb.

H. ficulneus (I.155). Tissamaharama! Mannar!

H. angulosus (I.156). Nuwara Eliya!

10. **Bombax.** *B. malabaricum* (I.160). Kadduparutti, T. Looks wild on Upper Uva patanas, quite 3,500 ft.

12. **Cullenia.** *C. excelsa* (I.162). Called Badulla in the W. and S. Provs. (Broun).

XXIII.—Sterculiaceæ.

4. **Pterospermum.** *P. suberifolium* (I.169). Hantana! Hanguranketa!

5. **Pentapetes.** *P. phœnicea* (I.169). Tissamaharama!

7. **Waltheria.** *W. indica* (I.171). In description, *after* clusters (line 6) *read* "on long or short peduncles." Fl. May.

XXIV.—Tiliaceæ.

After Key, *read* "With the exception of Elæocarpus and Triumfetta all," &c.

1. **Pityranthe.** *P. verrucosa* (I.172). Minneriya! Bibile!

3. **Grewia.** *G. tiliæfolia* (I.175). Ramboda! Teldeniya!

G. orientalis (I.176). Pundaluoya, apparently quite wild, 4,400 ft.!

G. polygama (I.177). Uma-oya!

G. populifolia (I.178). Chilaw!

4. **Triumfetta.** *T. pilosa* (I.179). Opposite Hakgala, on patana, 5,300 ft.! Hakgala! Haputale!

T. rhomboidea (I.179). At 3,800 ft. Pearson.

6. **Elæocarpus.** *E. obovatus* (I.186). Horton Plains! Fl. May.

E. zeylanicus (I.187). Sepals finely pilose, not glabrous.

E. glandulifer (I.187). Naminakuli!

XXV.—LINACEÆ.

1. **Linum.** *L. mysorense* (I.188). Craig, Bandarawela!

2. **Hugonia.** *H. Mystax* (I.189). Elephant Pass!

3. **Erythroxylon.** *Cf.* Schumann in das Pflanzenreich. He makes a new sp. *E. zeylanicum*. C. P. 222. Wahakotta (Deschamps 65 Herb. Delessert). Bata-kirilla. Fl. Aug. Near E. acuminatum, but distinguished by leaves truncated at base.

E. obtusifolia (I.192). Pasdun korale!

XXVI.—MALPIGHIACEÆ.

1. **Hiptage.** *H. Madablota* (I.193). Welimada, 3,800 ft.! Fort Macdonald valley, 4,600 ft.!

XXVIII.—GERANIACEÆ.

3. **Biophytum.** *B. sensitivum* (I.197). Hantane! Lunugala!

4. **Impatiens.** *I. acaulis* (I.201). Pitaratmale, near Haputale, 5,000 ft.!

I. macrophylla (I.204). Horton Plains! Hakgala! Adam's Peak! Nuwara Eliya! Fl. Jan.–Apr., Oct.

I. Hookeriana (I.208). Pitaratmale, near Haputale! Teldeniya! Madulkelle!

I. subcordata (I.208). Hakgala! Fl. Apr.

I. elongata (I.210). Line *after* "peduncles" *read* "of inflorescence." Adam's Peak to 6,500 ft.! Fl. Feb.–Mar.

XXIX. RUTACEÆ.

1. **Euodia.** Leaves compound.

E. Roxburghiana (I.214). Fl. Mar., Sept., Oct.

2. **Zanthoxylum.** Leaves compound.

Z. tetraspermum (I.215). Deltota road, below 2,000 ft.!

3. **Toddalia.** *T. aculeata* (I.215). Summit of Naminakuli, 6,600 ft.!

4. **Acronychia.** *A. laurifolia* (I.216). Sita Eliya, 5,800 ft.! Hakgala! Summit of Naminakuli, 6,600 ft.! Fl. Feb.–Apr., Oct.

5. **Glycosmis.** *G. pentaphylla* (I.217). Dimbula! Summit of Ritigala!

6. **Micromelum.** *M. pubescens* (I.218). Bandarawela, 4,000 ft.!

7. **Murraya.** *M. exotica* (I.219). Hakgala, 5,800 ft.! Fl. Mar.–June, Sept., Oct.

8. **Clausena.** *C. indica* (I.221). Watagoda! Hantane! Deltota! All in lower montane zone.

C. Willdenovii (I.222). Also found in India and Malaya.

12. **Atalantia.** *A. Missionis* (I.227). Perumkuruntu, T.

Citrus Hystrix (I.228). *Add* "It is not eaten, but only used as an insecticide."

XXXI.—Ochnaceæ.

2. **Gomphia.** *G. angustifolia* (I.235). Jungle below Hakgala, 4,800 ft.!

XXXII.—Burseraceæ.

3. **Filicium.** *F. decipiens* (I.240). Chittiraivempu, T.

XXXIII.—Meliaceæ.

1. **Munronia.** *M. pumila* (I.242). Sides of Ritigala! Wellawaya! Fl. Mar.

4. **Cipadessa.** *C. fruticosa.* Common to 4,500 ft.; 4,000 ft. Pearson. Diyatalawa! Fort Macdonald valley! Fl. Jan.–May.

XXXV.—Olacineæ.

2. **Olax.** *O. zeylanica* (I.257). Top of Ritigala!

3. **Strombosia.** *S. zeylanica* (I.257). Fig. in Icones Bogorienses I. 2, 137. Henaratgoda!

9. **Mappia.** *M. ovata* (I.262). Fl. Mar.

10. **Pyrenacantha.** *P. volubilis.* Lagalla, in intermediate region!

XXXVI.—Ilicineæ.

1. **Ilex.** *I. Wightiana* (I.265). Avisawella!

XXXVII.—Celastraceæ.

1. **Euonymus.** *E. revolutus* (I.267). Leaves sometimes loosely serrated. Hakgala! Summit of Naminakuli! Fl. Apr.

E. Walkerii (I.267). To 6,000 ft. Hakgala! Maturata! Fl. Oct.

3. **Microtropis.** *M. Wallichiana* (I.269). Madulkelle! Craig, Bandarawela, 5,000 ft.!

M. ramiflora (I.269). Summit of Naminakuli! Fl. May.

5. **Pleurostylia.** *P. Wightii* (I.271). Below Hakgala, 5,000 ft.!

6. **Elæodendron.** *E. glaucum* (I.271). Var. β, Dimbula, nearly 5,000 ft. Thwaites!

8. **Gymnosporia.** *G. emarginata* (I.273). Leaves sometimes slightly crenate. Mannar! Patana below Hakgala, 5,000 ft.!

11. **Salacia.** *S. reticulata* (I.277). Summit of Ritigala! Patanas at 4,000 ft. Pearson.

XXXVIII.—Rhamnaceæ.

2. **Zizyphus.** *Z. Œnoplia* (I.280). Used for hedging.

Z. Xylopyra (I.282). Elephant Pass! Fl. Sept.

3. **Rhamnus.** *R. Arnottianus* (I.283). Fl. Apr.

R. Wightii (I.283). Leaves sometimes entire. Fl. Mar.–Apr.

4. **Scutia.** *S. indica* (I.284). Tudari, T. Near Wilson's Bungalow, 4,000 ft.!

5. **Sageretia.** *S. costata* (I.284). Fl. Apr., May.

XXXIX.—Ampelideæ.

1. **Vitis.** In Key, *for* "2 V. erioclada" *read* "V. indica."

V. Gardneri (I.293). Ascent Adam's Peak from Maskeliya! High Forest, Maturata! Yelumalai, Naminakuli! Fl. Sept.–May.

V. pedata (I.295). Summit of Ritigala!

V. tenuifolia (I.295). Below Hakgala, 4,800 ft.!

V. lanceolaria (I.296). Haputale! Fl. May.

XL.—Sapindaceæ.

3. **Allophylus.** Floral parts often in 5's.

A. zeylanicus (I.302). Type at Hakgala, 5,500 ft.!

6. **Sapindus.** *S. Thwaitesii* (I.308). Fruit usually of a single carpel (the two abortive ones like warts on its base), about 8 in., ovoid, blunt, densely puberulous, pale ochre-yellow, pericarp thin, tough, seed enveloped in thin fleshy aril (Trimen).

8. **Pometia.** *P. eximia.* Called Na-imbul, S., in Sabaragamuwa. April sweet, but hardly worth eating.

9. **Harpullia.** *H. imbricata* (I.311). Tangalla!

10. **Dodonæa.** *D. viscosa* (I.312). Patanas in Fort Macdonald valley, 5,000 ft.!

11. **Turpinia.** *T. pomifera* (I.313). Kukuruman, S. Var. β, below Bandarawela, 3,700 ft.! Below Hakgala! Fl. Mar.–May.

XLI.—Sabiaceæ.

1. **Meliosma.** *M. simplicifolia* (I.315). Bandarawela, 3,800 ft.!

M. Arnottiana (I.315). Fl. May.

XLII.—Anacardiaceæ.

4. **Semecarpus.** *S. nigro-viridis* (I.323). To 6,000 ft. Nuwara Eliya! Haputale! Dimbula! Maskeliya!

XLIII.—Connaraceæ.

2. **Connarus.** *C. monocarpus* (II.2). Balangoda!

XLIV.—Leguminosæ.

3. **Crotalaria.** *C. ferruginea* (II.10). Patana, Fort Macdonald valley, 4,700 ft.! Patana, Hakgala, 5,500 ft.!

C. albida (II.12). Fl. Oct.

C. nana (II.13). 5,800 ft. Pearson.

C. retusa (II.15). Patana, Bandarawela, 4,000 ft.!

C. verrucosa (II.15). 5,600 ft. Pearson.

C. medicaginea (II.18). Var. β, patana in Fort Macdonald valley, 4,500 ft.!

5. **Indigofera.** *I. aspalathoides* (II.23). Much used for manuring in Jaffna District. Also known as Mantu in Tamil, and supposed to be specially good for manuring cassava (J. P. Lewis).

6. **Psoralea.** *P. corylifolia* (II.28). Kavothi. T. Used as manure in Delft Island. It is in great demand by the people of Mullaittivu as manure for tobacco. a boat load fetching as much as Rs. 40, but it is not used for this purpose by the people of the peninsula. It is known in Delft as Kovoti. Also in great demand by the people of Analativu I. (J. P. Lewis).

7. **Mundulea.** *M. suberosa* (II.29). All over a rocky hill called Eropotana in the Vavuniya district, where there are also some ruined temples, which, however, have probably not been in use for about 2,000 years.

8. **Tephrosia.** *T. purpurea* (II.31). Kairlai, T. Var. β, *pumila* Baker (*T. pumila* Pers.). Between Nalanda and Dambulla, 1896 (Trimen). Largely used in Jaffna as a manure for tobacco, a moderate sized bundle selling for 25 cents; also used as a manure in paddy fields (Capt. Walker). Thought more of as a manure for tobacco gardens than any other, a cartload being worth from Rs. 15 to Rs. 20 (J. P. Lewis).

10. **Zornia.** *Z. diphylla* (II.35). Var. γ at Haputale, 4,800 ft.! Craig, Bandarawela, 5,000 ft.!

20. **Desmodium.** *D. Wightii* (II. 52). Summit of Ritigala!

D. heterocarpum (II.53). Var. β, Albion, near Hakgala. Hakgala, 5,500 ft.!

D. heterophyllum (II.55). Wet places on patanas, Fort Macdonald valley, 4,500 ft.!

D. parvifolium (II.55). Fl. Mar.

D. gyroides (II.56). Fl. Oct.

22. **Shuteria.** *S. vestita* (II.58). Hakgala! Fl. Oct.

27. **Erythrina.** *E. ovalifolia* (II.64). Standard 2 in. rotundate-spathulate, recurved, wings ¾ in.; keel petals 1 in. obtuse.

33. **Phaseolus.** *P. adenanthus* (II.70). 5,800 ft. Pearson.

P. trinervius (II.72). Patana, Hakgala, 5,800 ft.! 5,600 ft. Pearson.

P. calcaratus (II.73). 5,600 ft. Pearson.

36. **Dolichos.** *D. Lablab* (II.76). Jungle, Craig, Bandarawela, 5,000 ft.! Fl. Mar.

37. **Atylosia.** Style not bearded (cf. general Key).

40. **Rhynchosia.** *R. cana* (II.83). Pasdun korale!

42. Dalbergia. *D. Championii* becomes *D. rostrata* Grah. in Wall. Cat. 5,867 (1832) in Prain's Monograph, Ann. R. B. G., Calcutta, X., p. 60. Jungle on way to Fort Macdonald, Hakgala, 4,600 ft.! Haputale, 4,500 ft.! Summit of Ritigala!

D. monosperma (II.89) becomes *D. torta* Grah. in Wall Cat. 5,873 (1832) in Prain l. c.

46. Sophora. *S. zeylanica* (II.96). Below Hakgala!

48. Cæsalpinia. *C. Bonduc* (II.98). Opposite Hakgala, 5,500 ft.!

C. sepiaria (II.100). Var. β, Diyatalawa camp!

51. Cassia. *C. Kleinii* (II.110). 3,800 ft. Pearson. Patana, Fort Macdonald valley, 4,800 ft. !

C. mimosoides (II.110). 5,800 ft. Pearson. Hakgala, 5,500 ft.! Craig, Bandarawela. 5,000 ft.! Fl. Sept.

25. Cynometra. *C. ramiflora* (II.111). Note by Trimen: "This description is taken from the Nilgala trees, which I strongly suspect ought not to be referred to *C. ramiflora* (cf. p. 113)." Under var. β he remarks, "this is doubtless *C. ramiflora*." In localities *after* Uva *add* "*i.e.*, forest between Nilgala and Kumbukkan-aar."

62. Acacia. *A. arabica* (II.122). Single tree midway between Kekirawa and Dambulla; single tree at Madatugama; single tree below Yodi-ela bund at Sangattewa.

A. Sundra (II.125). Fairly abundant near Pomparippu! Iranaimadu! Hambantota!

A. ferruginea (II.126). Ballala!

64. Pithecolobium. *P. subcoriaceum* (II.133). Fl. April.

XLV.—Rosaceæ.

1. Pygeum. *P. zeylanicum* (II.135). Watagoda!

2. Rubus. *R. lasiocarpus* (II.138). Summit of Naminakuli!

3. Potentilla. *P. Mooniana* (II.139). Dimbula! Fl. May.

4. Alchemilla. *A. indica* (II.140). Fl. Mar., Oct.

6. Agrimonia. *A. zeylanica* (II.141). Fl. October.

7. Photinia. *P. Notoniana* (II.142). Pidurutalagala, Hakgala, Horton Plains, Nuwara Eliya, summit of Naminakuli, Ramboda, Ambegamuwa (the last two in lower montane zone)! Fl. May.

XLVI.—Saxifragaceæ.

1. **Vahlia.** *V. oldenlandioides* (II.143). Pallai!

XLIX.—Halorageæ.

Cf. Schindler in Das Pflanzenreich, for species—splitting.

1. **Serpicula.** *S. hirsuta* (II.148). Summit of Naminakuli!

L.—Rhizophoraceæ.

5. **Weihea.** *W. zeylanica* (II.156). Summit of Ritigala! Fl. Mar.

LI.—Combretaceæ.

1. **Terminalia.** *T. belerica* (II.159). Common in the Uva park country. Used with *T. chebula* in a decoction as black dye for mats, afterwards oxidized in black pond mud containing iron.

T. chebula (II.159). Watagoda (over 2,500 ft.)!

T. parviflora (II.160). Common in W. Prov. and Sabaragamuwa.

4. **Combretum.** *C. extensum* (II.164). Nalanda (a var. with lax racemes).

5. **Gyrocarpus.** *G. Jacquini* (II.165). Thinakku, T. Delft Island.

LII.—Myrtaceæ.

1. **Rhodomyrtus.** *R. tomentosa* (II.166). Summit of Naminakuli!

2. **Eugenia.** In Key, move 42 *E. Mooniana* to after 39, *E. aprica*, and mark "leaves petiolate, oval, thin."

E. spicata (II.171). Summit of Ritigala!

E. revoluta (II.175). Naminakuli: cymes longer than leaves.

E. Neesiana (II.177). Watagoda, Thwaites!

E. rotundifolia (II.177). Summit of Naminakuli!

E. olivifolia (II.178). Fl. May.

E. mabæoides (II.186). Fl. Mar.

LIII.—Melastomaceæ.

1. **Osbeckia.** *O. Walkeri* (II.196). Summit of Pidurutalagala!

O. buxifolia (II.197). Nuwara Eliya ! Hakgala ! Var. β, Horton Plains !

O. rubicunda (II.197). Summit of Naminakuli ! Fl. Sept.

3. **Kendrickia.** *K. Walkeri* (II.200). High Forest. Maturata, 5,500 ft. ! Hakgala, 5,200 ft. !

4. **Sonerila.** Some specimens of *S. zeylanica* var. *affinis* are quite hairy beneath the leaves ; some of *S. rhombifolia* show leaves distinctly 5-nerved and unequal at base ; some of *S. Arnottiana* have leaves nearly glabrous below.

S. Arnottiana (II.204). Ohiya ! Fl. May.

S. lanceolata (II.206). Singhe Raja forest !

S. pilosula (II.207). Meddakanda, Balangoda ! Fl. Sept.

6. **Memecylon.** *M. macrophyllum* (II.214). Pasdun korale.

M. umbellatum (II.216). The leaves of this plant are used in a decoction with sappan to make a red dye for mats. They have no red colour and are probably the mordant.

LIV.—Lythraceæ.

1. **Ammannia.** *A. pentandra* (II.224). Bandarawela, 4,000 ft. !

A. octandra (II.225). Doluwa Kande !

LV.—Onagraceæ.

1. **Jussiæa.** *J. suffruticosa* (II.233). Maturata at 5,500 ft. ! Bandarawela at 4,000 ft. !

LVI.—Samydaceæ.

1. **Casearia.** *C. esculenta* (II.237). Dimbula ! Haputale !

C. coriacea (II.237). Hakgala, 5,500 ft. ! Horton Plains ! Summit of Naminakuli ! Fl. May.

3. **Homalium.** *H. zeylanicum* (II.239). Haputale, 4,800 ft. !

LVIII.—Cucurbitaceæ.

1. **Trichosanthes.** *T. nervifolia* (II.244). Dimbula !

2. **Gymnopetalum.** *G. Wightii* (II.246). Dimbula !

3. **Cephalandra.** *C. indica* (II.247). Summit of Ritigala !

8. **Bryonia.** *B. laciniosa* (II. 254). The fruit becomes a dull red when ripe, but the white vertical stripes remain. *After* "Hermann's Herb." *read* "except under B. palmata (see Modecca)."

9. **Mukia.** *M. leiosperma* (II.255). Patana in Fort Macdonald valley, 4,800 ft. !

10. **Zehneria.** *Z. Hookeriana* (II.256). High Forest, Maturata, 5,600 ft. !

16. **Gynostemma.** *G. laxa* (II.260). Fl. Mar.–Apr.

LXI.—CACTACEÆ.

1. **Rhipsalis.** *R. Cassytha* (II.266). A specimen with hairy areolæ found on rocks at Hakinda (near Peradeniya), growing erect. 5,600 ft. Pearson. Hakgala, 5,400 ft. ! Ritigala summit !

LXII.—FICOIDEÆ.

1. **Sesuvium.** *S. Portulacastrum* (II.268). Jaffna !

LXIII.—UMBELLIFERÆ.

1. **Hydrocotyle.** *H. javanica* (II.275). Summit of Naminakuli !

H. rotundifolia (II.275). Craig, Bandarawela !

3. **Bupleurum.** *B. virgatum* (II.277). Horton Plains. Fl. Jan.

5. **Pimpinella.** *P. Leschenaultii* (II.279). Fl. May.

LXIV.—ARALIACEÆ.

2. **Heptapleurum.** *H. racemosum* (II.283). Patana, Fort Macdonald valley ! Fl. Mar., Sept.

H. stellatum (II.283). Nuwara Eliya, Gardner ! Ritigala summit !

H. exaltatum (II. 284). High Forest, Maturata !

LXVI.—CAPRIFOLIACEÆ.

1. **Viburnum.** *V. coriaceum* (II.288). High Forest, Maturata ! Mahagastota !

LXVII.—RUBIACEÆ.

4. **Stephegyne.** *S. tubulosa* (II.295). Var. β, Kurunegala, Topawewa, Gardner !

6. **Uncaria.** *U. dasyoneura* (II.296). Nilambe !

9. **Neurocalyx.** *N. Wightii* (II.299). Eratne !

10. **Allæophania.** *A. decipiens* (II.301). Summit of Naminakuli !

12. Hedyotis. *H. fruticosa* (II.304). Adam's Peak! Watagoda! Hatton, 4,000 ft.! Summit of Ritigala! Fl. Mar., May.

H. coprosmoides (II.306). Fl. May.

H. nodulosa (II.307). Summit of Naminakuli!

H. Lawsoniæ (II.310). Summit of Naminakuli! Fl. Jan., May.

H. verticillaris (II.311). Fl. Jan., Mar.

H. nitida (II.312). Below Hakgala, 4,800 ft.! And in Malaya.

13. Oldenlandia. *O. corymbosa* (II.314). Haputale!

In small print, *for* "some species" *read* "some specimens."

O. diffusa (II.315). Ella, Uva!

O. herbacea (II.318). Maturata, 5,500 ft.! Hakgala, 5,000 ft.!

O. stricta (II.316). *For* "? Linn. f." *read* "non Linn. f. His plant is Peplidium humifusum."

14. Anotis. *A. nummularia* (II.318). Fl. Jan., Mar., May.

15. Ophiorrhiza. *O. Mungos* (II.320). Ritigala!

O. Harrisiana (II.321). Below Hakgala! Fl. Apr.

O. pectinata (II.322). Adam's Peak, 5,000 ft.! Hakgala, 5,500 ft.!

16. Mussaenda. *M. frondosa* (II.323). At 86 m. from Badulla on Batticaloa road! Diyatalawa, 4,000 ft.! Fort Macdonald valley, 4,500 ft.! Below Hakgala, 5,000 ft.! Albion estate, Hakgala, 5,300 ft.!

18. Leucocodon. *L. reticulatum* (II.325). Bogawantalawa!

19. Urophyllum. *U. zeylanicum* (II.326). Summit of Naminakuli!

21. Webera. *W. corymbosa* (II.328). Sticks much used for staking yams.

23. Randia. *R. uliginosa* (II.330). Bibile!

R. malabarica (II.331). Below Hakgala, 4,800 ft.! Ella, 3,000 ft.!

24. Gardenia. *G. coronaria* (II.333). Eastern boundary of Province of Uva. The Sinhalese call it Kollalakada, and think highly of it as a cure for bruises and such-like wounds. The leaf bruised and the flowers have a strong aromatic smell, and the young leaves and their buds make a viscous slimy mass like bird-lime when squeezed up (G. A. Baumgartner).

27. **Diplospora.** *D. Dalzellii* (II.336). Matale!

32. **Knoxia.** *K. mollis* (II.340). Fl. Feb., Mar.

K. platycarpa (II.341). Kiribatgas, S. (A. K. Coomaraswamy). Vars. *hirsuta* and *foliosa*. Summit of Naminakuli!

33. **Canthium.** *C. puberulum* (II.344). Dambulla! Fl. Nov.

C. parviflorum (II.346). Patana, Fort Macdonald valley, 4,700 ft.!

34. **Ixora.** *I. calycina* (II.347). Fl. May.

I. parviflora (II.348). Kanmuttan Kirrai, Kiriai, T.

I. coccinea (II.348). Summit of Ritigala!

35. **Pavetta.** *P. indica* (II.349). Summit of Ritigala! Var. β, below Hakgala, 5,000 ft.! Haputale, 4,900 ft.!

P. hispidula (II.350). Diyatalawa camp, 3,900 ft.!

P. involucrata (II.351). Pattipola! Fl. May.

37. **Morinda.** *M. tinctoria* (II.354). Wood said to be used for sandals.

M. umbellata (II.355). Dimbula! Summit of Rangala! Hakgala! Pattipola! High Forest, Maturata! Mahagastota, 6,200 ft.! Summit of Ritigala!

39. **Psychotria.** *P. Gardneri* (II.358). Hakgala, 5,500 ft. Below Bandarawela, 4,000 ft.! Fl. Feb., Mar.

P. bisulcata (II.362). Summit of Naminakuli! Fl. Feb.

40. **Chasalia.** *C. curviflora* (II.362). Summit of Ritigala!

41. **Geophila.** *G. reniformis* (II.363). Foot of Ritigala, abundant!

42. **Lasianthus.** *L. Walkerianus* (II.365). Hakgala, 5,700, 5,800 ft.! Fl. May.

L. Gardneri (II.366). Sita Eliya!

L. varians (II.368). Summit of Naminakuli!

L. oliganthus (II.366). Below Hakgala, 5,000 ft.! Fl. May.

L. strigosus (II.367). Ritigala!

43. **Saprosma.** *S. indicum* (II.368). Karawita (Trimen)!

45. **Spermacoce.** *S. ocymoides* (II.371). Kekirawa!

LXIX.—DIPSACACEÆ.

1. **Dipsacus.** *D. Walkeri* (III.2). Sita Eliya! Hakgala! Ambawela! Fl. Mar., Oct.

LXX.—Compositæ.

At end of Key (20 Xanthium), *after* "heads unisexual" *read* "male fl. tubular."

1. Vernonia. In the Key, *V. Thwaitesii* has a 10-ribbed achene; it must read—

Achenes terete or 4-5-ribbed.
  Bracts acute or mucronate 1. *V. Gardneri.*
  Bracts obtuse rounded 12. *V. pectiniformis.*
Achenes 10-ribbed.
  Semi-shrubby, heads clustered in groups of 3, 5, or more with very short stalks, bracts in many rows of different lengths, with "spine" at tip 7. *V. scariosa.*
  Annual, heads many, in loose panicles, larger, bracts all of same length without "spine" 8. *V. anthelmintica.*
  Perennial, heads few on long stalks, leaves more or less crowded at base, bracts of several lengths, with "spine" 2. *V. Thwaitesii.*

V. setigera (III.7). Ambawela! Horton Plains! Hakgala!

V. Hookeriana (III.8). Summit of Ritigala!

V. scariosa (III.8). Hakgala!

V. Wightiana (III.10). Naminakuli! 2,500 ft.; 3,800 ft. Pearson.

V. zeylanica (III.10). Hin-botiya, S.

V. pectiniformis (III.11). Bracts sometimes mucronate.

V. arborea (III.11). Horton Plains, 6,800 ft.!

3. Adenostemma. *A. viscosum* (III.13). Summit of Ritigala!

7. Lagenophora. *L. Billardieri* (III.16). Fl. Mar.

9. Microglossa. *M. zeylanica* (III.17). Pupula, S.

11. Blumea. *B. flexuosa* (III.20). 2,500 ft.; 3,800 ft. Pearson.

16. Anaphalis. *A. cinnamomea* (III.28). Summit of Naminakuli! Fl. Jan.

A. oblonga (III.30). 2,500 ft. Pearson. Summit of Naminakuli! Fl. Feb., Mar.

A. brevifolia (III.31). Fl. Jan., Feb.

17. Helichrysum. *H. buddleoides* (III.32). Fl. Apr., May.

18. **Vicoa.** *V. auriculata* (III.33). To 5,000 ft. in Fort Macdonald valley!

19. **Chrysogonum.** *C. heterophyllum* (III. 34). Summit of Naminakuli!

30. **Gynura.** *G. lycopersicifolia* (III.43). Summit of Ritigala!

31. **Emilia.** The two species run very much into one another when a lot of specimens are examined.

E. zeylanica (III.46). Var. β, Naminakuli!

33. **Senecio.** *S. gracilis* (III.48). Fl. Feb., Mar.

S. ludens (III.49). Fl. Apr., May.

S. Walkeri (III.49). Summit of Naminakuli.

S. scandens (III.50). Below Hakgala, 4,800 ft.! Fl. Mar.

34. **Crepis.** *C. fuscipappa* (III.51). Fl. Jan., Feb., Mar.

LXXIII.—Campanulaceæ.

1. **Lobelia.** *L. trigona* (III.56). Fl. Jan., Mar., May.

L. nicotianæfolia (III.57). A plant seen at Nawalapitiya, 2,000 ft.! Summit of Naminakuli (and var. trichandra)!

LXXIV.—Vacciniaceæ.

1. **Vaccinium.** *V. Leschenaultii* (III.61). Maturata, 5,500 ft.! Summit of Naminakuli! Hakgala do.! Fl. Oct.

LXXV.—Ericaceæ.

1. **Gaultheria.** *G. fragrantissima* (III.62). Fl. Jan., Mar., Oct.

2. **Rhododendron.** *R. arboreum* (III.63). Summit of Naminakuli!

LXXVII.—Primulaceæ.

1. **Lysimachia.** *L. deltoidea* (III.66). *For* 6,000 ft. *read* 5,500 ft. Hakgala! Pattipola! High Forest, Maturata!

LXXVIII.—Myrsinaceæ.

Cf. Mez in Das Pflanzenreich.

4. **Ardisia.** *A. Willisii* Mez. Weligama.

A. Missionis (III.71). Mez unites *A. courtallensis* Wight with this, so it ceases to be endemic, occurring also in S. India.

A. Gardneri (III.72). Type and var. β, Hakgala!

LXXIX.—SAPOTACEÆ.

5. **Palaquium.** *P. petiolare* (III.82). Molpedda, Kiri hembiliya, S.; common at Hewesse (Wright).

P. grande (III.82). Molpedda, S. Singhe Raja forest, Kadawata, Hinidum, common at Hewesse (Wright).

LXXX.—EBENACEÆ.

1. **Maba.** *M. acuminata* (III.88). Hewesse (Wright).

M. ovalifolia (III.88). Peniyaral forest (Wright).

M. buxifolia (III.89). Hewessa (Wright).

2. **Diospyros.** See Wright, The genus Diospyros in Ceylon, Ann. Perad. II., 1904, pp. 1 and 133.

D. ovalifolia (III.91). Anuradhapura !

D. montana (III.92). Kalugala !

D. Toposia (III.94). Eratne, Kurunegala, Hewesse, Gangaruwa !

D. ebenum (III.94). Line 3, *for* "dichotomously" *read* "distichously." Female fl. 2–4 together, umbellate, in a specimen from Vavuniya, 1896. Ruanwela, Gampola (Wright) !

D. pruriens (III.95). Kadawata (Peak Wilderness), Magala (do.), Eratne (Wright) !

D. oocarpa (III.97). Kalugala (Wright) !

D. quæsita (III.97). Madampe, Yagirala (Wright) !

D. sylvatica (III.89). Kurunegala, Gampola (Wright) !

D. hirsuta (III.99). Kitulgala, Eratne (Wright) !

D. insignis (III.100). Wilagama, Niriela near Ratnapura, Ratnapura, Singhe Raja forest (Wright) !

D. Thwaitesii (III.101). Palakata near Udugama (Wright) !

D. affinis (III.102). Kurunegala, Kanthalai (dry region) !

D. crumenata (III.102). Gangaruwa (Wright) ! Also occurs in Bombay (Cooke, Flora), so not endemic.

Localities of actual herbarium specimens given. See Wright for others.

LXXXI.—STYRACEÆ.

Cf. Brand in Das Pflanzenreich.

1. **Symplocos.** *S. spicata* (III.104). This tree is one of the most attractive hosts for the root parasite Rosellinia, and is dreaded by planters when felled.

S. obtusa (III.104). Brand says that this sp. is only found in India, and makes our plant *S. furcata* Brand, n. sp.

S. bractealis (III.106). Sita Eliya ! Fl. Mar., Apr.

S. hispidula (III.107). Nuwara Eliya (Thwaites), 6,000 ft. !

S. latiflora (III.108). Hakgala !

S. minor (III.109). Hakgala !

S. cordifolia (III.110). Ascent of Adam's Peak on Maskeliya side ! High Forest, Maturata !

S. pauciflora (III.111). Brand places this in *S. pendula* Wight.

LXXXII.—OLEACEÆ.

Line 1, Leaves opposite ; *add* " or alternate."

1. **Jasminum,** line 2, leaves opp. " or alt."

J. angustifolium (III.114). 4,000 ft. Pearson.

J. flexile (III.115). Summit of Ritigala !

J. humile (III.115). Leaves often alt. Sita Eliya !

2. **Linociera.** After *L. purpurea*, add " On *Chionanthus Ghaeri* Gaertn., see Boerlage in Journ. Linn. Soc. XXXI., Dec., 1895, p. 246. It is the fruit of *Scirpodendron costatum*. The specimens are in the Leyden Museum labelled " Gierietetta " and 99/1758. Probably a misplaced label (?), if Hermann's.

3. **Olea.** *O. glandulifera* (III.118). Hakgala !

4. **Ligustrum.** *L. Walkeri* (III.119). Hakgala !

LXXXIV.—APOCYNACEÆ.

Line 2, leaves whorled in Rauvolfia.

1. **Willughbeia.** *W. zeylanica* (III.123). The villagers in Wellaboda pattu eat the fruit ; the plant is also known near Galle as Kirigedi, S.

2. **Carissa.** *C. spinarum* (III.125). Maturata, 4,500 ft. !

3. **Rauvolfia.** *R. densiflora* (III.126). Horton Plains, 7,000 ft. !

12. **Parsonsia.** *P. spiralis* (III.134). Haputale, 4,500 ft. ! Fl. May.

14. **Wrightia.** *W. angustifolia* (III.136). Summit of Ritigala !

16. **Aganosma.** *A. cymosa* (III.139). Below Hakgala, 500 ft. ! Fl. very sweetly scented.

18. **Anodendron.** *A. rhinosporum* (III.141). Summit of Ritigala !

LXXXV.—Asclepiadaceæ.

4. **Toxocarpus.** Corolla tube inflated.

T. Kleinii (III.146). Fl. July. Apparently wild in the R. B. G., Peradeniya.

6. **Calotropis.** *C. gigantea* (III.148). Passara, 2,800 ft.!

10. **Cynanchum.** *C pauciflorum* (III.151). Hakgala, 5,600 ft.!

12. **Gymnema.** *G. pergularioides* (III.154). Summit of Naminakuli!

16. **Dregea.** *D. volubilis* (III.161). Follicles at first covered with orange-yellow meal.

18. **Hoya.** *H. ovalifolia* (III.162). Summit of Ritigala!

LXXXVI.—Loganiaceæ.

2. **Fagræa.** *F. obovata* (III.171). Summit of Ritigala! Below Hakgala, 5,000 ft.! Fl. Apr.

3. **Strychnos.** *S. Beddomei* (III.173). Rasagala near Balangoda.

S. Benthami (III.174). Var. β, Hakgala!

4. **Gærtnera.** *G. Walkeri* (III.178). Maturata, 5,000 ft.! Haputale! Fl. May.

LXXXVII.—Gentianaceæ.

1. **Exacum.** *E. Walkeri* (III.180). A form with blue fl. received in 1901 from Mr. T. Farr of Bogawantalawa. To 7,000 ft., Hakgala! Cone of Adam's Peak! Fl. Jan., Apr., May, Oct.

E. zeylanicum (III.181). *Add* var. γ, *Ritigalense* Willis, Ritigala!

E. macranthum (III.181). High Forest, Maturata! Fl. May.

6. **Crawfurdia.** *C. japonica* (III.187). Found on Horton Plains near Totapella, by J. F. Jowitt, 1901.

7. **Swertia.** See Burkill in Journ. R. A. S. Bengal, II., 1906, p. 363.

S. zeylanica (II.187). Common at Hakgala down to 5,400 ft.!

LXXXIX.—Boraginaceæ.

5. **Tournefortia.** *T. argentea* (III.198). Kachchaitivu Island, 1903, described "as a regular tree," so must have been there a long time.

6. **Heliotropium.** *H. paniculatum* (III.200). Elephant Pass !

8. **Cynoglossum.** *C. micranthum* (III.203). Type at Hakgala, 5,500 ft.! Fl. Jan. Var. *decurrens*, summit of Naminakuli !

XC.—Convolvulaceæ.

5. **Ipomoea.** *I. biloba* (III.224). *Before* Thw. Enum. 211 add *I. Pes-capræ* Sw.

8. **Evolvulus.** *E. alsinoides* (III.227). 3,800, 4,000 ft. Pearson. Common at Bandarawela to 4,500 ft.!

11. **Cuscuta.** *C. reflexa* (III.229). Fl. Aug.

XCII.—Scrophulariaceæ.

Adenosma subrepens is also endemic.

3. **Limnophila.** *L. gratissima* (III.243). Dimbula !

7. **Torenia.** *T. hirtella* (III.249). Hakgala! Ambawela! Haputale! Fl. Mar.

8. **Vandellia.** *V. pedunculata* (III.251). Near Ambawela, 5,800 ft.! Fl. Apr.

9. **Ilysanthes.** *I. rotundifolia* (III.252). High Forest, Maturata, 5,500 ft.!

13. **Striga.** *S. euphrasioides* (III.256). 3,800 ft. Pearson.

14. **Sopubia.** *S. delphinifolia* (III.257). Craig estate, Bandarawela, to 5,500 ft.! Bandarawela! Yelumalai, Naminakuli!

S. trifida (III.257). Bandarawela, 4,000 ft.! Hakgala!

16. **Pedicularis.** *P. zeylanica* (III.260). Fl. Oct.

XCIII.—Orobanchaceæ.

2. **Christisonia.** *C. subacaulis* (III.262). Ohiya, 6,400 ft.! Pattipola, 6,200 ft.! Fl. May.

XCIV.—Lentibulariaceæ.

1. **Utricularia.** *U. exoleta* (III.268). Tropical Asia generally.

U. affinis (III.269). Ambawela! Fl. Mar.

U. reticulata (III.269). Also in S. India.

U. bifida (III.270). 3,000 ft. Pearson.

U. nivea (III.270). Var. β, on Pidurutalagala and Horton Plains, to 7,500 ft.! Fl. Apr.

XCV.—GESNERACEÆ.

2. **Didymocarpus.** *D. Humboldtianus* (III.273). Var. β, between Haldummulla and Horton Plains (Trimen). At 5,600 ft. Pearson.

XCVIII.—ACANTHACEÆ.

1. **Thunbergia.** *T. fragrans* (III.288). Var. β, on Doluwe Kanda!

14. **Barleria.** *B. Arnottiana* (III.321). Hakgala! Fl. Mar.

16. **Asystasia.** *A. chelonioides* (III.324). Haputale! Below Hakgala! Lagalla!

A. variabilis (III.324). Patana in Fort Macdonald valley to 4,800 ft.!

17. **Eranthemum.** *E. malabaricum* (III.325). Summit of Ritigala!

22. **Justicia.** *J. Royeniana* (III.337). Patana in Fort Macdonald valley! Sita Eliya! Fl. May, Oct.

27. **Rungia.** *R. parviflora* (III.342). Summit of Ritigala!

XCIX.—VERBENACEÆ.

10. **Clerodendron.** *C. Phlomidis* (III.360). Topawewa!

C.—LABIATÆ.

1. **Ocimum.** *O. adscendens* (III.366). Kokkuvil to Elephant Pass!

2. **Geniosporum.** *G. elongatum* (III.368). Hakgala abundant! In small type, read *prostratum* for *elongatum.*

5. **Plectranthus.** *P. nigrescens* (III.370). Fl. Jan., Mar., Oct.

P. Gardneri (III.371). Summit of Naminakuli! Fl. May.

6. **Coleus.** *C. barbatus* (III.373). Summit of Ritigala! Fl. Mar., May.

C. malabaricus (III.374). Fl. May.

C. inflatus (III.375). Fl. Apr.

7. **Anisochilus.** *A. velutinus* (III.377). Summit of Ritigala!

8. **Pogostemon.** *P. Heyneanus* (III.378). Summit of Naminakuli!

P. rupestris (III.379). Fl. Apr., May, Oct.

P. hirsutus (III.379). Summit of Naminakuli!

P. reflexus (III.379). 7,000 ft. Pearson.

11. **Calamintha.** *C. umbrosa* (III.381). Horton Plains! Hakgala! Ambawela! Fl. Jan., Mar.

12. **Scutellaria.** *S. robusta* (III.383). Adam's Peak, above Usamale, 6,500 ft.!

14. **Leucas.** *L. marrubioides* (III.385). 5,600 ft. Pearson. Fl. Feb., Mar.

L. biflora (III.386). Summit of Naminakuli! Fl. Jan., Mar., May.

16. **Teucrium.** *T. tomentosum* (III.388). Fl. Mar.

CI.—Plantaginaceæ.

1. **Plantago.** *P. major* (III.384). Fl. Mar., Oct.

CII.—Nyctaginaceæ.

Mirabilis Jalapa (III.391). Pyrard de Laval mentions this as in the Maldives (1602-7).

2. **Pisonia.** *P. aculeata* (III.391). Nalande (Trimen).

CIII.—Amarantaceæ.

2. **Allmania.** *A. nodiflora* (III.394). Fl. Oct.

4. **Amarantus.** *A. viridis* (III.397). High Forest, Maturata! Hatton! Ambawela! Fl. Mar., May.

10. **Achyranthes.** *A. aspera* (III.404). Ohiya, 6,000 ft! Fl. May.

A. bidentata (III.404). Hakgala!

11. **Alternanthera.** *A. triandra* (III.405). Ponnankari. T.

CVI.—Podostemaceæ.

See Willis, "A revision of the Podostemaceæ of India and Ceylon," Ann. Perad. I., 1902, p. 181; and "Morphology and Ecology of the Podostemaceæ of Ceylon and India," do. I., 1902, p. 267.

Substitute the following list of species and localities :—

1. **Lawia** Griff.

zeylanica Tul.

Var. α. *Gardneriana* Willis. Endemic. Hakinda and Haragama in the Mahaweli-ganga, Laggal-oya, Guru-oya, Kelani-ganga near Kitulgala!

Var. β. *Parkiniana* Willis. Endemic. Hakinda, Guru-oya.

The species from Ceylon to Bombay.

2. **Dicrea** Tul.

elongata Tul. (Podostemon elongatus Gardn). demic. Mahaweli-ganga, Kelani-ganga, Bambarabotuwa-ganga!

stylosa Wight.

Var. α, *fucoides* Willis (Podostemon algæformis Trim.). Mahaweli-ganga, Guru-oya!

Var. β, *laciniata* Willis. Endemic. Mahaweli-ganga, Guru-oya.

The species, Ceylon and S.-W. India.

3. **Podostemon** Tul.

subulatus Gardn. Var. *mavœliæ* Willis. Mahaweli-ganga!

Ceylon and S. India.

4. **Hydrobryum** Endl.

olivaceum Tul. Var. *zeylanicum* Willis (Podostemon olivaceus Gardn.). Endemic var., Mahaweli-ganga! Maskeliya-ganga!

The species Ceylon and W. Ghats of India.

lichenoides Kurz. Var. *kelense* Willis. Endemic var., Dikoya-ganga!

The species Ceylon and India.

5. **Farmeria** Willis.

metzgerioides Willis. (*Podostemon metzgerioides* Trim.). Endemic. Mahaweli-ganga!

All species flower in the dry weather, from Christmas to the beginning of February.

Podostemon Gardneri Haw. (III.419) is simply the young state of Hydrobryum olivaceum.

For full details see papers quoted.

CVII.—Nepenthaceæ.

1. **Nepenthes.** *N. distillatoria* (III.420). See J. H. Slevogt, Prolusio de Bandura Ceylonensium, 1719 (Diss. Univ. Jena).

CVIII.—ARISTOLOCHIACEÆ.

2. **Aristolochia.** *A. indica* (III.423). Below Hakgala, 4,600 ft.!

CIX.—PIPERACEÆ.

1. **Piper.** *P. Thwaitesii* (III.426). Fl. Feb.–Apr.

2. **Peperomia.** *P. Wightiana* (III.431). *Add* var. β, *Ritigalensis* Willis. Summit of Ritigala!

P. confusa (III.431). Summit of Ritigala!

P. dindigulensis (III.431). Summit of Ritigala! Var. β, Hakgala! Haputale! Ohiya! Fl. Apr.

CXIII.—LAURACEÆ.

3. **Cinnamomum.** *C. ovalifolium* (III.442). Hakgala!

7. **Litsea.** *L. ovalifolia* (III.451). Hakgala! Adam's Peak! Fl. Mar.

CXIV.—PROTEACEÆ.

1. **Helicia.** *H. zeylanica* (III.457). Lagalla!

CXV.—THYMELÆACEÆ.

1. **Wikstrœmia.** *W. canescens* (III.458). Hakgala!

2. **Lasiosiphon.** *L. eriocephalus* (III.459). Patana, Fort Macdonald valley, 4,800 ft.!

CXVII.—LORANTHACEÆ.

1. **Loranthus.** *L. tomentosus* (III.465). Fl. Mar., May.

L. sclerophyllus (III.466). Summit of Naminakuli! Fl. Feb., Mar.

L. longiflorus (III.468). Fl. Feb., Apr.

L. neelgherrensis (III.468). Summit of Naminakuli!

L. loniceroides (III.469). Hakgala! Summit of Naminakuli! Fl. June.

2. **Viscum.** *V. japonicum* (III.472). Summit of Naminakuli!

CXVIII.—SANTALACEÆ.

1. **Osyris.** *O. arborea* (III.474). The berries are red.

Vols. IV. and V. contain a good many mistakes in the spelling of native names of plants, names of places, and similar errors, for which no fault can be attached to Sir Joseph Hooker.

Native names will be found in "A revised Catalogue of Ceylon Plants," by J. C. Willis, and the most important errors of place, such as Dambulla (dry low-country) for Dimbula (formerly spelt Dimbulla ; wet montane zone) are corrected here.

CXX.—Euphorbiaceæ.

1. **Euphorbia.** *E. Rothiana* (III.8). Fl. Jan.–Mar.

4. **Cleistanthus.** *C. patulus* (III.13). Summit of Ritigala ! *C. pallidus* (IV.13). Sitawaka !

5. **Actephila.** *A. neilgherrensis* (IV.14). Raxawa ! Balangoda !

8. **Phyllanthus.** *P. Rheedii* (IV.21). Fl. Jan., May. *P. myrtifolius* (IV.22). Balangoda ! *P. anabaptizatus* (IV.24). Fl. May.

9. **Glochidion.** *G. zeylanicum* (IV.28). Diyatalawa camp, 3,800 ft ! 4,000 ft. Pearson. Var. β, Lunugala, Uva ! *G. sp. nov.* Ritigala ! (See Ann. Perad. III., p. 285.)

13. **Hemicyclia.** *H. Gardneri* (IV.37). Cf. *H. Porteri* sp. nov. Madras, in Hooker's Icones, 2,701.

14. **Cyclostemon.** *C. macrophyllus* (IV.38). Watagoda ! Raxawa !

17. **Daphniphyllum.** *D. glaucescens* (IV.42). Summit of Ritigala !

20. **Croton.** *C. Klotzschianus* (IV.49). Mihintale ! Lenadore !

23. **Ostodes.** *O. zeylanica* (IV.52). Between Haputale and Ohiya, 4,800 ft. ! Fl. May.

28. **Acalypha.** *A. lanceolata* (IV.59). Summit of Ritigala ! Fl. Mar.

31. **Tragia.** *T. involucrata* (IV.61). Var. β, Hakgala !

32. **Podadenia.** *P. sapida* (IV.62). Sent in April, 1911, by W. Ferguson from Ratganga estate, Ratnapura, where it is plentiful : the coolies eat the arils of the seeds.

33. **Claoxylon.** *C. oligandrum* (IV.64). Hakgala, 5,500 ft. ! Maturata, 5,500 ft. !

34. **Mallotus.** *M. Walkeræ* (IV.66). Balangoda ! *M. philippinensis* (IV.68). Ritigala ! High Forest, Maturata, 5,600 ft. ! Fl. May.

42. **Excæcaria.** *E. crenulata* (IV.77). Fl. Mar.

CXXI.—URTICACEÆ.

2. **Celtis.** *C. cinnamomea* (IV.81). Elephant Plains!

4. **Gironniera.** *G. subæqualis* (IV.83). Balangoda!

5. **Ficus.** *F. Mysorensis* (IV.86). The specimen from Ekiriyankumbura is a Bassia, accidentally put in here.

F. retusa (IV.89). Fl. Mar., May.

F. nervosa (IV.89). Kotagala!

F. Thwaitesii (IV.95). Balangoda!

F. lævis (IV.95). Singhe Raja forest!

10. **Phyllochlamys.** *P. spinosa* (IV.101). Summit of Ritigala!

12. **Dorstenia.** *D. indica* (IV.102). Summit of Ritigala

17. **Girardinia.** *G. heterophylla* (IV.106). Var. β, Hakgala! Fl. May.

18. **Pilea.** *P. trinervia* (IV.108). Fl. Oct.

21. **Elatostema.** *E. lineolatum* (IV.110). Summit of Naminakuli!

22. **Procris.** *P. lævigata* (IV.112). Summit of Ritigala! Fl. Feb., Apr., May.

25. **Pouzolzia.** *P. Bennettiana* (IV.117). Adam's Peak! Bandarawela! Var. β, Hakgala! Horton Plains!

P. Walkeriana (IV.116). Welimada, 3,000 ft.! Summit of Ritigala! Fl. Mar.

27. **Debregeasia.** *D. velutina* (IV.119). Albion estate, near Hakgala, 5,000 ft.! Summit of Naminakuli! Fl. Oct.

CXXIII.—CYCADACEÆ.

1. **Cycas.** *C. circinalis* (IV.121). Common inland from Batticaloa!

CXXV.—BURMANNIACEÆ.

1. **Burmannia.** *B. disticha* (IV.130). 5,800 ft. Pearson. Bopatalawa, T. Farr.

CXXVI.—ORCHIDACEÆ.

1. **Oberonia.** *O. Wightiana* (IV.139). Hakgala! Summit of Naminakuli!

2. **Microstylis.** *M. lancifolia* (IV.142). Balangoda! Singhe Raja forest!

3. **Liparis.** *L. Walkeriæ* (IV.146). Hakgala!

L. obscura (IV.147). Summit of Ritigala !

L. disticha (IV.148). Fl. Apr.

5. Bulbophyllum. *B. purpureum* (IV.155). Maturata !

6. Cirrhopetalum. *C. grandiflorum* (IV.157). Maskeliya ! Talawakele ! Fl. May.

12. Eria. *E. braccata* (IV.165). Adam's Peak !

E. bicolor (IV.166). Summit of Naminakuli !

17. Ipsea. *I. speciosa* (IV.171). Ohiya ! Summit of Naminakuli !

19. Calanthe. *C. veratrifolia*, var. *discolor* (IV.178). Summit of Naminakuli !

24. Polystachya. *P. zeylanica* (IV.183). Hakgala, 5,000 ft. !

28. Ærides. *A. cylindricum* (IV.189). Maturata, 5,000 ft. !

29. Luisia. *L. teretifolia* (IV.190). Summit of Ritigala !

32. Saccolabium. *S. niveum* (IV.195). Summit of Ritigala !

S. filiforme (IV.196). Horton Plains, 7,000 ft. !

S. gracile (IV.196). *Read* "Montane zone, 4,000–7,000 ft."

S. brevifolium (IV.196). Summit of Naminakuli ! Fl. Oct.

34. Cleisostoma. *C. maculosum* (IV.200). Summit of Ritigala !

C. tenerum (IV.201). Summit of Naminakuli !

35. Mystacidium. *M. zeylanicum* (IV.202). Summit of Ritigala !

37. Tæniophyllum. *T. Alwisii* (IV.203). Summit of Ritigala !

39. Podochilus. *P. saxatilis* (IV.206). Summit of Ritigala !

41. Octarrhena. *O. parvula* (IV.208). Pattipola !

46. Anæctochilus. *A. regalis* (IV.213). Ritigala !

49. Spiranthes. *S. australis* (IV.217). Summit of Naminakuli. Fl. Jan., Feb., Oct.

58. Habenaria. *H. plantaginea* (IV.229). Below Hakgala, 5,000 ft. !

H. Trimeni (IV.233). Badulla. Fl. Nov.

H. torta (IV.234). Sita Eliya ! Fl. Oct.

H. Gardneri (IV.235). Var. β, Adam's Peak ! Fl. May.

CXXVII.—SCITAMINEÆ.

4. **Hedychium.** *H. coronarium* (IV.245). Hakgala, 5,000 ft.! Fl. Oct.

7. **Amomum.** *A. hypoleucum* (IV.254). Not endemic; occurs in Malabar.

CXXVIII.—HÆMODORACEÆ.

1. **Ophiopogon.** *O. intermedius* (III.267). Hakgala, 5,000 ft.! Horton Plains, 7,000 ft.! Fl. Oct.

CXXIX.—AMARYLLIDACEÆ.

1. **Curculigo.** *C. Finlaysoniana* (IV.269). Summit of Ritigala!

C. orchioides (IV.269). Hakgala frequent!

CXXXIII.—LILIACEÆ.

1. **Smilax.** *S. zeylanica* (IV.283). Hakgala. 5,500 ft.! Opposite Hakgala. 5,500 ft.! Fl. Mar., May.

2. **Asparagus.** *A. racemosus* (IV.285). A specimen from Horton Plains seems to be this species.

A. falcatus (IV.285). Maturata, 5,500 ft.! Haputale, 5,000 ft.! Hakgala, 5,800 ft.!

4. **Dianella.** *D. ensifolia* (IV.288). Bandarawela! Craig, above Bandarawela, 5,200 ft.! Hakgala, 5,500 ft.! Summit of Naminakuli, 6,600 ft.!

5. **Disporum.** *D. Leschenaultianum* (IV.289). Fl. Jan., Apr.

CXXXVI.—COMMELINACEÆ.

2. **Commelina.** *C. nudiflora* (IV.300). 5,800 ft. Pearson. Ambawela, 5,800 ft.! Haputale, 5,000 ft.! Fl. Mar., May.

C. clavata (IV.301). Maturata. 5,000 ft.! Craig, above Bandarawela, 5,000 ft.! Fl. May.

4. **Cyanotis.** *C. villosa* (IV.313). Hakgala, 5,600 ft.!

5. **Floscopa.** *F. scandens* (IV.316). Summit of Ritigala!

CXXXVIII.—JUNCACEÆ.

1. **Juncus.** *J. effusus* (IV.318). Fl. Mar.

J. prismatocarpus (IV.319). Summit of Naminakuli!

CXXXIX.—PALMEÆ.

4. **Caryota.** *C. urens* (IV.324). Summit of Ritigala !

CXL.—PANDANACEÆ.

2. **Freycinetia.** *F. Walkeri* (IV.342). Hakgala, 5,000 ft. !

CXLII.—ARACEÆ.

4. **Arisæma.** *A. Leschenaultii* (IV.352). Fl. Mar.

CXLVI.—NAIADACEÆ.

1. **Aponogeton.** *A. crispum* (IV.372). Fl. Oct.

CXLVII.—ERIOCAULONACEÆ.

1. **Eriocaulon.** *E. caulescens* (V.3). Fl. Apr.

E. zeylanicum (V.3). Fl. May.

E. atratum (V.4). Adam's Peak ! Fl. May.

E. Brownianum (V.6). Horton Plains ! Fl. Jan.

E. Trimeni (V.8). Delete " Montane zone."

E. collinum (V.10). Nuwara Eliya to Hakgala, and below Ambawela, Maturata ! Fl. Apr., May.

CXLVIII.—CYPERACEÆ.

1. **Cyperus.** In Key, transpose 26 and 27.

C. globosus (V.21). Fl. Feb.

C. distans (V.30). Maturata, 5,600 ft. ! Bandarawela, 4,000 ft. !

C. nutans (V.31). Talawakele !

C. digitatus (V.36). Var. β, Hakgala, 5,600 ft. !

Add *Cyperus sp. nov.* See Willis, Flora of Ritigala, Ann. Perad. II., p. 289.

3. **Kyllinga.** *K. monocephala* (V.44). Haputale !

K. brevifolia (V.45). Maturata, 5,600 ft. ! Hatton ! Ambawela, 5,500 ft. ! Fl. Mar., May.

4. **Fimbristylis.** *F. asperrima* (V.38). Top of Ritigala !

F. pentaptera (V.60). Fl. May.

6. **Bulbostylis.** *B. capillaris* (V.67). Hakgala ! Bandarawela ! Fl. Mar.

8. **Scirpus.** *S. mucronatus* (V.76). Nuwara Eliya lake !

11. **Lipocarpha.** *L. argentea* (V.81). Fl. May.

13. **Rhynchospora.** *R. glauca* (V.85). Fl. Apr., May.

20. **Scleria.** *S. lithosperma* (V.96). Top of Ritigala!

S. chinensis (V.98). Hakgala! Nuwara Eliya! Summit of Naminakuli!

22. **Carex.** *C. nubigena* (V.102). Fl. Apr.

C. phacota (V.104). Fl. Mar.

C. Arnottiana (V.105). Fl. Jan.

C. Walkeri (V.106). Pinnawela, Balangoda! Summit of Naminakuli! Fl. Jan.

C. spicigera (V.106). Fl. Apr.

C. leucantha (V.107). Side of Ritigala!

C. baccans (V.107). Fl. Jan.–Mar.

C. Lindleyana (V.109). Summit of Naminakuli! Fl. Jan., Mar.

C. zeylanica (V.109). Pidurutalagala, 7,500 ft.! Fl. Apr.

C. filicina (V.110). Haputale, 5,000 ft.! Ambawela! Naminakuli! Fl. Mar., May.

C. ligulata (V.111). Below Hakgala! Fl. June.

C. lobuliostris (V.113). Pidurutalagala! Fl. Apr., May.

CXLIX.—Gramineæ.

1. **Paspalum.** *P. scrobiculatum* (V.121). Fl. Feb., Mar.

P. conjugatum (V.122). Laxapana! Talawakele! Fl. May, July, Aug.

P. sanguinale (V.123). Fl. Feb.–May, Oct.

P. longiflorum (V.124). Ambawela! Fl. Mar.

P. Perrottetii (V.125). Fl. Mar., Sept.

3. **Isachne.** *I. Kunthiana* (V.127). *For* Dambulla *read* Dimbula. Hewaheta! Hakgala! Horton Plains! Top of Naminakuli! Haputale! Fl. Jan.–May.

I. elatior (V.127). Fl. Feb.

I. multiflora (V.127). *For* Dambulla *read* Dimbula. Fl. Apr.

I. australis (V.128). Hakgala! Fl. Apr., May, Sept., Oct.

I. miliacea (V.128). Fl. Oct.

I. Walkeri (V.129). Summit of Naminakuli! Fl. Jan., May, Sept.

I. Gardneri (V.130). Summit of Naminakuli! Fl. Feb., Apr.

4. **Panicum.** *P. punctatum* (V.134). Fl. Feb., Dec.

P. Crus-galli (V.135). Fl. Feb., Oct.

P. colonum (V.136). Fl. Mar., May, Sept., Nov.

P. ambiguum (V.137). Fl. Feb.

P. prostratum (V.138). Fl. Dec.

P. villosum (V.139). Fl. Jan.–Mar., May.

P. setigerum (V.141). Fl. Mar., Dec.

P. distachyum (V.142). Fl. Feb.

P. semiverticillatum (V.143). Fl. Mar., July.

P. remotum (V.144). Fl. Feb., Aug.

P. auritum (V.145). Fl. Dec.

P. interruptum (V.147). Fl. Jan., Sept., Nov.

P. indicum (V.147). Fl. Feb.

P. ovalifolium (V.149). Top of Ritigala! Fl. Mar.

P. miliare (V.150). Fl. Jan., Mar.

P. cæsium (V.151). Fl. Aug.

P. trypheron (V.152). Fl. Jan., Apr.

P. humile (V.152). Fl. Sept., Nov.

P. maximum (V.153). Fl. May.

P. repens (V.154). Fl. Apr.

P. montanum (V.155). Fl. Apr., June.

P. plicatum (V.157). Fl. Aug.

P. trigonum (V.157). Fl. Apr., Sept.

P. pilipes (V.158). Top of Ritigala! Fl. Feb., Mar., May.

P. patens (V.159). Top of Ritigala! Hakgala, 6,000 ft.! Fl. Mar.

6. **Setaria.** *S. glauca* (V.162). Fl. Mar.

S. verticillata (V.163). Fl. Feb., Dec.

S. intermedia (V.163). Craig, Bandarawela (Jowitt). Fl. June.

7. **Chamæraphis.** *C. spinescens* (V.165). Fl. July, Sept.

8. **Axonopus.** *A. cimicinus* (V.166). Fl. Oct.

A. semialatus (V.167). Fl. Jan., Mar.

9. **Oplismenus.** *O. compositus* (V.168). Summit of Naminakuli! Fl. Feb.–Apr., Oct., Dec.

O. Burmanni (V.169). Fl. Jan., Feb.

O. Thwaitesii (V.169). Fl. Mar.

10. **Pennisetum.** *P. orientale* (V.171). Fl. Sept.

11. **Stenotaphrum.** *S. complanatum* (V.172). Fl. Sept., Dec.

12. **Thuarea.** *T. sarmentosa* (V.173). Fl. Sept.

13. **Spinifex.** *S. squarrosus* (V.174). Mr. J. P. Lewis informs me that the Sinhalese name means the " great beard " (not bund) of Ravana.

14. **Arundinella.** *A. avenacea* (V.176). Fl. Apr.

A. setosa (V.177). Fl. Dec.

A. villosa (V.178). Fl. Mar., May, Sept., Nov., Dec.

A. leptochloa (V.178). Fl. June, Aug., Sept.

A. laxiflora (V.178). Fl. Jan., Oct.

A. blephariphylla (V.180). Fl. Nov.

A. Thwaitesii (V.181). Fl. Sept.

15. **Oryza.** *O. sativa* (V.182). Fl. Feb., Aug.

O. granulata (V.183). Fl. Jan., Apr., Nov.

O. latifolia (V.184). Fl. Apr., June, Sept., Nov., Dec.

16. **Leersia.** *L. hexandra* (V.184). Fl. Apr.

17. **Hygrorhyza.** *H. aristata* (V.185). Fl. June, July Sept.

18. **Trachys.** *T. mucronata* (V.186). Fl. Apr.

19. **Tragus.** *T. racemosus* (V.187). Fl. Feb., Dec.

20. **Zoysia.** *Z. pungens* (V.188). Fl. Apr., Sept.

21. **Lopholepis.** *L. ornithocephala* (V.189). Fl. Feb.

22. **Perotis.** *P. latifolia* (V.189). Fl. Feb., Mar.

23. **Leptaspis.** *L. urceolata* (V.190). Fl. Aug., Dec.

L. cochleata (V.191). Fl. Apr., Dec.

24. **Coix.** *C. Lachryma-Jobi* (V.192). Fl.

25. **Polytoca.** *P. barbata* (V.194). Fl. Jan., April Dec.

26. **Dimeria.** *D. pusilla* (V.195). Fl. Mar.

D. pubescens (V.196). Fl. Jan., Sept., Dec.

D. Lehmanni (V.196). Fl. Apr., July, Sept.

D. Thwaitesii (V.197). Fl. Mar.

D. fuscescens (V.198). Fl. Mar., May.

D. gracilis (V.199). Fl. Jan., May, Sept., Dec.

27. **Imperata.** *I. arundinacea* (V.200). Fl. Aug.

29. **Pollinia.** *P. Thwaitesii* (V.203). Fl. Apr.

P. argentea (V.204). *For* Nilgule *read* Nilgala, Bandarawela! Fl. Jan., Mar., Apr., Nov., Dec.

P. phæothrix (V.204). *For* Dambulla *read* Dimbula. Horton Plains! Ambawela! Summit of Naminakuli! Fl. Jan., Mar., July.

P. ciliata (V.205). Fl. Jan., Feb., Apr., Dec.

30. Rottbœllia. *R. compressa* (V.206). Fl. Sept., Nov.

R. exaltata (V.207). Fl. Mar.

R. nigrescens (V.207). Fl. Feb., Apr., Dec.

31. Manisuris. *M. granularis* (V.209). Fl. Jan., Feb., Apr.

32. Mnesithea. *M. lævis* (V.210). Fl. Jan., June, Sept., Dec.

33. Ischæmum. *I. aristatum* (V.111). Bandarawela! Fl. Mar., Sept., Dec.

I. rugosum (V.212). Fl. Feb.

I. semisagittatum (V.213). Fl. Nov.

I. commutatum (V.214). Ambawela! Fl. Mar.

I. muticum (V.216). Fl. Oct., Dec.

I. ciliare (V.216). Bandarawela! Fl. Feb., Dec.

I. rivale (V.217). Fl. Mar.

I. timorense (V.218). Fl. Feb., Dec.

I. laxum (V.219). *For* Passalowa *read* Pussellawa. Fl. Jan., Apr., Sept.

34. Eremochloa. *E. muricata* (V.220). Fl. Feb.

E. zeylanica (V.221). Fl. Jan., Feb.

35. Pogonatherum. *P. crinitum* (V.222). Ambawela! Fl. Mar., Oct.

36. Apocopis. *A. Wightii* (V.223). Fl. Feb.–Apr.

37. Arthraxon. *A. rudis* (V.224). Fl. Jan., Sept., Dec.

A. microphyllus (V.224.) Fl. Apr.

A. ciliaris (V.225). Fl. Oct.

38. Apluda. *A. varia* (V.226). Fl. Feb.

39. Andropogon. *A. pseudischœmum* (V.229). Fl. May, July.

A. pertusus (V.230). Bandarawela! Fl. Mar.

A. intermedius (V.230). Fl. May.

A. halepensis (V.231). Near Badulla! Fl. Mar., June, Aug.

A. serratus (V.232). Fl. Jan., Feb., Apr., May, Sept.

A. squarrosus (V.233). Fl. Feb., Mar., Dec.

A. venustus (V.233). Ambawela! Fl. Feb., Mar., June, Sept.

A. aciculatus (V.235). Haputale, 4,800 ft.! Fl. May, Aug., &c.

A. zeylanicus (V.235). Fl. Mar.–May.

A. monticola (V.236). Fl. Jan., Feb., Apr., June–Sept.

A. caricosus (V.237). Fl. Feb., Mar.

A. polyptychus (V.237). Fl. Jan., Mar., Apr., May, Aug., Sept.

A. contortus (V.238). Fl. Jan., Feb., Oct., Nov.

A. triticeus (V.239). Fl. June.

A. hirtiflorus (V.240). Fl. Jan., Apr., Sept., Oct.

A. Schœnanthus (V.241). Fl. Jan.–Apr.

A. lividus (V.244). Fl. May, Aug.

A. filipendulus (V.245). Fl. May, Sept.

40. **Pseudanthistiria.** *P. umbellata* (V.247). *For* Dambulla *read* Dimbula. Fl. Jan., Oct.

41. **Anthistiria.** In Key, *for* " superposed hairs " *read* " pairs."

A. imberbis (V.248). Fl. Jan.

A. cymbaria (V.249). Fl. Jan., June.

A. tremula (V.249). Fl. Jan., Mar.

42. **Iseilema.** *I. laxum* (V.251). In localities *read* Batulu-oya, Chilaw, &c.

43. **Aristida.** *A. adscensionis* (V.252). Called Teli-tana by the Sinhalese. Fl. Feb., Aug.

A. setacea (V.253). Fl. Feb., July, Sept.

44. **Garnotia.** *G. Thwaitesii* (V.254). Fl. May, Aug., Sept.

G. tectorum (V.254). *For* Dumballa *read* Dimbula. Hakgala! Sita Eliya! Ambawela! Horton Plains! Fl. Jan., Apr., Sept.

G. fuscata (V.255). Fl. Mar.

G. Fergusonii (V.255). *For* Udapassellana *read* Udapussellawa. Fl. Mar.

G. micrantha (V.256). Fl. Nov., Dec.

G. courtallensis (V.257). Fl. Mar., Dec.

45. **Sphærocaryum.** *S. elegans* (V.258). Fl. Mar., Sept.

46. **Polypogon.** *P. monspeliensis* (V.259). Fl. Mar., Apr., Sept.

47. **Sporobolus.** *S. diander* (V.260). Fl. Feb., May.

S. indicus (V.261). Fl. Mar., May. Oct., Nov.

S. virginicus (V.262). Fl. Feb., Aug., Dec.

S. tremulus (V.263). Fl. Feb., Aug., Dec.

S. orientalis (V.263). Fl. Aug.

S. coromandelianus (V.264). Fl. Feb., Dec.

48. **Calamagrostis.** *C. pilosula* (V.264). Fl. Feb., Apr., Aug.

49. **Avena.** *A. aspera* (V.265). Fl. Jan.–Mar., May.

50. **Eriachne.** *E. triseta* (V.266). Fl. Nov.

51. **Zenkeria.** *Z. obtusiflora* (V.267). Fl. Apr.

Z. elegans (V.268). Fl. Feb., Sept., Nov.

52. **Cœlachne.** *C. pulchella* (V.269). Pinnewela, Balangoda! Fl. Jan., Mar., Apr., Sept.

C. perpusilla (V.270). Fl. Mar.–May, Aug., Sept.

53. **Oropetium.** *O. Thomæum* (V.271). Fl. Feb., Dec.

54. **Enteropogon.** *E. melicoides* (V.272). Fl. Dec.

55. **Tripogon.** *T. bromoides* (V.273). Fl. Jan., Feb., Aug., Sept.

56. **Cynodon.** *C. Dactylon* (V.274). Nuwara Eliya! Maskeliya! Talawakele! Adam's Peak (ascent on Maskeliya side)! Fl. May.

57. **Chloris.** *C. incompleta* (V.275). Fl. Jan.–Mar., Dec.

C. barbata (V.275). Fl. Dec.

C. montana (V.276). Fl. Feb.

58. **Eleusine.** *E. indica* (V.277). Talawakele! Fl. May.

E. verticillata (V.277). Fl. Sept.

E. brevifolia (V.278). Fl. Feb., Dec.

E. ægyptiaca (V.279). Fl. Feb. Mr. Jowitt says that the name Wal-kurakkan, Sinh., belongs to the last named, *E. indica* being called Bala-tana.

60. **Dichætaria.** *D. Wightii* (V.281). In localities, *omit* "dry region." Dumbara! Deyandara! Fl. May, Dec.

61. **Leptochloa.** *L. uniflora* (V.282). Fl. Feb., Apr., June, July.

L. polystachya (V.282). Fl. Mar., Dec.

L. chinensis (V.283). Fl. Sept.

62. **Gracilea.** *G. nutans* (V.284). Fl. Feb.

63. **Pommereulla.** *P. Cornucopiæ* (V.286). Fl. Feb.

64. **Phragmites.** *P. Karka* (V.287). Fl. Feb.

65. **Elytrophorus.** *E. articulatus* (V.288). Fl. Feb., Mar.

66. **Myriostachya.** *M. Wightiana* (V.288). Fl. Aug.

67. **Eragrostis.** *E. tenella* (V.290). Fl. Feb., July, Sept., Oct.

E. interrupta (V.292). Fl. Feb., Aug., Sept., Dec.

E. amabilis (V.293). Fl. Jan.–Mar., Aug.–Oct.

E. gangetica (V.293). Fl. Mar., May.

E. stenophylla (V.294). Fl. Sept.

E. elongata (V.295). Fl. Mar., Apr.

E. nigra (V.295). Fl. Mar., May, Nov.

E. pilosa (V.296). Fl. Oct.

E. Willdenoviana (V.296). Fl. Feb., May.

E. major (V.297). Fl. July, Dec.

E. coromandeliana (V.298). Trincomalee! Kalutara! Kurunegala! Fl. Dec.

E. secunda (V.298). Fl. Feb.

69. **Diplachne.** *D. fusca* (V.300). Fl. Feb.

70. **Streptogyne.** *S. gerontogea* (V.301). Fl. Jan., Dec.

71. **Lopatherum.** *L. gracile* (V.302). Top of Ritigala! Fl. Mar., Dec.

L. zeylanicum (V.303). Fl. Sept., Dec.

72. **Centotheca.** *C. lappacea* (V.304). Top of Ritigala! Fl. Mar., May.

73. **Æluropus.** *A. villosus* (V.304). Fl. Feb.

74. **Poa.** *P. annua* (V.306). *For* Dambulla (twice) *read* Dimbula. Dimbula! Bandarawela! Fl. Mar., Sept.

75. **Brachypodium.** *B. sylvaticum* (V.306). Fl. Feb.

76. **Lepturus.** *L. repens* (V.307). Fl. Jan., Dec.

77. **Arundinaria.** *A. Walkeriana* (V.309). *For* Wallakelle *read* Wattekelle. Fl. Mar., Aug., Sept.

A. Wightiana (V.309). Fl. Aug., Sept.

A. floribunda (V.310). Fl. Oct., Nov.

A. debilis (V.311). Fl. Feb., Aug.

A. densifolia (V.312). Fl. Sept.

78. **Bambusa.** *B. arundinacea* (V.313). Fl. Jan.

79. **Oxytenanthera.** *O. Thwaitesii* (V.316). Fl. Feb., May.

80. **Teinostachyum.** *T. attenuatum* (V.317). *For* Dambulla *read* Dimbula. Fl. Apr.

81. **Ochlandra.** *O. stridula* (V.318). Fl. Apr.

A Note on Podadenia Sapida.

BY

J. C. WILLIS.

THE account of this endemic genus of the Euphorbiaceæ, given in Trimen's Flora, Vol. IV., p. 62, suffers from lack of material, and I take the opportunity to amplify it, having received a large supply of fruiting material through the kindness of Mr. W. Ferguson, of Ratganga estate, Ratnapura.

Mr. Ferguson says (under date September 27, 1910) that "it is common in the jungle belts on this estate up to 2,800 feet. Trimen's description is not good. The fruit he describes as indehiscent, but as you will see they are dehiscent. The seeds, he says, are 2 or 1. I have seen 3 in all the fruits I have examined. The leaf has a swelling at its junction with the petiole, which makes me think it is unifoliate. The fruit description as "fleshy" seems hardly correct, and the "large-stalked glandular processes" seem very vague.

"There is a mucilaginous excretion covering the fruit, which stains the hands as if with gamboge.

"I have tasted one of the fruits. It is not unpleasant, but would have to be an acquired taste with most people.

"I thought I knew all the jungle edible fruits, and when I saw (Tamil) coolies eating these was rather puzzled. When I asked them what they called them they gave the name of rambutan* (*cumbli musi palam*), and when I asked a Sinhalese carpenter he said he had seen them before in the Kandy District; but no one else seems to have known anything of them.

"I find I was wrong in describing it as a tree 30 feet high, as I have seen them much higher since I wrote."

* Really the name of *Nephelium lappaceum*.

To this we may add :—

Leaves to 10 in. by 6 in., entire obovate to oval, acute at base, very shortly acuminate, hairy on the veins above and below, with a few scattered hairs on the underside, penni-nerved with veins prominent below, and with stout joint at the base of the blade ; petiole to 2 in., cylindrical tomentose.

Inflorescence terminal, a simple panicle with fulvous tomentum, and covered with glandular stout hairs about 1/16 in. long.

Fruit $1\frac{1}{2}$ in. long, nearly spherical, red, covered with glandular stipes with green heads, of all lengths to $\frac{3}{8}$ in. ; dehiscent, with seeds 3, or more often 2, sometimes 1.

The Flora of Naminakulikanda, a somewhat isolated Mountain in the Province of Uva.

BY

J. C. WILLIS.

IN a paper on the Flora of Ritigala, an isolated mountain in the North-Central Province,* it was shown that the flora of that hill was made up largely of "wet-zone" plants, which must have been carried there over a distance of 40 miles; and in the total of 103 there are at least 10 endemic

* Ann. Perad., III., 1906, p. 271.

forms, including 3 or 5 species. From these facts, in a further paper,* we deduced some evidence against natural selection as a producer of species. In a third paper† we gave the species confined to hill tops in Ceylon, producing the remarkable number of 108 cases, showing that the Ceylon hill tops were, therefore, like such a group of oceanic islands as the Galapagos, each tending to have its own species.

In the present paper we deal with the flora of Naminakuli-kanda, the conspicuous mountain facing Hakgala, but at a considerable distance away, in the eastern mountain chain of Ceylon. The general trend of the mountain chains of Ceylon may be roughly indicated by the diagram on page 217.

Naminakuli is thus distinctly out of the line of the monsoons, though it may exchange plants with the lofty Haputale ridge, from which it is only distant about 10 miles. All the mountain country here shown is "wet," and Naminakuli is consequently not nearly so isolated as Ritigala, and one will not expect to find upon it so large an endemic element. That one finds any at all is a very striking fact, when one realizes how near it is to other peaks and ridges of almost equal height.

We visited the mountain on two occasions, in March and September respectively, and must express our thanks to Mr. John Rettie of Glen Alpin estate, who kindly allowed us the use of a bungalow which he has built upon the summit, and thus rendered easy what would otherwise have been a most toilsome task. We also sent the plant collector to the top on other occasions, and the result of these various collections is given below :—

1. Michelia nilagirica Zenk. A form rather distinct from any in the Peradeniya herbarium, drying brown, not gray, beneath as well as above ; leaves oval-lanceolate to 3½ in.
2. Cardamine africana L., at 4,000 ft.
3. Viola serpens Wall.
4. Scolopia crassipes Clos.
5. Pittosporum tetraspermum W. & A.
6. Polygala arillata Ham.
7. Calophyllum Walkerii Wight.

* Ann. Perad., IV., 1907, p. 1.
† Ann. Perad., IV., 1908, p. 131.

8. Eurya japonica Thunb. (?) This and a specimen found at Horton Plains are very close to E. acuminata DC., and closer examination of these species is required.

9. Elæocarpus glandulifer Mast.

10. Acronychia laurifolia Bl.

11. Toddalia aculæta Pers.

12. Mappia ovata Miers.

13. Ilex Walkeri Wight & Gardn. Some have very large leaves 2 in. long, markedly toothed, and inclined to be acuminate.

14. Euonymus revolutus Wight.

15. Microtropis ramiflora Wight.

16. Vitis gardneri Laws.

17. Rubus lasiocarpus Sm.

18. Photinia notoniana W. & A.

19. Serpicula hirsuta W. & A.

20. Rhodomyrtus tomentosa Wight.

21. Eugenia Fergusoni Trim. (??)

22. E. subavenis Duth. (?)

23. E. revoluta Wight.

24. E. rotundifolia Wight.

25. E. oligantha Duth. (?)

26. E. mabæoides Wight. (?) Most of these Eugenias were not in flower.

27. Osbeckia rubicunda Arn. Rather small flowered.

28. Sonerila zeylanica W. & A. A form with the leaves hairy below.

29. Memecylon varians Thw., var. rotundatum Thw. (?) No flowers.

30. Casearia coriacea Thw.

31. Hydrocotyle javanica Thunb.

32. Allæophania decipiens Thw.

33. Hedyotis nodulosa Arn.

34. H. Lessertiana Arn., var. confertiflora Thw.

35. H. Lawsoniæ W. & A.

36. Urophyllum zeylanicum Thw.

37. Knoxia platycarpa Arn., var. hirsuta Thw., and var foliosa Thw.

38. Psychotria bisulcata W. & A.

39. Chasalia curviflora Thw.

40. Lasianthus varians Thw.

41. Vernonia Wightiana Arn.

42. V. pectiniformis DC. A form with good petioles, leaves hardly reflexed at margins, and ten clear ribs on the achene.

43. Blumea hieraciifolia DC.

44. Anaphalis cinnamomea Clarke.

45. A. oblonga DC.

46. Chrysogonum heterophyllum Clarke.

47. Emilia zeylanica Clarke, var. walkeri Trim.

48. Senecio Walkeri Arn.

49. Lobelia nicotianæfolia Heyne, and also var. trichandra Wight.

50. Vaccinium Leschenaultii Wight. Flowers bright red.

51. Gaultheria fragrantissima Wall.

52. Rhododendron arboreum Sm.

53. Ardisia pauciflora Heyne (?)

54. Myrsine capitellata Wall. (?), var. sessiliflora Thw.

55. Isonandra lanceolata Wight, var. montana Thw.

56. Symplocos furcata Brand. (obtusa Wall.) (?), var. major Thw.

57. S. læta Thw.

58. S. latiflora Clarke.

59. S. minor Clarke. Agrees closely with var. glabrescens Thw., which by the way is not glabrous beneath ; the first specimen on sheet C. P. 2,204 is, but not the rest, which are hairy along the veins.

60. S. pendula Wight (pauciflora Wight).

61. Gymnema pergularioides Wight & Gardn.

62. Dregea volubilis Benth. (?)

63. Cynoglossum micranthum Desf., var. decurrens Moon.

64. Solanum nigrum L.

65. Sopubia delphinifolia G. Don.

66. Strobilanthes viscosus And.

67. Plectranthus Gardneri Thw., var. **Jowittii**, a well-marked form, to be described later.

68. Pogostemon heyneanus Benth.

69. P. hirsutus Benth.

70. Leucas biflora Br.

71. Piper Thwaitesii Cas. DC.
72. Loranthus sclerophyllus Thw.
73. L. neelgherrensis W. & A.
74. L. loniceroides L.
75. Viscum japonicum Thunb.
76. Glochidion coriaceum Thw. (?)
77. Aporosa fusiformis Thw. (?)
78. Daphniphyllum glaucescens Bl.
79. Pilea trinervia Wight.
80. Elatostema lineolatum Wight. Leaves almost entire.
81. Debregeasia velutina Gaud.
82. Oberonia Wightiana Lindl.
83. O. scyllæ Lindl. (?)
84. Cirrhopetalum Wightii Thw. (?)
85. C. Thwaitesii Rchb. (?)
86. Eria bicolor Lindl.
87. Ipsea speciosa Lindl.
88. Calanthe veratrifolia Br., var. discolor Lindl.
89. Saccolabium filiforme Lindl.
90. S. brevifolium Lindl.
91. Cleisostoma tenerum Hook. f.
92. Spiranthes australis Lindl.
93. Smilax zeylanica L.
94. **Smilax Rettiana** Willis. A new species, to be described in a later paper.
95. Asparagus zeylanicus Hook. f.
96. Dianella ensifolia Redouté.
97. Cyanotis villosa Schultes f. (?)
98. Juncus prismatocarpus Br.
99. Bulbostylis capillaris Kunth, var. trifida Clarke.
100. Scleria chinensis Kunth, var. biauriculata Clarke.
101. Carex longipes D. Don. (?)
102. C. Walkeri Arn.
103. C. spicigera Nees.
104. C. lindleyana Nees.
105. C. filicina Nees.
106. C. maculata Boott. (?)
107. Isachne Kunthiana W. & A.
108. I. Walkeri W. & A.

109. I. Gardneri Benth.
110. Oplismenus compositus Beauv.
111. Arundinella villosa Arn.
112. Pollinia phæothrix Hack.
113. Arundinaria floribunda Thw.
114. Lycopodium phlegmaria L.
115. Psilotum triquetrum Sw.
116. Hemitelia Walkeræ Pr.
117. Dryopteris calcarata O. Ktze. (?)
118. D. sparsa O. Ktze.
119. Polystichum auriculatum Pr.
120. P. aculeatum Schott, var. anomalum Hk. & Arn.
121. Nephrolepis cordifolia Pr.
122. Humata vestita Moore.
123. Lidnsaya decomposita Willd.
124. Diplazium maximum C. Chr.
125. Asplenium caudatum Forst.
126. Blechnum Patersoni Mett.
127. Pteridium aquilinum Kuhn.
128. Antrophyum plantagineum Kaulf.
129. Polypodium hastatum Thunb.
130. Gleichenia linearis Clarke.

Considering that any of these species could reach the top of Naminakuli by easy stages, the hill being joined by hill tops at an average level of 5,000–5,500 ft. to the other high summits of the montane zone (it is itself 6,680 ft. high), to discuss the methods of transport in detail would be futile. It will suffice to call attention to the fact that on the extreme summit, which *is* isolated by some miles from others even nearly as high, there occur one endemic species, *Smilax Rettiana*, and one endemic variety, *Plectranthus Gardneri*, var. *Jowittii*, besides small variations in quite a number of species. The Smilax may be bird-carried, but the Plectranthus must probably have come by easy stages, and developed the new variety as it ascended the higher summit levels of the mountain from the point where it first arrived.

There is thus evidence to support the views to which expression was given in the paper on Ritigala from the facts observed on this comparatively little isolated mountain.

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Ustilagineæ and Uredineæ of Ceylon.

(*A Preliminary List.*)

BY

T. PETCH, B.A., B.Sc.

IN their "Fungi of Ceylon" Berkeley and Broome enumerated 44 species of *Ustilagineæ* and *Uredineæ*. Subsequent examinations by various mycologists have reduced that number to 36. The present list, which contains 130 species, does not make any pretence to completeness, but merely records those which have been collected at Peradeniya and, practically by chance, during visits to different parts of the planting districts. Systematic collecting would be certain to increase this number considerably, especially in the hotter and drier districts, in which very little has yet been done. It may be noted that those of the older records which have not been confirmed relate chiefly to species in those districts.

Attention may be specially directed to the notes on *Ustilago spermoidea*, *Thecaphora inquinans*, *Th. Berkleyana*, *Puccinia congesta*, *P. tremandræ*, *Uredo gossypii*, and *Ravenelia macrocystis*.

USTILAGINEÆ.

Ustilago Pers.

Ustilago Grewiæ (Pass.) P. Henn.

On *Grewia columnaris* Sm., Maha Illuppallama, August. 1910, coll. E. E. Green.

Ustilago emodensis Berk. (*Ustilago Treubii* Solms).

Abundant on *Polygonum chinense* L., Hakgala. This species was described and figured by Solms Laubach under the name of *Ustilago Treubii*, in Ann. Jard. Bot. Buitenzorg, VI., p. 79. Massee (Text book of Plant Diseases, 1899, p. 216) has pointed out that it was previously described by Berkeley.

According to Berkeley the spores are smooth and very minute; but in the description in Saccardo (furnished by Cooke) they are said to be "subtiliter rugulosis," 12–15μ diameter. Massee states (*loc. cit.*, pp. 402–3) that they are smooth and 5–6μ diameter, while Dietel (Engler-Prantl, Pflanzenfamilien) gives them as smooth and 4μ diameter. McAlpine (Smuts of Australia, p. 164) states that in a specimen from Java examined by him the spores were globose to ellipsoid, very delicately echinulate, and 7–8μ diameter, or 7–8 × 5–6μ, violet-tinted. He also quotes a communication from Kew to the effect that the type specimen of *emodensis* has irregularly globose spores, violet, thick-walled, almost smooth, and measuring 5–7μ, and that it agrees with *Ustilago Treubii* Solms (Exsicc., No. 56).

In Ceylon the fungus forms either spherical galls in the inflorescence, or clustered conical outgrowths on the stem, which agree exactly with the figures of the Javan species. In both situations the spores are spherical, 7–10μ, with a few irregularly ellipsoid, 7–10 × 5–7; they have a pronounced violet tint, and an epispore so closely and regularly warted that it appears reticulated in certain aspects.

Ustilago Scleriæ Tul.

Recorded by Berkeley and Broome, Fungi of Ceylon, No. 841 (Thwaites 450, 459).

Ustilago endotricha Berk.

On *Carex bengalensis* Thw. (= *C. indica* L.), Dolosbage, May, 1868 (Berkeley and Broome, No. 843). Abundant at Hakgala on *Carex baccans* Nees.

All the specimens of *endotricha* at Kew are marked *trichophora* by Berkeley, one Ceylon specimen being labelled var. *Thwaitesii*. Berkeley and Broome give the spores of the Ceylon species 5–12·5 × 4–10μ, and state that there are more fibres than in the New Zealand species on *Gahnia*, from which it was first described. The Ceylon species certainly is more woolly, according to the Kew specimens, and it is olive, whereas the New Zealand specimens at Kew are black. Spores of the latter (Kew specimen) are blackish olive, minutely warted, globose, 5–7μ diameter. Spores of the Ceylon species are pale olive, ellipsoid, coarsely warted with dark warts, 5–9 × 4–6μ (Kew specimens); ellipsoid, 5–11 × 4–6μ, or globose, 5–7μ (Peradeniya herbarium); 5–11 × 4–7μ, or globose, 4–7μ diameter (fresh specimens, Ceylon). The spores of the fresh specimens are darker than those in the herbarium. The filaments in the Ceylon species are greenish olive, up to 40μ diameter and several millimetres in length, composed of numerous parallel hyphæ. It would appear that the Ceylon species is identical with *Ustilago olivacea* (DC.) Tul.

Ustilago digitariæ (Kze.) Rabh.

On *Panicum repens* L., Bandarawela, April, 1908; Hakgala, October, 1908; Haputale, March, 1912.

Ustilago anthistiriæ Petch.

In ovaries of *Anthistiria tremula* Nees, Peradeniya, May, 1908.

Ustilago tonglinensis Tracy & Earle.

On *Ischæmum ciliare* Retz., Peradeniya, April, 1907, &c.; Bandarawela, April, 1908. In the ovaries, or converting the whole inflorescence into a black mass, surrounded by a thin white membrane. Spores 11–13μ, blackish olive, rough, with close-set warts.

Ustilago spermoidea B. & Br.

In the ovaries of Citronella grass (Lena batu), February, 1908, leg. J. F. Jowitt. *Andropogon nardus* L., Bandarawela, March, 1908; Hakgala, April, 1907. *Andropogon venustus* Thw., Peradeniya, May, 1908.

This species was originally recorded by Berkeley and Broome as "On *Cymbopogon Martii*." The herbarium specimen at Peradeniya is marked *Cymbopogon Martini*, which, as understood by Thwaites, is a synonym of *Andropogon nardus*. Spores subglobose, almost smooth, 7–10μ. It would seem probable that *Ustilago nardi* Syd. & Butl. is the same species.

Cintractia Cornu.

Cintractia axicola (Berk.) Cornu.

On *Fimbristylis diphylla* Vahl., Bandarawela, April, 1908.

In Grevillea, XIX., p. 53, Cooke writes : " There has been some error in regard to this species. The original type specimen from St. Domingo is not a *Cintractia* but an *Ustilago*, as are also Australian specimens. The variety B from Alabama is the *Cintractia*, from which a fragment must have been sent to M. Cornu, without examination, under the impression that all the specimens under the same name in the Berkeley herbarium were the same species. Hence there are two species, *Ustilago axicola* (B.) from St. Domingo and Australia, and *Cintractia axicola* (B.) from North America. The former is probably the same as "*Ustilago fimbristylis* Thuem." But McAlpine, in " The Smuts of Australia," describes and figures the Australian species as *Cintractia axicola* (Berk.) Cornu, with the synonyms *Ustilago axicola* Berk. and *Ustilago fimbristylis* Thuem.

Cintractia peribebuyensis Speg.

On *Cyperus distans* L.f., September, 1909, leg. C. Drieberg.

Cintractia leucoderma (Berk.) P. Henn.

On *Rynchospora aurea* Vahl., Ratnapura (B. & Br., No. 840).

Cintractia sorghi-vulgaris (Tul.) Clint.

On *Andropogon sorghum* Brot., Maha Illuppallama, February, 1911.

Sphacelotheca De Bary.

Sphacelotheca hydropiperis (Schum.) De Bary.

Abundant on *Polygonum minus* Huds., Nuwara Eliya, September, 1908.

Sorosporium Rud.

Sorosporium paspali McAlpine.

On *Paspalum scrobiculatum* L., Peradeniya, September, 1907.

Spores subglobose 11–13μ, or irregularly oval 9–10 × 13–15μ, blackish yellow-brown, smooth or very finely warted.

In the inflorescence, converting the whole into a black mass enclosed in the leaf.

Sorosporium andropogonis-aciculati Petch.

= *Ustilago andropogonis-aciculati* Petch, Ann. Perad., IV., p. 303.

Spores at first in balls up to 80μ diameter, readily separating. Spores spherical, olivaceous, smooth, 5μ diameter. In the inflorescence, which it converts into a black mass enclosed within the sheath.

Thecaphora Fing.

Thecaphora inquinans B. & Br.

This was described by Berkeley and Broome from specimens on *Paspalum scrobiculatum* L., collected by Thwaites in Dolosbage, May, 1868. Their description is: "Semina tota implens; sporis angulatis conglomeratis; pedicellis elongatis pellucidis. Spores 3–7 together, ·0004–·0007 (inches) across collectively. Turning the whole contents of the seed into a black powder." In Grevillea, XVIII., p. 19, it is said to be identical with *Cerebella paspali* Cke. & Mass. (Grev., XVI., p. 20). In Saccardo, IX., p. 290, it is listed as *Cerebella inquinans* Cke. & Mass.

The specimens at Kew are all of them Thwaites 588. The mounted specimen from Herb. Berk. consists of three inflorescences, from which most of the fruits have disappeared, and shows nothing, except in one spot where four fruits are bound together by what appears to be a developing *Cerebella*. The packet of duplicates from Herb. Berk. contains several inflorescences which bear an undoubted *Cerebella*, well developed but somewhat mouldy; in addition there are numerous detached fruits, but I was unable to find that any of them contained a black powder. The co-type from Herb. Cooke appears to be quite sound, without any fungus of any description. Berkeley's drawing shows a piece of the stroma of a *Cerebella*.

Berkeley and Broome's description suggests that they had before them the *Sorosporium* which has been listed above as *Sorosporium paspali* McAlp.; but there is nothing in the specimens to support that view, and it would therefore appear that their description, "Turning the whole contents of the seed into a black powder," was a mistake. According to the specimens, the species must be known as *Cerebella inquinans* (B. & Br.).

Thecaphora Berkeleyana Fischer.

This was recorded by Berkeley and Broome as *Polycystis macularis* B. & Br. "Soris brevibus spicicolis; sporis globosis paucicellulosis. On *Andropogon perforatus*, Damboul, March, 1868."

Fischer, in "Apercu systematique des Ustilaginees," p. 38, refers to it as *Urocystis macularis* (B. & Br.) Fischer, and mis-translates "Soris brevibus spicicolis" as "en sores courts et peu pointus." In "Les Ustilaginees et leurs plantes nourricieres" he names it *Thecaphora Berkeleyana*, and gives a re-description based upon a specimen sent by Berkeley. Finally, in Grevillea, XVII., p. 19, Cooke states that it is identical with *Cerebella andropogonis* Ces.

It is evident that the name *Andropogon perforatus* is an error, since that grass does not grow in Ceylon. The name has been queried on the specimen in Herb. Kew, and some one has added *Andropogon faveolatus* Delile, which again is not a Ceylon species. An examination of the *Andropogon* shows that it is *Andropogon pertusus* Willd., "*perforatus*" being apparently a slip on Thwaites' part, since the name is in his handwriting.

The type specimen in Herb. Kew contains *Andropogon pertusus* Willd. and ? *Paspalum* sp., while the packet of duplicates contains, in addition, ? *Eragrostis* sp. The fungus on *Andropogon pertusus* is immature; it is probably immature *Cerebella andropogonis*, but it has not reached the stage at which the brain-like structure of the latter is evident; it forms very minute firm stromata on the exterior of the fruits, with spores up to 10μ diameter. The ? *Paspalum* bears an undoubted *Cerebella*, which is probably *Cerebella inquinans* (B. & Br.). Very little is left of the specimen on ? *Eragrostis*, and what there is might be immature *Cerebella* or *Balansia*, &c.; I was not able to find any spores.

The fungus described by Berkeley and Broome was on the *Andropogon ;* and as far as can be ascertained it is the species which had previously been described by Cesati as *Cerebella andropogonis.* All the other names are therefore unnecessary.

UREDINEÆ.

Uromyces Link.

Uromyces appendiculatus (Pers.) Link.

(= *Uredo Dolichi* B. & Br., *fide* Sydow, Mon. Ured., II., p. 120.)

On *Phaseolus vulgaris* L., Peradeniya, May, 1905, &c.

On *Phaseolus lunatus* L., Kalutara, June, 1910. On *Vigna Catiang* Engl., Peradeniya, June, 1910. On *Psophocarpus tetragonolobus* DC., Peradeniya, June, 1910.

Uromyces fabæ (Pers.) De Bary.

On *Vicia faba* L., Hakgala, September, 1908.

Uromyces Mucunæ Rabh.

On leaves of *Mucuna puriens* DC., Peradeniya, June, 1910.

Uromyces pseudarthriæ Cooke.

On leaves of *Pseudarthria viscida* W. & A., Gangaruwa, June, 1910.

Uredo-sori minute, scattered or crowded, about 0·25 mm. diameter, on the under surface of the leaf, cinnamon-brown. Uredospores globose or ovoid, pale brown, echinulate, with short scattered spines, 19–27 × 17–20μ.

Teleuto-sori black-brown, minute, gregarious, on the under surface of the leaf ; spores usually spherical, 21–25μ diameter, or ovoid, 26–28 × 18–21μ, dark brown, wall about 4μ thick, covered with very short, close-set, blunt spines ; pedicel hyaline, short (4μ) or absent.

Uromyces Vestergreni Syd.

(= *Uromyces verruculosa* B. & Br.)

On leaves of *Bauhinia tomentosa* L., Damboul, March, 1868 (Thwaites).

Uromyces Blainvilleæ Berk.

On *Blainvillea latifolia* DC., Batticaloa. 1858 (Thwaites).

Uromyces bidentis Lagh.

Uredo. On leaves of *Bidens pilosa* L., Passara, April, 1908; Hakgala, September, 1908.

Uromyces echinulatus Niessl.

On leaves of *Bassia longifolia* L., Peradeniya, June, 1908.

Spots up to 5 mm. diameter, upper surface purple-red with a yellowish margin, lower surface purple and swollen. Sori encircling the spot, hypophyllous, purplish than black, minute, surrounded by the upturned epidermis. Spores black in mass, dark brown when magnified, pyriform, covered with scattered conical spines about 3μ high, apex of spore thickened, 38–40 × 27–28μ; pedicel deciduous, sometimes a short remnant persisting.

The cuneate spores with a long pedicel, referred to in the original description, are immature. H. & P. Sydow consider that the fungus is a Uredo only (Ann. Myc., VI., p. 139).

Uromyces Scleriæ P. Henn.?

The species recorded by Berkeley and Broome, on *Scleria zeylanica* Poir., Pasdun Korale, July, 1868, under the name of *Uredo rubigo vera* DC., is probably *Uromyces Scleriæ* P. Henn. (Uredo only).

Uromyces linearis B. & Br.

On *Panicum repens* L., Peradeniya, March, 1868 (Thwaites). On *Panicum repens*, Passara, April, 1908; Hakgala, September, 1908, May, 1910. A Uredo on *Panicum montanum* Roxb., Peradeniya, April, 1909, probably belongs to this species.

Sori linear, dark brown, long. Uredospores thick-walled, yellow-brown, somewhat fuscous, echinulate, globose, 20–25μ, or ovoid, 21–27 × 17–21μ. Teleutospores dark yellow-brown, smooth, wall 4μ thick, 5μ at the apex, sometimes slightly apiculate, globose, 21–30μ, or ovoid, 25–28 × 20–21μ; pedicel tapering, thick-walled, yellow-brown, 25–48μ long, up to 9μ diameter above, 4μ diameter below.

Uromyces apludæ Syd. & Butl.

On *Apluda varia* Hack., Gangaruwa, June, 1910.

Uromyces eragrostidis Tracy.

On *Eragrostis nigra* Nees, Hakgala, May, 1910.

Puccinia Pers.

Puccinia droogensis Butl.

On leaves of *Berberis aristata* DC., Nuwara Eliya, April, 1908.

Puccinia heterospora B. & C.

(= *Uromyces Thwaitesii* B. & Br.)

" On leaves of *Sida humilis* Willd. and *S. hirsuta*, Peradeniya, Jan., 1855, Dec., 1867 " (Thwaites). On *Sida humilis* Cav., Galle, January, 1908. On *Sida cordifolia* L., Tumpalamcholai, April, 1908. Thwaites's specimen in Herb. Peradeniya (No. 450) is on *Sida humilis* : what " *Sida hirsuta* " indicates is not known.

Puccinia abutili B. & Br.

On leaves of *Abutilon graveolens* W. & A., Kandy, February, 1868 (Thwaites).

Puccinia lateritia B. & C.

On leaves of *Hedyotis Lessertiana* Arn., Hakgala, May, 1910.

Puccinia spongiosa B. & Br.

On leaves of *Webera corymbosa* Willd., Minuwangoda, December, 1908 ; Gangaruwa, December, 1908. leg. Dr. Werner Magnus.

Puccinia Sonchi Rob. et Desm.

On leaves of *Sonchus* sp., Haputale, March, 1912. Uredo.

Puccinia Vernoniæ Cke. ?

On leaves of *Vernonia Hookeriana* Arn., Peradeniya, June 1910. Uredo only.

Sori minute, on red-brown spots when old, scattered, hypophyllous. Spores globose, 19–21μ, or oval or pyriform, 20–24 × 16–20μ echinulate, pale brown or hyaline, rather thick-walled. Paraphyses clavate, septate, thick-walled, 36–50 × 12–16μ.

Puccinia Lorentzii P. Henn. ?

Uredo only. On leaves of *Vernonia cinerea* Less., Peradeniya, December, 1908. On leaves of *Vernonia Wightiana* Arn., Hakgala, May, 1910. Differs from the foregoing in the absence of paraphyses.

Puccinia exhauriens Thüm.

On leaves of *Jasminum flexile* Vahl., Hakgala, May, 1910.

Puccinia Tabernæmontanæ B. & Br.

On *Tabernæmontana dichotoma* Roxb., common. Peradeniya, Waga, Minuwangoda, &c.

Æcidia (*Æcidium ceraceum* B. & Br.) orange on yellowish, bullate, waxy-looking spots on the leaf, amphigenous, or on strongly swollen areas on the petioles and stems; crowded, 0·3–0·4 mm. diameter, cylindrical, up to 2·5 mm. high. The æcidia on the galls on the stem are usually higher than those on the leaf. Pseudoperidium thin, hyaline, laciniate above; pseudoperidial cells, thin-walled, smooth, irregularly oval or oblong 50–65 × 20–36μ. Æcidiospores irregularly oval, verrucose, with large flattened, simple, or elongated and branching warts, 58–76 × 32–38μ.

Uredo-sori circular, clustered or scattered, on yellowish green circular spots, chiefly hypophyllous, pale brown, about 0·25 mm. diameter. Uredospores 40–50 × 33–34μ, brownish yellow, echinulate, with strong conical spines.

Teleutosori dark brown, with the uredo. Teleutospores reddish brown, oval or slightly clavate, slightly constricted, smooth, 42–50 × 24–27μ; pedicel short.

Puccinia Ruelliæ (B. & Br.) Lagh.

Uredo: on leaves of *Ruellia ringens* L. (= *prostrata*). Peradeniya, May, 1910, January, 1868 (Thwaites).

Puccinia Thwaitesii B. & Br.

On leaves of *Justicia gendarussa* Burm. f., Peradeniya, 1867, January, 1850 (Thwaites); Colombo, November, 1906; Kalutara, July, 1908; Bentota, October, 1908.

Puccinia Shiraiana Syd.

On leaves of *Justicia procumbens* L., Lunugalla, April, 1908.

Puccinia congesta B. & Br.

In the original description of this species the name of the host plant is not mentioned. It has been re-described by Lagerheim in Ured. Herb. El. Fries, p. 54, the host being unknown. The specimen in the Peradeniya herbarium is clearly marked "On *Polygonum chinense*," and it is common on that plant in Ceylon. It appears to be identical with *Puccinia Solmsii* P. Henn.

Pattipola, June, 1905, leg. E. E. Green; Hakgala, March, 1907, May, 1910; Gangaruwa, June, 1909.

Uredo-sori minute, gregarious, on minute purple spots, hypophyllous, circular, bright brown, up to 0·25 mm. diameter. Uredospores yellow-brown, echinulate, globose, pyriform, or ovoid, 21–25 × 17–22μ.

Teleutosori on circular spots up to 1 cm. diameter. Spots at first bright crimson on the upper surface, and depressed, then red-brown with a broad purple margin. Sori hypophyllous, circular, 0·25 mm. diameter, or elongated, becoming crowded and confluent, almost entirely covering the spots, compact, pale purple-brown. Teleutospores oblong, apex truncate or rounded, thickened, pale brown, constricted at the septum, lower cell often inflated and often oblique, 38–55 × 14–20μ; pedicel hyaline, persistent, 3–6μ thick, up to 80μ long. The teleutospores break up readily into two cells.

Puccinia ferruginea Lév.

On *Smilax zeylanica* L., æcidia, uredo, and teleutospores, Hakgala, September, 1908, May, 1910. On *Smilax aspera* L., uredo and teleutospores, Hakgala, March, 1907. On *Smilax* sp., uredo and teleutospores, Peradeniya, June, 1910, leg. E. E. Green.

Puccinia phyllocladiæ Cooke.

According to Sydow, Mon. Ured., this was collected in Ceylon by Thwaites; it was not recorded by Berkeley and Broome, nor is there any Ceylon specimen collected by Thwaites at Kew or Peradeniya. Recently collected on cladodes and stems of *Asparagus falcatus* L., Hakgala, May, 1910.

Æcidia on yellow swollen spots involving both sides of the cladode and forming ellipsoid galls up to 5 mm. long, 2 mm. broad, and 2 mm. thick. Æcidia on either side, in clusters of up to 20. Æcidia tubular, 0·3 mm. high, 0·2 mm. diameter, margin laciniate and slightly recurved; pseudoperidium white, æcidiospores in mass, orange-red. Pseudoperidial cells polygonal, very variable in size, 36–50 × 20–34μ, verrucose, with close-set, rather small warts and narrow ridges; wall 3μ thick. Æcidiospores irregularly oval or globose, contents orange; wall hyaline, up to 3μ thick, very minutely warted; 30–40 × 26–30μ.

Uredo-sori minute, elongated, ferruginous, on the cladodes. Uredospores oval, echinulate, pale brown, 35–48 × 21–25μ.

Teleutosori on stems and cladodes, scattered, circular, dark brown. Teleutospores globose, subglobose, or ellipsoid, not constricted, thick-walled, apex sometimes thickened up to 12μ, yellow-brown, 35–45 × 30–36μ; pedicel hyaline, thin, persistent, up to 70μ long.

Puccinia mysorensis Syd. & Butl.

On *Kyllinga brevifolia* Rottb., Pattipola, October, 1906; Hakgala, September, 1908. On *Kyllinga monocephala* Rottb., Peradeniya, October, 1906, December, 1906.

Puccinia flaccida B. & Br.

= *Diorchidium flaccidum* (B. & Br.) Lagh.

On leaves of *Panicum* sp., collected by Thwaites at Peradeniya, not found recently.

In the type specimen at Peradeniya most of the teleutospores have horizontal or oblique septa and measure 34–40 × 18–20μ, a few with vertical septa measure 28 × 30μ. Pedicel hyaline, 3μ diameter. Uredospores oval, echinulate, 30 × 19μ.

A *Uredo* on *Panicum antidotale* Retz., Peradeniya, April, 1909, may belong to this species. Sori without evident spots, crowded, amphigenous, oval, about 0·25 mm. long. Spores in mass golden brown, yellow-brown when magnified, rather thick-walled, oval, or subglobose, or pyriform, 27–30 × 21–24μ, some globose, 26–34μ, echinulate.

Puccinia substriata Ell. & Barth. ?

On leaves of *Panicum sanguinale* L., Peradeniya, May, 1910. Uredo only, Peradeniya, June, 1908.

Puccinia rufipes Diet.

On *Imperata arundinacea* Cyrill., Gatembe, April, 1907.

Puccinia pogonatheri n. sp.

On *Pogonatherum crinitum* Kunth., Hakgala, May, 1910.

Uredo-sori circular, oval, or elongated, 0·25–0·6 mm. long, on the under surface of the leaf, red-brown. Uredospores oval, dark brown, spinulose, 25–30 × 17–20μ; paraphyses capitate, dark brown, thick-walled, up to 66μ long, 6μ diameter below, inflated into a globose flattened head, up to 24μ diameter.

Teleutosori black, circular, 0·25 mm. diameter, or oval, up to 0·25 × 0·6 mm. Teleutospores dark brown, oval or oblong-oval, sometimes clavate, slightly constricted, apex thickened (up to 8μ), rounded, or obtusely pointed, 34–48 × 18–24μ; pedicel dark brown, paler below, tapering, persistent, 30–60 × 5–6μ.

Soris uredosporiferis hypophyllis, rotundatis, ovalibus, vel elongatis, 0·25–0·6 mm. longis, rubrobrunneis; uredosporis ovalibus, fusco-brunneis, spinulosis, 25–30 × 17–20μ. Paraphysibus capitatis, fusco-brunneis, incrassatis, usque 66μ longis, infra 6μ diametro, supra in caput globosum depressum usque 24μ diametro inflatis.

Soris teleutosporiferis nigris, rotundatis, 0·25 mm. diametro, vel ovatis, usque 0·25 × 0·6 mm.; teleutosporis fusco-brunneis, ovalibus vel oblongo-ovalibus, quandoque clavatis, leniter constrictis, apice incrassato (usque 8μ), rotundato vel obtuso, 34–38 × 18–24μ; pedicello fusco-brunneo, infra dilutiore, persistente, 30–60 × 5–6μ.

Puccinia nakanishikii Diet.

On leaves of *Cymbopogon confertiflorus* Stapf., Hakgala, September, 1908, May, 1910. On *Andropogon intermedius* Br., uredo only, Peradeniya, April, 1909.

Puccinia longicornis Pat. & Har. ?

Uredo only. On leaves of *Bambusa arundinacea* Willd., Peradeniya, January, 1910, &c. On *Bambusa vulgaris* Schrad., Katukende, January, 1912.

Spots pale brown, linear. Sori minute, chiefly hypophyllous, oval or circular, about 0·2 × 0·1 mm., pale ferruginous. Spores oval or pyriform, sometimes spherical, epispore hyaline, spinulose, contents yellow, 30–35 × 19–22μ. Paraphyses hyaline, curved, clavate, often irregularly nodulose, thick-walled, 60–70 × 10–12μ, almost solid, the cavity occupying one-half to two-thirds the length and situated nearer the concave side of the paraphysis. This Uredo was recorded by Berkeley and Broome as *Lecythea Baryi* Berk., on *Bambusa Thouarsii* (= *Bambusa vulgaris*), Fungi of Ceylon, No. 828.

[**Puccinia Tremandræ** B. & Br.

This was described by Berkeley and Broome on leaves of *Tremandra oppositifolia*, supposed to have been collected in Ceylon by W. H. Harvey. It was evident that some mistake had been made, since *Tremandra oppositifolia* is not a Ceylon plant and has never been grown in the Botanic Gardens ; but as there was no specimen of the fungus at Peradeniya, it was impossible to say whether the wrong locality or the wrong host plant had been given. On an examination of the type specimen at Kew, it was found to be marked " Fungus on leaves of *Tremandra oppositifolia* ; K.G.S." Reference to the phanerogamic collection disclosed the fact that Harvey had collected several examples of *Tremandra oppositifolia*, but these had all been gathered at King George's Sound. The fungus is therefore an Australian, not a Ceylon, species.

Hennings has described *Puccinia Pritzeliana*, on leaves of *Tremandra stelligera* R. Br. (= *T. oppositifolia*), from the neighbourhood of Perth (Western Australia), and stated that it is quite distinct from *Puccinia Tremandræ* from Ceylon.

An examination of the type specimen of the latter shows that it answers exactly to Henning's description and McAlpine's photograph of the spores of *P. Pritzeliana*. There can be no doubt that the two species are identical ; and they are on the same host plant and practically from the same district. Henning's name is therefore superfluous.]

Phragmidium Link.

Phragmidium ? orientale Syd.

On *Rubus moluccanus* L., Hakgala, May, 1910. On *Rubus ellipticus* Sm., Hakgala, May, 1910. Uredo only.

Paraphyses and spore wall yellow-brown, not hyaline, as in the description of *Phragmidium orientale*.

Triphragmium Link.

Triphragmium clavellosum Berk.

This was described by Berkeley in the Gardeners' Chronicle, 1857. It was subsequently recorded by Berkeley and Broome from Ceylon on *Paratrope terebinthacea*, and at the same time Berkeley and Broome described *Triphragmium Thwaitesii* on leaves of *Hedera Vahlii*, also from Ceylon. The names of the host plants are synonyms (= *Heptapleurum stellatum* Gærtn.), and, as Massee has already pointed out (Grev., XXI., p. 118), the fungi are identical.

In a recent re-description (Saccardo, XVI., p. 322) the spots are said to be fuscous, and the sori hypophyllous. In Ceylon the spots are yellow and bullate when fresh and the sori are epiphyllous.

Common. Lunugalla, April, 1908 ; Kandy, June, 1909 : Peradeniya, &c.

Hapalophragmium Syd.

Hapalophragmium derridis H. & P. Sydow.

On *Derris* sp., Maha-oya, April, 1908. On *Derris uliginosa* Benth., Peradeniya, May, 1908. On *Derris* sp., Haragama, July, 1910.

Ravenelia Berk.

Ravenelia ornata Syd.

On leaves of *Abrus precatorius* L., Peradeniya, May, 1908 March, 1909.

Ravenelia aculeifera Berk.

On *Mezoneurum enneaphyllum* W. & A., collected by Thwaites.

Ravenelia indica Berk.

On *Cassia absus* L., collected by Thwaites, Damboul, March, 1868. Berkeley and Broome state : " On *Bauhinia tomentosa* and *Cassia absus*." Dietel (Monographie der Gattung Ravenelia Berk., Beihefte zum Bot. Centralb., Bd. XX., Hft. 3, pp. 343–413) states that he has not seen a specimen on *Bauhinia*, and doubts the record. There is no specimen on *Bauhinia* in Herb. Peradeniya.

Ravenelia sessilis Berk.

On leaves of *Albizzia Lebbek* Benth., collected by Thwaites. Berkeley and Broome state that Thwaites 1135, on *Gleditschia*, is the same species. Dietel (*loc. cit.*) described the latter gathering as *Ravenelia zeylanica*, but subsequently withdrew the name, as the supposed *Gleditschia* leaves are really *Albizzia Lebbek* and the fungus *Ravenelia sessilis*.

Ravenelia Munduleæ P. Henn.

On leaves of *Mundulea suberosa* Benth., collected by Thwaites, but included by Berkeley and Broome under *Ravenelia stictica*.

Ravenelia stictica B. & Br.

On leaves of *Pongamia glabra* Vent., collected by Thwaites, Gatembe, April, 1907, &c.

Cooke separated *Ravenelia stictica* into *Ravenelia stictica* on *Pongamia glabra*, and *Ravenelia hobsoni* on an unknown leaf ; but, according to Dietel, the unknown leaf is really *Pongamia glabra*, so that although there were two species in *R. stictica*, Cooke's separation was incorrect.

Ravenelia Breyniæ Syd.

On leaves of *Breynia patens* Hk. f., Hakgala, March, 1907, May, 1910; Haputale, March, 1912.

A bush at Peradeniya has for some years borne a Uredo whose spores appear identical with those found among the teleutospores of the Hakgala specimens, but no *Ravenelia* has yet been found on it. These uredo-sori are amphigenous, either scattered, or clustered on pale yellow spots up to 2 mm. diameter, about 0·25 mm. diameter, circular, pale yellow, almost white. Spores oval or globose, almost hyaline, spinulose, 19–27 × 18–21μ. Paraphyses up to 100μ long, slightly inflated upwards, 8μ diameter at the apex, which is sometimes slightly capitate; wall thickened at the apex.

Ravenelia macrocystis B. & Br.

This was described by Berkeley and Broome as follows:—

'Pseudosporis e cellulis paucis magnis compactis e mycelio radiante oriundis (No. 515). On *Cassia Tora*, Damboul, March, 1868. Spores ·0015 (inches)."

Cooke (Journ. Roy. Microsc. Soc., XI., p. 387) stated that he had not seen a specimen. Dietel (Monographie der Gattung *Ravenelia*) states that specimens sent him from Kew did not show any of the fungus. The specimens at Kew from Herb. Berkeley and Herb. Cooke exhibit several patches of the fungus along the pieces of stem or along the veins of the leaves. Numerous circular black bodies, which to some extent resemble *Ravenelia* spores and correspond with Berkeley and Broome's figure, are crowded together, but they are seated upon a superficial mycelium which scales off when touched with a needle. The mycelium is fuscous and furnished with appressoria. From the various stages of these spore-like bodies, it is evident that they are the developing perithecia of a *Meliola*, or some allied species.

Hemileiopsis Rac.

Hemileiopsis Wrightiæ Rac.

On leaves of *Wrightia zeylanica* Br., Peradeniya, May, 1908.

Hemileia Berk.

Hemileia Canthii B. & Br.

On leaves of *Canthium campanulatum* Thw., Peradeniya, May, 1908 ; Minuwangoda, December, 1908.

The pustules are orange-red, deeper in colour and smaller than those of *Hemileia vastatrix* B. & Br. In the uredo-spores of *H. vastatrix* the processes are thicker, blunt, and more crowded, giving a broad toothed margin to the spore, which is not evident in *H. Canthii.* Massee (Diseases of Cultivated Plants and Trees, p. 330) states that *H. Canthii* is identical with *H. vastatrix*, but the experimental proof of that is wanting.

Hemileia vastatrix B. & Br.

On leaves of *Coffea arabica* L., and *Coffea liberica* Hiern., wherever these occur. On *Coffea bengalensis* Roxb., Peradeniya.

Melampsora Cast.

Melampsora ricini (Biv. Bernh.) Pass.

On leaves of *Ricinus communis* L., Gangaruwa, August 1905, &c.

Melampsora acalyphæ Petch.

On leaves of *Acalypha fruticosa* Forsk., Peradeniya, May, 1908.

Melampsora ? epitea (Kze. & Schm.) Thuem.

Uredo. On leaves of *Salix tetrasperma* Roxb., Hakgala, May, 1910.

Pucciniastrum Otth.

Pucciniastrum agrimoniæ (DC.) Diet.

On leaves and stems of *Agrimonia zeylanica* Moon, Hakgala, May, 1910.

Cronartium Fr.

Cronartium Premnæ n. sp.

On leaves of *Premna corymbosa* Rottl., Peradeniya, December, 1911.

Uredo-sori minute, orange, up to 0·2 mm. diameter, crowded, on the under surface of the leaf. Uredospores ovate, echinulate, contents yellow, wall hyaline, 20–28 × 16–19μ. Paraphyses hyaline, clavate, thick-walled, one-septate, irregular, 32–56 × 10–12μ.

Teleuto-tendrils dark brown, several millimetres in length, 50μ diameter. Teleutospores lozenge-shaped, 40–58 × 8μ.

Soris uredosporiferis minutis, usque 0·2 mm. diametro, aurantiacis, confertis, hypophyllis; uredosporis ovatis, echinulatis, episporio achroo, plasmate flava, 20–28 × 16–19μ; paraphysibus hyalinis, clavatis, incrassatis, uniseptatis, irregularibus, 32–56 × 10–12μ.

Soris teleutosporiferis elongatis, tenuissimis, circa 50μ diameter, fusco-brunneis; teleutosporis rhomboideis, 40–50 × 8μ.

Æcidium Pers.

Æcidium polyalthiæ n. sp.

On *Polyalthia longifolia* B. & Hk. f., Peradeniya, June, 1910.

Spots yellow, somewhat bullate, about 5 mm. diameter, becoming brown with a black border when old. Æcidia clustered, hypophyllous, 0·25 mm. diameter; pseudoperidium strongly developed, recurved and split, white; spores orange, in mass. Æcidiospores globose or ovate, 14–17 × 11–14μ, minutely verrucose. Pseudoperidial cells polygonal, verrucose, 17–19 × 12–15μ.

Maculis primum flavis, aliquanto bullatis, circa 5 mm. diametro, deinde brunneis margine nigro cinctis. Æcidiis confertis, hypophyllis, 0·25 mm. diametro, pseudoperidiis prominentibus, recurvis, fissis, albidis; æcidiosporis globosis vel ovatis 14–17 × 11–14μ, minute verrucosis, aurantiacis, cellulis pseudoperidii polyhedricis, verrucosis, 17–19 × 12–15μ.

Æcidium erythrobasis B. & Br.

On leaves of *Hibiscus collinus* Roxb., Damboul, March, 1868. Not collected recently.

Æcidia on the under side of the leaf, most along the midrib, but some on a blackish patch; crowded, up to 0·3 mm. diameter, pseudoperidium well developed, cylindric. Spores oval, minutely and closely warted, 24–32 × 18–20μ. Pseudo peridial cells polygonal, 20–25 × 16–18μ, strongly verrucose, with warts and sinuous ridges.

[**Æcidium hiptages** B. & Br.

On leaves of *Hiptage*, Peradeniya, January, 1868 (Thwaites). An examination of the type specimen of this species does not reveal any *Æcidium*. Some of the spots bear the clustered conidiophores of a *Cercospora*. It appears to be identical with a leaf spot, caused by a species of *Cercospora*, which is very common on *Hiptage Madablota* Gaertn. at Peradeniya.]

Æcidium toddaliæ Petch.

On leaves of *Toddalia aculeata* Pers., Nuwara Eliya, April, 1908, August, 1908; Hakgala, May, 1910.

Æcidium Petchii Sacc. & Trott. (= **Æc. paramignyæ** Petch.)

On leaves of *Paramygnya monophylla* Wight, Kandy, June, 1907, leg. E. E. Green; Kandy, June, 1910.

Æcidium Vignæ Cooke.

On leaves of *Vigna* sp., Gangaruwa, June, 1905.

Æcidium toræ P. Henn.

On leaves and stems of *Cassia Tora* L., Maha-oya, April, 1908; Peradeniya, June, 1910.

Æcidium flavidum B. & Br.

Collected by Thwaites on leaves of *Pavetta indica* L., Peradeniya, February, 1868. Specimens collected on leaves of *Pavetta hispidula* W. & A., Bentota, October, 1908, appear, from a comparison with the type specimen, to be the same. The following description was drawn up from the latter specimens.

Spots pale yellowish green, 1–1·5 cm. diameter, somewhat waxy-looking, slightly bullate. Æcidia numerous on either side of the leaf, but chiefly on the lower, concentrically arranged, up to 0·25 mm. diameter. Pseudoperidium white, recurved, strongly developed: mass of spores pale orange. Æcidiospores irregularly spherical, 17–20μ, or oval, 22–24 × 15–18μ, studded with close-set large warts. Pseudoperidial cells irregularly pentagonal or hexagonal, 30–36 × 16–22μ, covered with close-set coarse warts, often arranged in transverse rows or confluent in irregular ridges.

[**Æcidium Pavettæ** Berk.

There is no specimen of this at Kew, the British Museum, or Peradeniya. From the description it is by no means clear that it was an Æcidium.]

Æcidium ? iquitosense P. Henn.

On leaves of *Psychotria elongata* Hk. f., Hakgala, May, 1910. Æcidia amphigenous, on pale green blistered or swollen spots up to 3 mm. diameter, convex above, which become hard galls when old. Æcidia white, tubular, becoming funnel-shaped, 0·15–0·2 mm. diameter, up to 0·2 mm. high; pseudoperidium well developed, white; spores in mass, very pale yellow. Æcidiospores irregularly ovoid, hyaline, thin-walled, minutely and closely verrucose, 25–34 × 17–22μ. Pseudoperidial cells usually elongated, polygonal, thick-walled, verrucose, with close-set warts and ridges, 34–36 × 14–18μ.

Æcidium ? Vernoniæ P. Henn.

On leaves of *Vernonia Hookeriana* Arn., Peradeniya, May, 1910.

Spots pale yellow-green, often extending over the whole leaf. Æcidia usually hypophyllous, rarely one or two on the upper surface, crowded, not concentrically arranged, 0·25–0·5 mm. diameter, pseudoperidium strongly developed, stout, recurved, white, mass of spores yellow. Æcidiospores ovoid, 18–21 × 13–15μ, or globose, 16–21μ diameter; wall hyaline, closely and minutely verrucose; contents yellow. Pseudoperidial cells pentagonal or quadrangular, 18–31 × 15–25μ, verrucose, with large close-set warts and ridges; wall up to 4μ thick.

The spores are smaller than those of *Æc. tarapotense* P. Henn., but larger than those of *Æc. Vernoniæ*, according to the descriptions of those species, and the latter is said to be epiphyllous.

Æcidium gynuræ n. sp.

On leaves and stems of *Gynura lycopersicifolia* DC. (low-country form), Bentota, April, 1909; Galboda, December, 1911; Karawanella, December, 1911.

Spots pale yellow. Æcidia clustered, chiefly hypophyllous, about 0·25 mm. diameter, pseudoperidium well developed, white; mass of spores pale yellow. Æcidiospores oval or subglobose, wall hyaline, minutely warted, contents pale yellow, 14–18 × 12–14μ. Pseudoperidial cells polygonal, tuberculate, 20–28 × 16–19μ.

Maculis pallide flavis. Æcidiis confertis, sæpius hypophyllis, circa 0·25 mm. diametro, pseudoperidiis prominentibus, albidis. Æcidiosporis ovalibus vel subglobosis, episporio hyalino, minute verrucoso, plasmate pallide flavo, 14–18 × 12–14μ; cellulis pseudoperidii polyhedricis, tuberculatis, 20–28 × 16–19μ.

Æcidium rhytismoideum Berk.

= *Æcidium miliare* B. & Br. = *Æcidium rhytismoides* Racib.

Originally described on leaves of *Diospyros*. *Æcidium miliare* was first found on leaves of *Diospyros ovalifolia* Wight, Damboul, March, 1868, and has been recorded by Sydow and Butler on leaves of *Diospyros tomentosa* from Mysore. Found recently on leaves of *Diospyros embryopteris* Pers., Trincomalee, September, 1910, leg. E. E. Green, and *D. ovalifolia*, Peradeniya, February, 1912.

Æcidia hypophyllous, 0·2–0·5 mm. diameter; disc orange-red, pseudoperidium pinkish white, either scarcely elevated or up to 0·5 mm. high; surrounded by a black rhytismoid zone about 0·1 mm. wide; gregarious, in large numbers on pale yellow-green areas, which become black and rhytismoid when old. Upper surface of the leaf marked at first with black shining dots, which look like the stromata of a *Phyllachora*, afterwards with black continuous patches. Pseudoperidial cells oblong, or elongated pentagonal, yellowish hyaline, thickly covered with close-set, sinuous, coarse ridges, thick-walled, 27–30 × 12–13μ. Æcidiospores irregularly oval or globose; wall hyaline, sometimes thickened at the base;

contents orange; wall closely studded with rounded flattened warts; 25–30 × 17–22μ.

Æcidium Chionanthi B. & Br.

On leaves of *Chionanthus*, Central Province, July, 1869. Not collected recently.

Æcidium parsonsiæ Petch.

On leaves of *Parsonsia spiralis* Wall., Weligama, March, 1908; Dickwella, May, 1908.

Æcidium nummulare Berk.

On *Ceropegia biflora* L., Fungi of Ceylon, No. 856. No locality given on the type specimen. Not collected recently.

Æcidium Argyreiæ B. & Br.

On *Argyreia elliptica* Chois., Peradeniya, January, 1868 (Thwaites). On *Argyreia pomacea* Chois., Galle, March, 1908; Weligama. On *Argyreia populifolia* Chois., Urumuwela, December, 1911.

Spots yellow-green and somewhat bullate at first, then brown or black and membranous, rounded or angular, up to 5 mm. diameter.

Æcidia pale yellow or almost white, up to 0·5 mm. diameter, clustered or sometimes solitary in the centre of the spot, hypophyllous, pseudoperidium well developed, surrounded by the upturned epidermis, which forms a short persistent tube. Pseudoperidial cells polygonal, hyaline, 28–34 × 21–28μ; wall 4–5μ thick, ornamented with close-set tubercles and short flattened ridges. Spores subglobose or ovoid, closely verrucose, pale yellow or hyaline, wall 2μ thick, 21–28 × 18–24μ.

The type specimen at Peradeniya agrees with the above description. It is to be noted that the type is on *Argyreia elliptica* Chois. (*fide* Thwaites), which is now placed in another genus as *Lettsomia elliptica* Wight.

Æcidium Kærnbachii P. Henn.

On leaves of *Ipomœa cymosa* Roem. & Sch., Peradeniya, April, 1907; Yatiyantota, August, 1907; Maddegedara, May, 1907.

Spots at first yellow, then pale brown.

Æcidium ? acanthacearum Cooke.

On leaves of *Justicia procumbens* L., Kotmale, November, 1905. leg. E. E. Green.

Æcidium echinaceum Berk.

Originally described from leaves of *Actinodaphne molochina* Nees. There are no specimens in the cryptogamic herbarium at Peradeniya, but the specimens of *Actinodaphne speciosa* Nees in the Hakgala collection have furnished immature examples, while the specimens of *Actinodaphne molochina* in the Peradeniya herbarium (phanerogamic) bear the characteristic galls. Recently collected on *Actinodaphne molochina*, Nuwara Eliya, June, 1911, E. E. Green.

Galls pulvinate, 2–3 mm. diameter, on the under side of the leaf, bearing conico-cylindrical æcidia about 0·2 mm. diameter and 0·5–0·6 mm. high, dark brown, white at the tip, white interiorly, hard and brittle. The æcidia can be removed entire, leaving cylindrical holes in the gall. Spores subglobose, 16–20μ, or irregularly oval or polygonal, 20–32 × 12–20μ, verrucose, hyaline to dark brown, thick-walled, wall up to 8μ thick, or 12μ at the apex. The outer spores (? pseudoperidium) are dark brown, the inner pale brown or hyaline, but there is apparently no constant difference in size or shape. I have not seen fully ripe, *i.e.*, dehisced, æcidia.

Æcidium elæagni-latifoliæ Petch.

On leaves of *Elæagnus latifolia* L., Peradeniya, December, 1908, June, 1910.

Æcidium ? bulbifaciens Neger.

On leaves of *Loranthus* sp., March, 1911. Locality ?

The Ceylon species forms hard galls up to 4 mm. diameter on the leaf. The æcidia are up to 1 mm. high, cylindrical, conical at the apex, and rather hard at first ; then expanding, funnel shaped, with the pseudoperidium split and recurved. The pseudoperidial cells are arranged regularly in parallel vertical rows, generally oblong, hyaline, equally thick-walled, strongly verrucose, with warts and ridges, 34–50 × 18–24μ. The æcidiospores are verrucose, thick-walled, thickened at the apex, 32–46 × 30–32μ.

Apparently *Æcidium luculentum* Syd. from Mysore differs in having pseudoperidia immersed, pseudoperidial spores larger (50–70 × 28–40μ) and æcidiospores larger (38–52 × 26–35μ), but in other points the two species agree. It may be noted that the character of an Æcidium, whether immersed or columnar, depends to some extent on the state in which the specimen is collected, or, when dried specimens are examined, on the treatment to which the specimens have been subjected; it may also vary normally, as in *Æcidium rhytismoideum* Berk., some specimens of which have immersed æcidia, while others have columnar æcidia up to 0·5 mm. long when gathered.

Æcidium bulbifaciens was said to grow on stems, but there is no reason to suppose that it is confined to that position. Of the remaining species recorded on *Loranthus*, *Æc. Cookeanum* de Toni does not exhibit galls, but the specimens are apparently on immature leaves. *Æcidium goyazense* P. Henn. differs in having smooth spores and æcidia up to 5 mm. high (? correct). *Æcidium Loranthi* Thumen has " cupuliform " æcidia, and spores 30–36μ diameter. The Ceylon species appears nearest to *Æcidium bulbifaciens*, but the descriptions suggest that a re-examination of the types might establish the identity of at least all the South American species.

Uredo Pers.

Uredo uguressæ Petch.

On unripe fruits of Uguressa (*Flacourtia ramontchi* Sher.), Galle, July, 1907. On leaves of *Flacourtia* sp., Peradeniya, December, 1910, leg. E. E. Green, January, 1912.

Uredo gossypii Lagh.

On leaves and bracts of *Gossypium* spp., Peradeniya, June, 1905, July, 1909. This is identical with *Æcidium desmium* B. & Br., Fungi of Ceylon, No. 850, collected at Peradeniya, January, 1868. The name must therefore stand as *Uredo desmium* (B. & Br.).

Uredo bombacis n. sp.

On leaves of *Bombax malabaricum* DC., Peradeniya, December, 1911.

No evident spots. Sori minute, on the under surface of the leaf, orange, up to 0·2 mm. diameter, clustered. Uredospores oval or subglobose, echinulate, wall hyaline, contents orange, 16–28 × 12–18μ. Paraphyses curved, tips wedge-shaped, equal, fuscous, 32–34 × 8μ.

Maculis nullis; soris uredosporiferis confertis, minutis, usque 0·2 mm. diametro, hypophyllis, aurantiacis; uredosporis ovalibus vel subglobosis, echinulatis, episporio hyalino, plasmate aurantiaco, 16–28 × 12–18μ; paraphysibus falcatis, apice cuneatis, æqualibus, fuscis, 32–34 × 8μ.

Uredo balsaminæ Cooke (Grev., VIII., p. 94).

On leaves of *Impatiens oppositifolia* L., collected by Morris.

Uredo spondiadis n. sp.

On leaves of *Spondias mangifera* Willd., Peradeniya, December, 1911.

On the under surface. Spots becoming gray or blackish, and dry. Sori various, circular, elongated, straight or curved, sometimes horseshoe-shaped, arranged circularly or in small groups, surrounded by the upturned epidermis. Mass of spores golden brown. Uredospores ellipsoid, echinulate, pale yellow-brown, contents yellow, 28–35 × 17–19μ.

Maculis canescentibus vel nigrescentibus, aridis. Soris uredosporiferis hypophyllis, rotundatis vel elongatis, rectis vel curvatis, epidermide everta cinctis, circulatim vel in greges parvos dispositis; uredosporis ellipsoideis, echinulatis, episporio dilute flavobrunneo, plasmate flavo, 28–35 × 17–19μ.

Uredo erythrinæ-ovalifoliæ n. sp.

On leaves of *Erythrina ovalifolia* Roxb., Peradeniya, June, 1910.

Uredo sori minute, scattered or crowded, on red-brown spots, hypophyllous, peritheciiform, up to 0·2 mm. diameter, opening by a distinct circular orifice; spores oval, 21–30 × 18–21μ, or globose, 19–24μ, wall pale brown, verrucoso-aculeate, contents hyaline.

Soris uredosporiferis minutis, sparsis vel aggregatis, maculis rubrobrunneis insidentibus, hypophyllis, peritheciiformibus, usque 0·2 mm. diametro, poro rotundo dehiscentibus; uredosporis ovalibus, 21–30 × 18–21μ, vel globosis, 19–24μ diametro, episporio dilute brunneo, verrucoso-aculeato, plasmate hyalino.

Uredo Cassiæ-glaucæ Syd.

On leaves of *Cassia glauca* Lam., Peradeniya, May, 1908.

Uredo Socotræ Syd.

On leaves of *Cassia corymbosa* L., Peradeniya, May, 1908.

Uredo Sissoo Syd. & Butl.

On leaves of *Dalbergia sissoo* Roxb., Peradeniya, May, 1908.

Uredo Pruni Cast.

On leaves of *Prunus persica* Stokes, Hakgala, September, 1908.

Uredo trichosanthes n. sp.

On leaves of *Trichosanthes palmata* Roxb., Peradeniya, May, 1910.

Sori hypophyllous, ferruginous, scattered or crowded, 0·2–0·4 mm. diameter. Spores ovate, pyriform, or subglobose, echinulate, with scattered, rather short, stout spines, wall hyaline, contents orange, 30–42 × 20–25μ, or about 32μ in subglobose examples.

Soris hypophyllis, ferrugineis, sparsis vel aggregatis, 0·2–0·4 mm. diametro; uredosporis ovatis, pyriformibus, vel subglobosis, echinulatis, episporio hyalino, plasmate aurantiaco, 30–42 × 20–25μ, vel 32μ diametro.

Uredo chasaliæ Petch.

On leaves of *Chasalia curviflora* Thw., Hakgala, March, 1907, September, 1908.

Uredo elephantopodis n. sp.

On leaves of *Elephantopus scaber* L., Peradeniya, May, 1910.

Spots none. Uredo sori minute, scattered, hypophyllous, circular, 0·2 mm. diameter, orange. Spores ovate, 25–30 × 18–23μ, or globose, 20–25μ diameter; wall hyaline, thick, echinulate, contents orange. Paraphyses 50–70μ long, 8–12μ diameter below, clavate, 12–19μ diameter at the rounded apex, thick-walled, hyaline or faintly brownish, usually one-septate.

Maculis nullis; soris uredosporiferis minutis, sparsis, hypophyllis, rotundatis, aurantiacis, 0·2 mm. diametro; uredosporis ovatis, 25–30 × 18–23μ vel globosis, 20–25μ diametro, episporio hyalino, crasso, echinulato, plasmate aurantiaco paraphysibus clavatis, incrassatis, hyalinis vel dilute brunneis, uniseptatis, apice rotundatis, 50–70μ longis, infra 8–12μ, supra 12–19μ diametro.

Uredo microglossæ n. sp.

On *Microglossa zeylanica* Clarke, Hakgala, May, 1910.

Spots minute, blackish on the upper surface. Sori circular, pale brown, 0·25–0·5 mm. diameter, scattered or clustered, hypophyllous, surrounded by the upturned epidermis. Spores pale brown, oval or pyriform, spinulose, 24–36 × 17–20μ.

Maculis minutis, in pagina superiore nigrescentibus ; soris uredosporiferis rotundatis, dilute brunneis, 0·25–0·5 mm. diametro, sparsis vel aggregatis, hypophyllis, epidermide rupta cinctis ; uredosporis dilute brunneis, ovalibus vel pyriformibus, spinulosis, 24–36 × 17–20μ.

Uredo gynuræ n. sp.

On *Gynura lycopersicifolia* DC. (up-country form), Hakgala, May, 1910.

Spots purple above, brown beneath, indeterminate. Sori minute, scattered, 0·25–0·3 mm. diameter, pale brown, circular. Spores pale brown or hyaline, oval or narrow-oval, or elongated pyriform, echinulate, 27–47 × 16–21μ.

Maculis supra purpureis, infra brunneis, indeterminatis ; soris uredosporiferis minutis, sparsis, 0·25–0·3 mm. diametro, dilute brunneis, rotundatis ; uredosporis dilute brunneis vel hyalinis, ovalibus vel angusto-ovalibus vel elongato-pyriformibus, echinulatis, 27–47 × 16–21μ.

Uredo crepidis japonicæ Lindr.

On leaves and stems of *Crepis japonica* Benth., Hakgala, May, 1910.

Uredo hemidesmi n. sp.

On leaves of *Hemidesmus indicus* Br., Peradeniya, June, 1910.

Spots small, purple on the upper side, not evident on the lower. Sori circular, 0·25–0·75 mm. diameter, scattered, hypophyllous, reddish orange. Spores pear-shaped, ovate, or subglobose, coarsely echinulate, wall hyaline, contents orange, 20–27 × 15–19μ.

Maculis minutis, supra purpureis, infra nullis ; soris uredosporiferis rotundatis, sparsis, hypophyllis, rubro-aurantiacis, 0·25–0·75 mm. diametro ; uredosporis pyriformibus vel ovatis vel subglobosis, crasse echinulatis, episporio hyalino, plasmate aurantiaco, 20–27 × 15–19μ.

Uredo dregiæ Petch.

On leaves of *Dregia volubilis* Benth., Peradeniya, May, 1908.

Uredo callicarpæ n. sp.

On leaves of *Callicarpa lanata* L., Avisawella, October, 1909.

Spots pale yellow, rather small and irregular. Sori scattered over the spots, or solitary, on either side of the leaf, but chiefly on the upper, up to 0·5 mm. diameter, pale brown when dry, somewhat fawn-coloured when fresh. Spores almost hyaline, thick-walled (3μ), strongly spinulose, with conical, acute, scattered spines, globose, ovate, or pyriform, 20–27μ diameter, or 27–29 × 23–27μ. Sori surrounded by yellow-brown, thick-walled, septate, irregularly bent and curved paraphyses, sometimes branched, often inflated at the apex, equal or irregularly contracted at the septa, or nodulose, 100–150 × 10–17μ.

Maculis dilute flavis, minutiusculis, irregularibus ; soris uredosporiferis sparsis vel solitariis, amphigenis, principue epiphyllis, usque 0·5 mm. diametro, recente cervina, sicco dilute brunneis ; uredosporis globosis, ovatis, vel pyriformibus, pæne hyalinis, episporio crasso (3μ), spinulosis, spinis conicis, acutis, sparsis, 20–27μ diametro, vel 27–29 × 23–27μ ; paraphysibus flavobrunneis, incrassatis, septatis, irregulariter flexuosis vel curvatis, aliquando furcatis, sæpe apice inflatis, æqualibus, vel nodulosis vel irregulariter constrictis, 100–150 × 10–17μ.

Uerdo clerodendricola P. Henn.

On leaves of *Clerodendron inerme* Gaertn., Galle, March, 1908 ; Weligama, May, 1908 ; Dickwella, May, 1908.

Uredo Tectonæ Rac.

On leaves of *Tectona grandis* L.f., Peradeniya, December, 1911.

Uredo moricola P. Henn.

On leaves of *Morus indica* L., Gangaruwa, August, 1906

Uredo Fici Cast.

On leaves of *Ficus Carica* L., Hakgala, September, 1908. On leaves of *Ficus parasitica* Koen., Peradeniya, December, 1908.

Uredo artocarpi B. & Br.

On leaves of *Artocarpus lakoocha* Roxb., Peradeniya (Thwaites); Peradeniya, January, 1912.

Spots minute, about 0·5 mm. diameter, black, on the under side of the leaf, sometimes clustered. Uredo sori one or two on each spot, circular or linear, minute, 0·1 mm. diameter, or 0·2 × 0·1 mm. Uredospores pyriform or oval, very pale brown, echinulate, 18–34 × 13–20μ; a few spherical, 14–18μ diameter.

Uredo Pouzolziæ Syd.

On *Pouzolzia Bennettiana* Wight, Hakgala, May, 1910.

The spots are minute and brown, not "Flavescentibus, indeterminatis," and the sori are very pale brown, not ochraceous.

Uredo amomi n. sp.

On *Amomum involucratum* Trim., Hakgala, May, 1910.

Spots pale yellow-brown, extending for several centimetres; sori clustered, minute, circular, about 0·25 mm. diameter, pale brown, surrounded by the upturned epidermis, hypophyllous. Spores hyaline, ovate, oval, or globose, strongly spinulose, with acute broad-based spines, 25–38 × 20–28μ.

Maculis dilute flavobrunneis; soris uredosporiferis minutis aggregatis, rotundatis, dilute brunneis, epidermide rupta cinctis, circa 0·25 mm. diametro, hypophyllis; uredosporis hyalinis, ovatis vel ovalibus vel subglobosis, echinulatis, spinis acutis basim extensis, 25–38 × 20–28μ.

Uredo Dioscoreæ (B. & Br.) Petch.

(*Æcidium Dioscoreæ* B. & Br.)

Peradeniya, July, 1868 (Thwaites). On leaves and petioles of *Dioscorea alata*, Undugoda, July, 1908; common on cultivated varieties of *Dioscorea*, R. B. G., Peradeniya, November, 1908.

Sori minute, up to 0·25 mm. diameter, on either side of the leaf, clustered on yellowish spots, or along the veins, or on 'hickened areas on the stalks, each situated in the middle of a minute purple patch ; circular or elongated, surrounded by the purple epidermis. Pseudoperidium wanting ; mass of spores reddish orange. Spores oval or globose, contents orange, wall hyaline, rather thick, echinulate, with large, scattered, blunt spines, 17–26 × 15–21μ.

The type specimens at Kew and Peradeniya agree with the above description ; their spores measure 18–24 × 16–17μ. This is apparently identical with *Uredo Dioscoreæ-alatæ* Rac.

Uredo dioscoreæ-pentaphyllæ n. sp.

Sori usually hypophyllous, on spots which are grayish on the under surface, becoming purple on the upper ; up to 0·3 mm. diameter, scattered, pulvinate, rupturing irregularly, ashy. Spores hyaline to pale brown, ovate or subglobose, rather thick-walled, echinulate, with large, rather distant spines, 22–35 × 18–21μ.

On leaves of *Dioscorea pentaphylla* L., Kandy, January, 1912.

Maculis supra purpurascens, infra griseis ; soris uredosporiferis sparsis, pulvinatis, irregulariter dehiscentibus, cinereis, usque 0·3 mm. diametro ; uredosporis hyalinis vel dilute brunneis, ovatis vel subglobosis, episporio crassiusculo, echinulatis, spinis magnis subdistantibus, 22–35 × 18–21μ.

Uredo Dianellæ Diet.

On *Dianella ensifolia* Redoute, Hakgala, May, 1910.

Uredo ochracea Diet.

On *Commelina nudiflora* L., Hakgala, May, 1910.

Uredo paspali-scrobiculati Syd.

On *Paspalum scrobiculatum* L., Peradeniya, June, 1908 ; Hakgala, September, 1908.

Uredo setariæ-italicæ Diet.

On *Setaria italica* Beauv., Peradeniya, April, 1909. On *Setaria glauca* Beauv., Hakgala, May, 1910. On *Setaria intermedia* Roem. & Sch., Gangaruwa, July, 1910.

Uredo operta Syd. & Butl.

On *Coix lachryma* L., Peradeniya, May, 1905, May, 1910.

Uredo ischæmi-ciliaris n. sp.

On leaves of *Ischœmum ciliare* Retz., Hakgala, September, 1908.

Sori linear, minute, up to 0·3 × 0·1 mm., arranged in lines on red-brown streaks on the under surface of the leaf. Spores pale brown, spinulose, oval or pyriform, 34–36 × 25–28μ, some spherical, 27–28μ diameter.

Maculis elongatis rubrobrunneis; soris uredosporiferis minutis, usque 0·3 × 0·1 mm., linearibus, hypophyllis, lineatim dispositis; uredosporis dilute brunneis, ovalibus vel pyriformibus, 34–36 × 25–38μ, vel globosis 27–28μ diametro, spinulosis.

Uredo ischæmi-commutati n. sp.

On leaves of *Ischœmum commutatum* Hack., Hakgala, May, 1910.

Sori minute, brown, up to 0·4 mm. long, on red-brown streaks on the under surface of the leaf. Spores yellow-brown, thick-walled, echinulate, ovate 25–36 × 20–30μ, or globose 21–30μ diameter. Paraphyses clavate or capitate, 50–65μ long, 4–10μ diameter, with a globose head 13–18μ diameter.

Maculis rubrobrunneis, elongatis; soris uredosporiferis minutis, brunneis, hypophyllis, usque 0·4 mm. longis; uredosporis flavobrunneis, episporio crasso, ovatis, 25–36 × 20–30μ, vel globosis, 21–30μ diametro; paraphysibus clavatis vel capitatis, 50–65μ longis, 4–10μ diametro, apice globoso 13–18μ diametro.

Uredo anthistiriæ n. sp.

On leaves of *Anthistiria imberbis* Retz., Peradeniya, June, 1910. On leaves of *Pseudanthistiria umbellata* Hook. f., Hakgala, May, 1910.

Sori bright ferruginous when fresh, pale brown when dry, on red or red-brown streaks, hypophyllous, elongated, up to 0·6 × 0·25 mm. Spores chiefly globose, 21–30μ diameter, some ovate, 23–28 × 20–23μ, thick-walled, wall pale brown or hyaline, contents orange, echinulate, with rather short, scattered, blunt spines.

Maculis rubris vel rubrobrunneis, elongatis; soris uredosporiferis recente ferrugineis, sicco dilute brunneis, hypophyllis, elongatis. usque 0·6 × 0·25 mm.; uredosporis principue globosis, 21–30μ diametro, nonnullis ovatis, 23–28 × 20–23μ, episporio crasso, dilute brunneo vel hyalino, plasmate aurantiaco, echinulatis, spinis breviusculis, sparsis, obtusis.

Uredo anthistiriæ-tremulæ n. sp.

On leaves of *Anthistiria tremula* Nees, Hakgala, May, 1910.

Sori bright ferruginous when fresh, pale brown when dry, hypophyllous. Spores chiefly ovate, a few globose, 18–30 × 16–20μ, usually thin-walled, echinulate, yellow-brown or hyaline. Paraphyses stout, thick-walled, usually curved, 40 × 11–12μ.

Soris uredosporiferis, recente ferrugineis, sicco dilute brunneis, hypophyllis; uredosporis principue ovatis, nonullis globosis, 18–30 × 16–20μ, episporio tenui, echinulatis, flavobrunneis vel hyalinis; paraphysibus incrassatis, sæpius curvatis, 40× 11–12μ.

Uredo ochlandræ n. sp.

On leaves of *Ochlandra stridula* Thw., Peradeniya, June, 1908.

Spots elongated, rusty brown. Sori minute, scattered, hypophyllous, circular, 0·2 mm. diameter, or slightly elongated. Spores in mass rusty brown, yellow when magnified, oval or subglobose, wall hyaline, verrucose, 21–25 × 17–20μ.

Maculis ferrugineofuscis, elongatis; soris uredosporiferis minutis, sparsis, hypophyllis, rotundatis, 0·2 mm. diametro, vel leniter elongatis; uredosporis flavis, ovalibus vel subglobosis, episporio hyalino, verrucosis, 21–25 × 17–20μ.

Inquirenda.

The exact status of the following forms is doubtful. Probably some, at least, must be referred to *Synchytriaceæ*. But no germination of the spores has yet been obtained.

Æcidium umbilicatum B. & Br.

On *Phaseolus Grahamianus* W. & A., Damboul (Thwaites).

Æcidia numerous, scattered, on either side of the leaf, up to 0·4 mm. diameter, surrounded by the upturned epidermis, or along the leaf stalks. No pseudoperidium. Spores oval or subglobose, smooth, almost hyaline, 25–34 × 21–25μ. (Type specimen.)

Berkeley and Broome refer to a pseudoperidium, but there is no pseudoperidium in the herbarium specimens. They also state that in drying the cuticle contracts all round so as to present a radiated appearance. It is evident from that that each Æcidium was situated in a small gall when fresh.

The following appear to be identical with *Æcidium umbilicatum* :—

(*a*) On *Dunbaria Heynei* W. & A., Kandy, May, 1910. Pustules orange-red, scattered at first, then crowded, usually along the veins of the leaves and on the stem, causing minute hemispherical or elongated, pulvinate, orange-red swellings, up to 0·5 mm. diameter, subsequently forming deep cavities surrounded by the upturned epidermis. Spores orange-red in mass, oval, 27–35 × 21–25μ, or globose 22–32μ diameter; contents granular, orange; epispore hyaline, smooth.

(*b*) On *Phaseolus calcaratus* Roxb., Hakgala, May, 1910.

(*c*) On *Crotalaria Walkeri* Arn., Hakgala, May, 1910. Spores 22–30 × 21–30μ.

(*d*) On *Glycine javanica* L., Gangaruwa, June, 1910. *Æcidium glycines* P. Henn.? Hennings gives the size of the spore, 22–26 × 21–24μ.

(*e*) On *Cajanus indicus* Spr., Peradeniya, June, 1908. *Æcidium cajani* Petch. Spores 20–45 × 20–23μ.

(*f*) On *Atylosia Candollei* W. & A., Hakgala, March, 1907, September, 1908. *Æcidium atylosiæ* Petch. Spores 25–32 × 21–28μ.

(*g*) On *Atylosia rugosa* W. & A., Hakgala, May, 1910. Spores globose, 14–18μ, or ovate, 17–24 × 14–19μ.

Notes on Colour Inheritance in Maize.

BY

R. H. LOCK, M.A. Sc.D.

IN an interesting and extensive memoir entitled Inheritance in Maize,* Messrs. East and Hayes have published data which go far towards elucidating the complex heredity of the colours of the aleurone layer. This problem was left unsolved in my paper on Experiments with Maize,† published in these Annals in 1906, but relating to work concluded early in 1904. The object of the present note is to give a brief summary of the conclusions arrived at by East and Hayes so far as they affect the problems discussed in my own papers—a statement which may be useful owing to the absence of any summary from the paper under review. At the same time I desire to express a general agreement with those conclusions and to adduce a few further figures in confirmation of the explanations given.

Messrs. East and Hayes have shown conclusively that the method generally employed by me, of pollination in bulk from a supposed pure white strain, was defective, owing to the fact that individuals of such a strain may carry different invisible factors which react differently in the production of colour. In extenuation of my practise it may be pointed out that the first published record of such differences was contained in Cuénot's description of his experiments with mice. This paper‡ appeared in 1904, and only came into my hands after my own experiments were completed. At that time such advanced students of Mendelian phenomena as Messrs. Bateson and Punnett were still employing the vague formula of "compound allelomorphism."§ The idea of separately segregating factors had not yet been introduced to describe

* Connecticut Agricultural Experiment Station Bulletin, No. 167.

† Annals of the Royal Botanic Gardens, Peradeniya, Vol. III., Part II., November, 1906.

‡ L'Heredite de la Pigmentation chez les Souris. 3me. note. Archives de Zool. Exp. Notes et Revue. XLV., 1904.

§ W. Bateson: Address to the Zoological Section of the British Association, 1904, p. 9.

the development of the purple colour which may appear when two white-flowered sweet peas are crossed together.

The principal conclusions arrived at by East and Hayes are expressed in the hypotheses here enumerated.

A cob from a cross-bred plant from either purple × white or white × purple may bear F2 grains in the proportion of either 3 P : 1 W or 9 P : 7 W on self-fertilization.

These ratios are explained by supposing that the purple colouration, as in the case of the flowers of the sweet pea, depends upon the simultaneous presence of two separate factors P and C. If one of these factors is present in both parents and the other in the purple parent only, the result is a simple Mendelian ratio in F2. If both factors are present in the purple parent and neither in the non-purple parent, a ratio of 9 : 7 is obtained in F2 in accordance with the well known formula.

In certain families the coloured grains could be differentiated into purples and reds, the former being three times as numerous as the latter in the simplest cases. In order to explain these cases a separate factor R is hypothecated which is hypostatic to P.

In certain families particoloured or very light purples made their appearance in such numbers as to suggest that their gametic formula is correctly represented by the expression Pc. It is therefore supposed that in these cases the appearance of the purple colour is not entirely suppressed by the absence of the factor C.

In a final experiment the cross between purple and non-purple resulted in a certain proportion of white grains. This phenomenon is explained by the presence of an inhibiting factor I, in the presence of which the red or purple pigment fails to develop.

It should be noticed that no case has so far been observed in maize of the curious relation between allelomorphs, which is spoken of as reduplication by Bateson and Punnett in their latest publication upon the subject.*

All the above postulates have their analogies in the work of authors who have dealt with other groups of animals and plants. All were further confirmed by East and Hayes from the study of further generations of the hybrids. It is therefore

* Journal of Genetics, Vol. I., No. 1, 1911.

of interest to inquire how far these explanations fit the facts recorded in my own earlier paper. I may first, however, record the results of certain pollinations made by myself at the beginning of the present year, which confirm the ratios obtained by the American authors.

The material used by me was a mixed strain of native maize similar to that described in the second part of my earlier paper. The plants upon which self pollination was carried out were the offspring of plants which showed a number of the abnormalities described by Blaringham in his Mutation and Traumatismus,* and were grown mainly with the object of studying the inheritance of such abnormalities. With this part of the subject, however, we are not at present concerned. It so happened that in January, 1912, for the first time in my experience of experiments with maize in Ceylon, almost perfect climatic conditions synchronized with the flowering of a considerable number of plants, and a large number of self-pollinations were effected.

The method adopted for ensuring self-pollination consisted in covering both tassel and young cobs with parchment paper bags prior to the opening of the flowers and appearance of the silks. The pollen was poured from the bag covering the tassel into the bag covering the silks, the latter being then immediately reclosed. The accuracy of the method was tested as follows. In the main plot, which included numerous plants derived from purple grains, there were also included certain rows of plants derived from non-purple strains. Twelve cobs were obtained by self-fertilization of such plants, bearing from 100 to 600 grains each. On each of two such cobs a single purple grain made its appearance, whilst on the remaining ten cobs no grain showed any trace of purple colouration. Uncovered cobs of the same parentage showed numerous purple grains. The substantial accuracy of the method may therefore be assumed.

The annexed table shows the result of 21 pollinations, from each of which over 100 ripe grains were obtained, including in each case a considerable number which showed the purple colouration. With two exceptions the plants recorded were

* 1907.

derived from grains which showed more or less purple pigmentation in the aleurone layer :—

Entry Number.	Reference Number.	Deep Purple.	Intermediate	Pale Purple.	Yellow.	White.	Purple %	White % of non-purple.	Colour of parent grain.
1	3 1	511	.	.	.	.	100	.	P
2	3 3	351	.	.	120	.	74·4	.	P
3	3 4	279	.	.	94	.	77·2	.	P
4	3 5	110	.	.	40	.	73·1	.	P
5	3 6	56	.	.	11	.	83·5	.	P
6	1 4	306	.	.	55	20	80·1	26·7	P
7	9 4	361	.	.	95	42	72·5	30·6	P
8	9 5	246	.	.	64	34	71·5	34·6	P
9	13 1	189	.	.	47	10	76·6	18·0	P
10	13 2	.	267	.	59	25	75·9	29·9	P
11	13 3	120	.	.	28	8	76·9	22·3	P
12	9 3	268	.	.	182	.	59·7	.	P
13	9 1	138	.	35	.	132	56·5	.	P
14	9 2	183	.	.	88	29	60·8	24·8	P
15	1 1	.	180	.	108	34	55·8	24·0	P
16	1 2	55	.	.	37	15	51·5	28·9	P
17	1 3	255	.	.	129	55	58·1	29·8	P
18	13 4	65	.	.	48	11	52·4	18·6	P
19	2 1	60	.	16	.	230	24·7	.	W
20	14 3	88	.	.	259	32	23·1	11·0	Y
21	8 1	77	.	63	265	75	29·1	22·0	P

Inspection shows that the entries in the table fall into a number of groups.

The first entry clearly represents a purple homozygote.

Entries 2 to 11 show percentages of purple grains ranging around 75 per cent. Adding all these entries together we get a total of 2,296 purple to 752 non-purple, or 75·3 per cent. of purple—evidently a 3 : 1 ratio (expectation 75 ± ·52 per cent.).

Entries 12 to 18 show values ranging around 56·25 per cent. The total obtained by adding up these entries amounts to 1,159 purple and 868 non-purple, or 57·3 per cent. of purple. There can be little reason to doubt that this correctly represents a 9 : 7 ratio (expectation 56·25 ± ·75 per cent.).

All the above are the produce of the self-fertilized offspring of purple grains. Entries 19 and 20 show the offspring of non-purple grains, and these include approximately 25 per cent. of purples. It is, therefore, necessary in these two cases to suppose either that non-purple has suddenly become dominant over purple, or that an inhibiting factor is present. The latter supposition, which is the one adopted by East and

Hayes, is clearly preferable. It is hoped to put it to the test by growing a further generation.

So far everything is in accordance with the hypothesis of East and Hayes. The last entry of the table appears to constitute an exception, since we have here an apparent ratio of 3 non-purple to 1 purple arising from a purple parent grain. In order to account for this phenomenon it is necessary to take into consideration the differences which the purple grains show among themselves.

All the purple grains of the plants recorded in entries 10 and 15 showed a curious intermediate tinge not readily definable. These require further study, and will be omitted from the present discussion.

Many of the grains tabulated as deep purple possessed more or less a reddish tinge as opposed to purple, and it is possible that in some cases a ratio of 3 purple to 1 red might have been made out. It was found, however, that a sharp distinction between red and purple could not be made by eye with any real constancy. Both classes, if classes they are, vary much in tint. In the three cases, however, in which the presence of pale purples is recorded, there was never any doubt about the distinction between a dark and a pale purple. Some of the pale purples are very pale indeed, and scarcely distinguishable from white, and it seems clear that the classes pale purple and non-purple may intergrade to some extent. It seems necessary to suppose that some of the very pale purple grains arise by partial failure of the inhibiting factor, though present, since we can only account for entry No. 21 by supposing that it is possible for a pale purple grain to carry the inhibiting factor, which is nevertheless fully effective in the majority of the offspring obtained. This possibility is also suggested by East and Hayes.

The supposition that pale purple grades into non-purple may also explain the deficiency of pale purples in entries 13 and 19, where a ratio of 3 dark purples to 1 pale purple is apparently to be expected.

Among uncovered cobs from the same field, which arose from promiscuous pollination, were several which contained a large majority of dark purple grains and were evidently derived from plants which were homozygous purple in constitution.

Some of these cobs showed a few grains which were conspicuous for the complete absence (at first sight) of purple pigment. On closer examination a minority of these supposed non-purple grains were found to show a very faint purple pigmentation, although in the majority no such pigmentation could be recognized.* It must be supposed that these grains were produced by the action of pollen bearing an inhibiting factor which is not always completely effective.

In the case of entry No. 21 it seems probable that dark purples are to pale purples in the ratio of 9 : 7. If this interpretation is correct, it would appear that two separate factors are required to account for the difference between dark purple and pale. The case again requires further study.

On page 117 and the following pages of my earlier paper† are recorded the results of crosses between Black Mexican Sugar Corn and a number of non-purple strains. In the interpretation then given I was partly misled by the facts that the single example of the cross, purple male by non-purple female, gave rise to exclusively purple grains, whilst white × purple in each case yielded a certain proportion of non-purple grains. It is necessary to suppose that the inhibiting factor was absent from the white individuals used in experiment 33, but present in those employed in experiments 34, 35, and 37.

The offspring of the cross White Dent × Black Mexican pollinated *inter se* are recorded in Table 13. From 18 plants 4,052 purple grains and 3,023 white grains were obtained, or 57·27 per cent. of purple grains. This proportion would appear to represent a ratio of 9 : 7 (expectation 56·25 ± ·40). The series was sufficiently uniform to make it highly probable that all the plants were of the same constitution.

Table 14 shows the progeny of nine similar heterozygotes pollinated in bulk from plants of a supposed recessive. In order to account for the proportion of purple grains produced in this instance (32·6 per cent.) it is necessary to suppose that some of the non-purple pollen bearers were pure recessives in respect of both the factors P and C (expectation, if all were of

* In one such cob the majority of the pale grains were distinctly pale purple.

† Annals, Vol. III., Part II., November, 1906.

this nature, 25 per cent. of grains purple) and that others were heterozygous for either P or C (expectation, if all were of the constitution Pc or pC, 50 per cent. of grains purple).

Table 15 shows the effect of the pollen of the supposed uniform series of plants recorded in Table 13 upon a series of non-purple seed bearers of unknown constitution. As stated in my earlier paper, the comparatively wide variation in the percentage of purple grains on individual plants, in the case of this series, must depend upon differences in the seed parents, which we have no means of checking. Plant No. 8 is of special interest. So low a percentage of purple grains as 13·7 per cent. can only be accounted for by supposing that the seed plant was heterozygous for an inhibiting factor (expectation 1 purple grain in 8, or $12 \cdot 2 \pm 1 \cdot 19$ per cent.).

It is not necessary to carry out a similar detailed analysis of the whole of my former paper, but it may be stated that there is no reason to doubt that all the supposed aberrant results there recorded can be interpreted with the aid of the several hypotheses put forward by East and Hayes.

I may take this opportunity of replying to another and a more serious criticism of my paper made by East and Hayes. These authors write: " Lock mentioned that light yellow seeds appeared in his crosses, but he classes them as whites, which vitiates his study of Mendelian numerical proportions." And again: " The occurrence of the two yellow colours casts a further doubt upon the correctness of Lock's work, since his main object was to show the truth of Mendel's mathematical conclusions when dealing with large numbers."

East and Hayes have overlooked the fact that the second yellow factor made its appearance in two only out of a large number of experiments. There was no sign of any such disturbing factor in the experiment recorded in the table on pages 139 and 140 of my earlier paper. In the final stage of that experiment, 95 plants, simply heterozygous in respect of the yellow and non-yellow characters, were pollinated by a non-yellow variety, and yielded a total of 26,792 yellow grains to 26,751 non-yellow. It is quite clear that in the whole of this experiment a single yellow factor only was concerned, and the result remains—I venture to assert—the most complete statistical proof of Mendel's law established up to the present date.

East and Hayes found in certain cases a ratio of 15 yellow to 1 non-yellow among the progeny of a self-pollinated heterozygote between yellow and white, indicating the presence of two separate dominant yellow-producing factors. No similar ratio ever appeared in my earlier experiments. In two experiments I described the appearance of certain very pale yellow grains, scarcely distinguishable from white, amongst the progeny of plants of very mixed ancestry. The discrimination of this type of grains was a matter of so much difficulty that the precise ratio in which they occurred was not definitely ascertainable, but they were stated to have made up about 10 per cent. of the total number of grains.

There can be very little doubt that the real ratio was 12 yellow : 3 white : 1 very pale yellow, the pale yellow being a separate recessive character, and therefore quite distinct from either of the yellows studied by East and Hayes. The non-yellow grains of maize studied by me were never by any means pure white in colour, and the very pale yellow grains might almost as well have been called "dark white." In the state of knowledge of Mendelian phenomena existing in 1904, it was almost justifiable to group together both classes of non-yellow grains, *i.e.*, "white" and recessive yellow, and to record the simple Mendelian ratio between yellow and non-yellow in the exceptional cases in which the "very pale yellow" character appeared. It must be admitted that my earlier account of this phenomenon was not clearly expressed, but the account of the deviation from a strict Mendelian ratio then intended was to all intents and purposes the same as that now given.

Amongst non-purple grains produced by the self-fertilized plants recorded in the present note, the ratio of yellow to white, in cases where both colours appeared, usually approximated to 3 : 1. Entry No. 20 of the table constitutes an exception, since among non-purple grains there are only 11 per cent. of non-yellows. If this should prove to represent a ratio of 15 : 1 similar to those described by East and Hayes, it is the first example of the kind which I have witnessed (expectation 6·7 ± 1 per cent.).

Revisions of Ceylon Fungi.

(PART III.)

BY

T. PETCH, B.A., B.Sc.

IN Part I. of this series (Ann. Perad., IV., pp. 21–68) it was stated that the specimens which Gardner sent to Berkeley were now in the Herbarium of the British Museum. That statement was based on information furnished in Ceylon, and has since been found to be incorrect. Gardner's specimens were apparently retained by Berkeley, and are now in the Kew Herbarium, while the paintings which accompanied that consignment are in the Kew Library. These paintings are contained in a small octavo volume, and consequently are much reduced ; they are for the most part more or less impressionist, and in many cases it is impossible to decide from the figure whether the fungus represented is an agaric or not. Figure 51, which was reproduced by Berkeley in Hooker's London Journal of Botany, is missing. The specimens are all available, and in the majority of cases it would be possible to determine what the fungi are, but except in the case of new species it is scarcely worth while. A large number were assigned to European species ; the correction of these identifications would serve no useful purpose, and would certainly not provide information commensurate with the time and labour involved.

The Kew Herbarium contains the majority of the specimens forwarded to Berkeley by Thwaites, while many duplicates and some types are to be found in the Broome collection at the British Museum. The distribution of types (or co-types) appears to have been decidedly irregular ; most of them are at Kew, with duplicates at the British Museum. But the latter herbarium contains some species which are not represented at Kew, and others are at Peradeniya only.

It may be noted that the herbarium specimens show that when Berkeley and Broome cited two Thwaites' numbers, such as "(Nos. 5 and 1094 in part)," they did not mean that Thwaites sent two collections, but that 1094 is part of Thwaites' 5, separated, apparently, by Berkeley.

The British Museum Herbarium contains also the Ceylon specimens which were collected by König and described by Berkeley in "Notices of Fungi in the Herbarium of the British Museum," Ann. Nat. Hist., Vol. X. (1842), pp. 369–384. In his early lists, Berkeley makes frequent reference to "Fl. Zeyl.," and these references have caused some confusion. Mycologists who have wished to verify them have consulted Linnæus, Flora Zeylanica (1747), only to find that there are no descriptions of fungi in that work. For example, Fries writes: "Accepi nomine *Boleti lactei* Linn., Fl. Zeyl., sed in opere citato non reperi." An examination of his specimens shows that König assigned a name to each species he collected; and that Berkeley, in citing Fl. Zeyl., referred merely to the (unpublished) names on the herbarium sheets.

71.—Lepiota continua Berk.

Agaricus (*Lepiota*) *continuus* Berk., Lond. Jour. Bot., VI., p. 480.

Agaricus (*Lepiota*) *oncopus* B. & Br., Jour. Linn. Soc., XI., p. 496.

When Berkeley and Broome described *Lepiota oncopoda*, they suggested that it might be identical with *Lepiota continua*, previously described by Berkeley. From the type specimen (Gardner 29) and the figure sent by Gardner, that view appears to be correct, though all the warts have been rubbed off the pileus. The species will therefore be known as *Lepiota continua*. For re-description see Annals of Peradeniya, IV., p. 47.

72.—Lepiota albuminosa Berk.

This species was No. 51 of Gardner's collection, and was described by Berkeley in Lond. Jour. Bot., VI., p. 482, with a figure, tab. XX., fig. 3. On consulting Gardner's book of paintings at Kew, it is found that there is no figure 51: it may have been removed for the purpose of reproduction, but as the other figures which were reproduced were not removed, that seems hardly probable. Berkeley's figure shows an agaric, apparently with a viscid cuticle which extends in shreds beyond the margin: the stalk is thickened below and black at the base, where it is truncate, as though it had been cut short. Berkeley's description states that the pileus is covered with a glutinous veil and has an appendiculate margin; and that the stalk is rooting and transversely squamulose with fragments of the ruptured veil.

In the herbarium Gardner No. 51 is included with Gardner No. 29 under *Lepiota continua*. But 29 bears the inscription *Lepiota continuus* Nov. sp., written by Berkeley on Gardner's label, while No. 51 has *Agaricus continuus* Berk. attached to the sheet on a separate label, though in Berkeley's handwriting. Apparently there has been some error in the labelling of No. 51. The two specimens in 51 have glabrous pilei, and to judge from the grains of sand adhering to them they were viscid when moist; their stalks are suddenly strongly inflated below. But apparently neither of these specimens furnished the figure reproduced by Berkeley. It would seem that the name *Agaricus continuus* has been attached to these specimens at a later date, because they had inflated bases like those of the latter species.

The only Ceylon agaric at present known which in any way resembles the figure and specimens, is the species which grows from termite nests. The latter has a rooting stalk which is black below the ground level, and a cartilaginous cuticle, viscid in wet weather, which sometimes extends in shreds over the margin. The inflated base occurs in the form which was named *Collybia sparsibarbis*. This adds another name to the already lengthy list of synonyms which refer to that species, and as it is prior to *Armillaria eurhiza* Berk. it necessitates another change of name. In "The Fungi of certain Termite Nests" I referred this species to *Volvaria*, as it has pink spores, a universal veil, and an adherent volva; but Prof. F. von Höhnel considers that it should be regarded as a rosy-spored *Collybia*. In general appearance it is certainly a *Collybia* in most of its forms, and, as we have little information concerning the presence or absence of a universal veil in the majority of agarics, I am not disposed to dissent from von Höhnel's correction. The nomenclature will therefore stand as follows:—

Collybia albuminosa (Berk.) Petch.
= *Lepiota albuminosa* Berk.
= *Armillaria eurhiza* Berk.
= *Lentinus cartilagineus* Berk.
= *Armillaria termitigena* Berk.
= *Collybia sparsibarbis* B. & Br.
= *Agaricus* (*Pluteus*) *Rajap* Holtermann.
= *Flammula Janseana* P. Henn. et E. Nym.
= *Pholiota Janseana* P. Henn. et E. Nym.
= *Flammula filipendula* P. Henn. et E. Nym.
= *Pluteus Treubianus* P. Henn. et E. Nym.
= *Pluteus bogoriensis* P. Henn. et E. Nym.
= *Pluteus termitum* P. Henn.
= *Collybia radicata* Pat. non Relh.
= *Tricholoma subgambosum* Cesati.
= *Volvaria eurhiza* (B. & Br.) Petch.
= *Collybia eurhiza* (B. & Br.) v. Höhnel.

73.—Tricholoma crassum Berk.

Agaricus (*Tricholoma*) *crassum* Berk., Lond. Jour. Bot., VI., p. 483.

Agaricus (*Tricholoma*) *pachymeres* B. & Br., Jour. Linn. Soc., XI., p. 515.

Pileus convex, sometimes slightly depressed in the centre, occasionally obtusely umbonate, margin incurved and often sinuate, grayish brown or dark brown in the centre, becoming pale ochraceous towards the margin, hoary with a fine whitish tomentum, in dry weather minutely areolated and cracking radially, often guttate, up to 14 cm. diameter. Flesh white, up to 2 cms. thick in the centre.

Stalk up to 18 cm. high, usually strongly inflated at the base and attenuated upwards, but sometimes swollen in the middle and attenuated above and below: base 2·5 to 5·5 cm. diameter, apex 1·5–4 cm.; rough: solid; white with brownish streaks, or with the outer layer split into small upwardly-directed, dark gray, fibrillose scales ; base white and slightly tomentose.

Gills narrow, crowded, pallid, strongly attenuated outwards, sinuato-adnexed ; edge usually irregular.

Spores white, oval or subglobose, 5–6 × 3–4 μ.

On the ground among grass, sometimes in a ring : often connate. Peradeniya, 28·8·06 ; 9·9·07 ; 15·8·10, &c.

74.—**Armillaria dasypepla** Berk.

Agaricus (*Armillaria*) *dasypeplus* Berk., Hooker's London Journal of Botany, VI., p. 482.

Agaricus (*Lepiota*) *dasypeplus* Berk., Journ. Linn. Soc., XI., p. 506.

Pholiota dasypepla (Berk.) Cooke. Saccardo, Sylloge Fungorum, IX., p. 93.

This species was sent to Berkeley by Gardner, and was described as follows :—

"Cæspitosa ; pileo e convexo-expanso demum depresso sinuatoque tomentoso squamuloso fulvo : stipite subæquali annuloque fugaci tomentoso fulvis ; lamellis incarnatis purpurascentibus, postice sinuatis, dente affixis.

"On dead wood, Hantane, Ceylon. Pileus 4 cms. latus, densa lanugine obtectus, hic illic squamulosus ; stipes 2·5 cm. longus, 4–6 mm. crassus. Affinis *A. melleæ* sed bene distincta ob naturam lanuginis, annulum fugacem atque lamellas nitentes."

In Saccardo, Sylloge Fungorum, IX., p. 93, Cooke states that the spores are pale brown, 10–11 × 8 μ, and therefore transfers it to *Pholiota*.

Gardner's painting shows an infundibuliform fungus, clustered, yellow-brown dotted with red-brown, margin at first strongly inrolled, gills violet. The type specimens are much damaged and eaten by insects ; the damage most probably occurred when they were in process of drying, and, if so, the description was based on the figure only. The annulus referred to by Berkeley is apparently the termination of the tomentum on the stem.

From the texture of the fragments now available, the fungus appears to be a *Lentinus.* The colour agrees with that view, since there are several Ceylon *Lentini* which are at first violet, but become brown when mature, *e.g.*, *L. Lecomtei*, *L. similis*, *L. estriatus*, &c. The stalks are too long for *L. Lecomtei* and the pileus is not sulcate as in *L. similis.* But the abundant spores in the herbarium specimens are pale brown, 4–8 × 3–5 μ, and hence its reference to *Lentinus* is excluded.

It is curious that Berkeley should have referred this species to *Armillaria* and *Lepiota*, seeing that the gills are coloured, and that there is an abundance of brown spores. Can it be that continual poisoning has changed the colour of the spores ? At present, the question of its exact position must be left open until fresh specimens have been gathered.

75.—**Clitocybe scotodes** (B. & Br.) Petch.

A. (*Collybia*) *scotodes* B. & Br., Jour. Linn. Soc., XI., p. 522.

Pileus up to 3 cm. diameter, broadly convex, grayish brown in the centre, dark gray elsewhere, extreme margin almost white, minutely radially rugose, hygrophanous. Flesh thin, dark when moist.

Stalk about 3 cm. long, 4 mm. diameter, stuffed then hollow, densely covered with minute white particles, equal, brittle. Gills white, adnate, abruptly narrowed behind, ventricose, edge irregular.

Spores white, 4–5 × 3 μ, oval, smooth.

On the ground in shrubberies, Peradeniya ; smells strongly of new meal.

76.—**Collybia omotricha** Berk.

This species was originally described from South Africa in Hooker's London Journal of Botany, Vol. II., p. 410, and was subsequently enumerated among the fungi sent by Gardner from Ceylon.

Gardner's figure is scarcely recognizable ; from the colour of the gills his fungus was apparently a small *Psalliota.* Thwaites did not collect it, and there is no Ceylon specimen at Kew. Under the circumstances, the record must be considered doubtful, and the name *Collybia omotricha* should be deleted from the Ceylon list.

77.—Pluteus chrysægis (B. & Br.) Petch.

A. (*Entoloma*) *chrysægis* B. & Br., Jour. Linn. Soc., XI., p. 536.

Pileus 2·5–4 cm. diameter, broadly convex, golden yellow, fuscous in the centre, becoming brown when old, glabrous, margin striate, feebly sulcate when old, edge pale ; flesh thin, white, becoming yellow.

Stalk up to 3·5 cm. long, 2–3 mm. diameter, slightly attenuated upwards, white, becoming yellowish at the base, longitudinally striate, sometimes twisted, powdered below, glabrous above, solid.

Gills free, crowded, rounded behind, up to 4 mm. broad, white, then pink, equal. Spores salmon in mass, globose, smooth, 4–6 μ diameter.

On rotting stumps, Peradeniya.

78.—Naucoria micropyramis (B. & Br.) Massee.

Agaricus (*Hebeloma*) *micropyramis* B. & Br., Jour. Linn. Soc., XI., p. 540.

Inocybe micropyramis (B. & Br.) Cooke, Grevillea, XIX., p. 104.

Naucoria micropyramis (B. & Br.) Massee, Annals of Botany, XVIII., p. 501.

Pileus at first conical, sometimes obtusely campanulate, then almost plane, acutely or obtusely umbonate, dark brown, up to 3·5 cm. diameter, centre covered with dark brown conical warts, cuticle elsewhere split into dark brown, rather rigid, recurved scales ; margin at first incurved, fimbriate ; flesh white, becoming purplish when cut.

Stalk up to 3·5 cm. high, 3 mm. diameter, equal, dark brown, with fine white longitudinal striæ, clothed with brown fibrils on the lower two-thirds, base whitish, almost solid.

Gills brown, edge white and serrate, adnexed, ventricose ; no cystidia. Spores pale brown, oblong-oval, 8–10 × 5 μ.

On the ground among grass : often clustered. Peradeniya.

79.—Æruginospora singularis v. Höhnel.

An agaric which answers in many respects to von Höhnel's description of this species has been observed on several occasions at Peradeniya, but has not hitherto been recorded because it could not be determined whether it had been previously described, as would be expected, by Berkeley and Broome. It grows among short grass in the open, usually solitary. The pileus is about 5 cms. in diameter, almost plane, margin slightly incurved, ashy, with a pink tinge in the centre, becoming tinged with green when old, with innate radiating fibrils, sometimes slightly scurfy, but generally smooth, dull, not shining ; flesh of the pileus white, thin except over the stalk. Stalk straight or curved, white, expanding upwards into the pileus, up to 6 cm. high, 6 mm. diameter in the middle, attenuated below, slightly longitudinally fibrillose, solid, white, and fibrous internally. Gills pale green, thick, edge obtuse, decurrent or adnato-decurrent, margin entire, of three lengths, broad (4 mm.), brittle, attenuated outwards, sometimes ventricose, ridged and veined above. Spores white, globose, 4-6 μ diameter.

The substance of the stalk and pileus is somewhat dry. The whole fungus has a most peculiar, almost an artificial, appearance, as though the turbinate stalk and pileus had been carved out of white wood, and the thick green gills stuck on in the curve.

The above appears to correspond closely with v. Höhnel's description, and his specimen in the Kew Herbarium. But the spores are not green, " hell spangrun, fast himmel-blau," but white, and the gills are permanently green, not at first white and then becoming green from the spores. I was unable to obtain any but mould spores (? *Sterigmatocystis*) from the specimen in the Kew Herbarium.

80.—Marasmius tortipes B. & C.

This was described by Berkeley, Journ. Linn. Soc., X., p. 298, from a gathering made by Wright in Cuba. Subsequently it was recorded by Berkeley and Broome from Peradeniya, Thwaites' collection number being 156. There is no specimen in the Broome collection at the British Museum, and the type, ex. Herb. Berkeley, at Kew contains only one specimen, which is marked Wright (Curtis) No. 156. Thus there is only one (type) specimen in existence, and as the collection number of that is identical with that attributed to the missing Ceylon specimens, it would seem that the species has been included in the Ceylon list in error.

81.—Lentinus radicans B. & Br.

The type specimen at Kew is identical with *Lentinus giganteus* Berk. (see Ann. Perad., IV., pp. 406–408).

When Berkeley described *Lentinus stenophyllus* (= *L. giganteus*) he stated that it was identical with *Peziza Zeylonica* Houttuyn, in Linn., Pflanzensyst, Vol. 13, p. 51, tab. 105, f. 4. That species is not cited in Edition 13, J. F. Gmelin, 1788; but in a Dutch version published in Amsterdam, 1783, entitled "Handleiding tot de Plant- en Kruidkunde, benevens eene uitvœrige Beschrijving der Boomen," &c., Vol. XIV., p. 655, there is a description of *Peziza ceylonsche* as follows:—

"Hier zal die fraaije *Ceylonsche* behooren, welke de Edele Heer Chr. P. Meijer, keurig Verzamelaar van uitgezogte Naturaliën, onlangs uit Oostindie, onder verscheide andere Zwammen ontvangen, en mij ter Afbeelding gunstig medegedeeld heeft; zie Fig. 4 op Plaat CV. Want, schoon dezelve geenszins vliezig is, maar eene vaste zelfstandigheid heeft, toont de Gestalte genoegzaam, dat zij hier t' huis te brengen zij en de volgende, die beiden gesteeld zijn in dit Geslagt. Dat zij troopswijze groeijen blÿkt aan den Voet; de Gestalte uit de Afbeelding, zo wel als de dikte van den Rand, die stomp is en rond eenigermaate uitgehoekt of als ingefneeden. De hoogte is omtrente vier Rynlandsche Duimen boven het Voetstuk, dat voor Wortel schijnt te vertrekken. Zij heeft den Steel of Stam, tot omtrent een Duim beneden den Rand, zeer glad zwartachtig bruin, even als of zij gevernist ware, en zodanig is ook de binnenhalt, meer dan een Duim diep, voor een groote gedeelte. In 't overige heeft der geheele Top eene geelachtig witte Kleur en is van onderen vol uitermaate, kleine, naauwlijks met het bloote oog zigtbaare Gaatijes; welke haar veeleer tot de *Boleti* zouden betrekken, indien niet de Trechter- of Trompetachtige Gestalte haar hier t' huis bragt."

From the figure, " *Peziza ceylonische* " would appear to be a half-expanded *Lentinus giganteus*, as Berkeley supposed, though there is nothing very characteristic about it. But it is quite evident that the description does not refer to a *Lentinus*, but rather to a *Polystictus*, most probably *Polystictus xanthopus*.

82.—Lentinus badius Berk.

This species was originally described by Berkeley under the name *Panus badius* from specimens collected by Cuming in the Philippines. Subsequently Berkeley received specimens from Ceylon, sent by Gardner (No. 59), which he assigned to the same species, and changed the name to *Lentinus badius*.

Thwaites sent the same Ceylon species to Berkeley and Broome, in numbers 94 and 686. These were named *L. blepharodes* (94 and 686) and *L. similis* (686, cum icone); the latter was listed in the " Fungi of Ceylon " as " *C. similis*," evidently a printer's error. There was some confusion with regard to the figure. Thwaites sent two figures, both numbered 686; one of these is the brown species under consideration, while the other is a white species altogether different.

Considering first of all the figures, we find that though Berkeley and Broome cite *L. similis* as " 686, cum icone," they labelled the original drawing of the brown species *L. blepharodes*, while that of the white species was not named. The copies in the Kew Library were dealt with in the same way, but some one has subsequently detected the confusion, and has labelled the brown species *L. similis*, and the white species *L. blepharodes*, which it is not.

In the Kew Herbarium, under *Lentinus badius*, there are the original specimens from the Philippines, and four Ceylon specimens from the Hookerian Herbarium; the latter are numbered No. 69, which is probably an error for Gardner's 59, since 69 is a *Polyporus* in Gardner's numbers and a *Platygrapha* in Thwaites'. These two gatherings are quite different in stature, gills, stalk, and apparently in texture also. The same is true of the corresponding specimens in the British Museum Herbarium.

Under *Lentinus similis* at Kew are Thwaites 686 together with Gardner 59. The latter was first labelled *badius* by Berkeley, but subsequently changed by him to *similis* B. & Br. Hence it appears that Berkeley discovered that his *Panus badius* from the Philippines was not the same as *Lentinus badius* from Ceylon, and altered the name on his herbarium specimens, but those in the Hookerian Herbarium retained the name under which they had been distributed.

Under *Lentinus blepharodes* at Kew, one Ceylon sheet bearing two specimens is labelled "*Lentinus blepharodes* (B. & Br.) B. & C., *Lentinus similis* B. & Br., Ceylon, G. H. K. T."; another is marked "94 *Lentinus blepharodes* B. & C., Peradeniya, G. H. K. T., Nov., 1867;" while a third collection, consisting of two almost glabrous specimens, is labelled "*Lentinus blepharodes* B. & C. 686. *Lentinus similis* B. & Br., Var., Central Province, Ceylon." All these are identical with the Ceylon specimens under *Lentinus similis* and *Lentinus badius*. Our Ceylon species is certainly not *L. badius*. According to the herbarium specimens it is not *L. blepharodes*, since the latter has a velutinate stem, while the stem of the Ceylon species bears a spongy coating. *L. blepharodes* appears to be restricted to the Western hemisphere, but there is a specimen in Herb. Kew, with a velutinate stem, from the Nilghiris. As far as the three names considered are concerned, the Ceylon species must be known as *L. similis*, and the records of the other two species for Ceylon discarded.

Lentinus similis is entirely amethyst or violet when young, becoming pale brown to red-brown when old. The pileus is up to 8 cm. in diameter, deeply infundibuliform, edge decurved or plane, regularly plicatosulcate to the centre, coarsely velvety with short close-set hairs which are often grouped into tufts within the tube, margin regular and fimbriate. Total height up to 14 cms. Stalk usually straight, tough, solid, white internally, equal, expanded at the base, where it sometimes arises from a dense tuft of hyphæ, clothed with long silky hyphæ entangled in a spongy mass. Gills decurrent, their lower ends hidden in the covering of the stem, narrow, rather crowded, edge entire; the gills change from violet to cream-coloured, and finally become brown. Spores white, narrow-oval or oblong-oval, 5–7 × 3–3·5 μ. On dead wood, scattered or fasciculate. The whole fungus is tough and elastic when fresh, but become somewhat brittle when dry. It frequently arises from peculiar pseudosclerotia, of which it is hoped to publish a description shortly.

83.—Hydnum gilvum Berk.

Berkeley and Broome described this species (Jour. Linn. Soc., XIV., p. 59) as "Pileo flabelliformi ochraceo pilis cartilagineis radiantibus vestito ; contextu fibroso spongioso, aculeis acutis. Pileus 3 inches across, $2\frac{1}{4}$ long, flabelliform, clothed with radiating cartilaginous hairs ; substance spongy, mixed with cartilaginous bodies like those with which the pileus is clothed ; prickles 2 inches long ; spores ·0005–·0006 long, with a strong nucleus ·0002–·0003 wide. Intermediate between *Hydnum* and *Hydnoglœa*." That description was compiled from the Ceylon specimens sent by Thwaites ; but the species had been previously described by Berkeley, in Hooker's Journal of Botany, III. (1851), p. 168, as follows :— "Imbricatum tenue subcarnosum ; pileo flabelliformi pallide gilvo postice virgato antice strigoso ; aculeis tenuibus subulatis teretibus integris fuscescentibus. On dead trunks, Darjeeling. Imbricated. Pileus 2 to 3 inches long, flabelliform, sometimes laterally connate, thin but fleshy, pale reddish gray, attenuated behind, strigose at the base, disc more or less virgate, rarely rough, margin strigoso-cirrhate, acute. Hymenium yellowish-brown, at length dark ; aculei elongated, subulate, entire, margin generally sterile."

Whether the Ceylon species is identical with that from India would appear doubtful. A specimen recently gathered at Peradeniya grew in a rubbish heap, where it formed a labyrinthine mass about 2 feet in diameter, encrusting the dead stems, leaves, &c. The part buried in the rubbish formed a pseudostalk which developed a hymenium, or produced lateral pilei, wherever it was exposed. The pilei are orbicular or flabelliform, 2 to 3 inches across, imbricated, and usually fused laterally into sheets 6 inches or more in length. The whole fungus is pure white when fresh, the hymenium becoming brown where bruised ; its substance is soft, spongy, and fibrillose, up to 1 cm. thick. The pilei are minutely tomentose, sometimes smooth, but usually clothed with radiating innate fascicles of coarse fibrils. The margin is usually thick when fresh. The aculei are conical, terete, entire, and up to 8 mm. long.

In drying, the pilei become much thinner, and the appearance of the fungus alters considerably. In some places the margins of the pilei become quite thin and cartilaginous when dry, sometimes for a breadth of more than a centimetre, though there is no sign of that when the fungus is fresh. Such cartilaginous margins are sterile below, or bear aculei in early stage of development. At first sight it would appear that the pilei possess an inner cartilaginous layer which develops more rapidly than either the hymenial layer or the upper layers of the pileus, but sections do not uphold that supposition, for the cartilaginous margin is continuous with normal hyphæ behind. Coarse cartilaginous strands do, however, occur in the white flesh, especially running longitudinally in the pseudostalk, and Berkeley and Broome noted that the substance of the fungus is " mixed with cartilaginous bodies like those with which the pileus is clothed." As the herbarium specimens bear strong radiating innate fascicles of coarse fibrils, it must be supposed that the " bodies " referred to were cartilaginous strands. This development of a margin which becomes cartilaginous when dry, or of cartilaginous hairs on the pileus, is not dependent upon the age of the pileus, *i.e.*, it is not necessarily a normal feature of young pilei: one young specimen recently gathered, in which the pilei do not exceed one centimetre in breadth, has a white swollen margin when dry, and no evidence of any cartilaginous structure in any part. The development of that particular feature would appear to depend rather upon the weather conditions prevailing at the time of growth.

Neither on the specimens in the Peradeniya Herbarium nor on those recently collected do the aculei exceed one centimetre in length ; it would appear therefore that Berkeley and Broome's measurement is a mistake, as far as the Ceylon species is concerned. The fungus bears no resemblance whatever to *Hydnoglœa* (*Tremellodon*) when fresh.

84.—Hydnum scariosum B. & Br.

Hydnum scariosum B. & Br. in herb., Cooke (?), Grevillea, XX., p. 2.

Examination of the type specimen at Kew shows that this is identical with *Heterochæte tenuicula* (Lev.) Pat. This is a common species in Ceylon, but it was not included in Berkeley and Broome's list. It was hard to understand how Thwaites managed not to collect it, but the difficulty has now been removed.

85.—Corticium salmonicolor B. & Br.

Corticium salmonicolor B. & Br., Jour. Linn. Soc., XIV. p. 71.

Corticium javanicum Zimm., Centralb. f. Bakt., VII., p. 103. non Sacc. et Syd., Sylloge Fungorum, XVI., p. 189.

Corticium Zimmermanni Sacc. et Syd., Sylloge Fungorum, XVI., p. 1117.

Examination of the type specimen at Kew has shown that *C. salmonicolor* is identical with the well-known parasitic species, hitherto recorded in the East as *Corticium javanicum* Zimm. Massee's re-description of *Corticium salmonicolor* in Mon. Thelephoreæ (Jour. Linn. Soc., XXVII., p. 122) does not refer to the type.

86.—Cyphella versicolor B. & Br.

Cyphella versicolor B. & Br., Jour. Linn. Soc., XIV., p. 73.

Cyphella pruinosa B. & Br., Jour. Linn. Soc., XIV., p. 74.

Gregarious, in patches covering several square centimetres sometimes on a thin, dark brown or tawny, tomentose stroma with a whitish edge, sometimes on the substratum without any stroma; especially without a stroma when growing in lines through cracks in the bark.

Cup-shaped, margin at first incurved, up to 1 mm. diameter and 0·75 mm. high, narrowed below into a short stem-like base, 0·25 mm. diameter, membranous, disc pale brown, externally tawny at first, then white; clothed externally with short, irregular, brown or hyaline hairs, 25–60 μ long, 4–8 μ diameter, which are roughened with lime deposits especially towards the apex; the exterior appears granular or pruinose under a low magnification. When old, the substance of the cups contains numerous cubic crystals, up to 15 μ broad. The larger specimens are laterally compressed when dry. Spores smooth, ellipsoid, pale brown to yellow-brown, 8–10 × 5–7 μ, often with a large gutta.

Common on dead branches, *e.g.*, cacao. *Versicolor* is the form with a stroma, *pruinosa* the form without.

87.—**Exobasidium cinnamomi** Petch.

This species was described in Ann. Perad., Vol. IV., p. 301 (March, 1909). It occurs on *Cinnamomum zeylanicum* Bl. and *Cinnamomum cassia* Bl. In a paper by J. S. Gamble "On the determination of the fungi which attack forest trees in India" (Indian Forester, *circa* 1900), I find a reference to *Exobasidium Cinnamomi* Mass., on *Cinnamomum Tamala*, which is said to have been recorded previously in Indian Forester, XXI., p. 133. I am unable at present to consult that volume of the Indian Forester, but it would appear from Gamble's statement that the description of the fungus had not been published when he wrote. As there is no record of Massee's species in Saccardo, it would seem probable that the description has not been published.

88.—**Physarum chlorinum** Cooke.

Examination of the type specimen at Kew shows that this is identical with *Melanconium melanoxanthum* B. & Br. = *Endocalyx melanoxanthus* (B. & Br.) Petch. Cooke's name was published in Grevillea, V., p. 101 (March, 1877), Berkeley and Broome's in Jour. Linn. Soc., XIV., p. 89 (Dec., 1873).

89.—**Reticularia apiospora** B. & Br.

Reticularia apiospora B. & Br., Jour. Linn. Soc., XIV., p. 82.

Trichosporium apiosporum (B. & Br.) Massee, Jour. Myc., 1889, p. 186.

This species was described by Berkeley and Broome as follows:—"Effusa, dendritica, fulva; peridio fibroso-sericeo; sporis obovatis, basi breviter auctis hyalinis (No. 266).

Resembling, when young. *Hymenochæte dendritica*; spreading widely: peridium consisting of branched silky fibrils; spores ·0003 long, ·00015 wide." Subsequently it was re-described by Massee as "*Trichosporium apiosporum*: Late effusum fulvum; hyphis agglutinatis in fasciculos dendritice radiantes; conidiis ex apice subpyriformi ramulorum oriundis, ellipsoideis, minute verrucosis, subhyalinis, 8–9 × 5 μ." In Lister's Monograph it was excluded from the Mycetozoa, but an examination of the specimen in the Peradeniya Herbarium threw no light upon its real nature. The specimen consists of a block of red-brown hyphæ, in which are mingled a few hyaline spores and a large number of echinulate, obovate spores, which, as stated in "The Mycetozoa of Ceylon," look exactly like the spores of *Fomes lucidus*, or rather the Ceylon species which has been supposed to be *lucidus*.

A search through Berkeley and Broome's List of the Fungi of Ceylon reveals the fact that Thwaites' 266 provided not only *Reticularia apiospora*, but also *Hymenochæte dendroidea* B. & Br. and *Hypomyces chrysostomus* B. & Br. The latter was said to be parasitic on a brown feathery mycelium. The reference to *Hymenochæte dendritica*, in the description quoted above, is an error for *dendroidea*; this species was transferred to *Thelephora* by Cooke (Grevillea, VIII., p. 150).

Thelephora dendroidea has recently been collected again in Ceylon, and its re-discovery has solved the problem of the identity of *Reticularia apiospora*.

Thelephora dendroidea usually grows on the under surface of *Fomes australis*, sometimes spreading to and surrounding grasses, &c., in the neighbourhood. In its mode of growth it resembles a *Thelephora*, but as spores and basidia have never been observed, its true position is unknown. Mr. C. G. Lloyd informs me that it occurs in America, usually on *Fomes applanatus* (which is the temperate form of *australis*), and that it is equally sterile there. It is generally orbicular, and centrally attached, but it becomes adherent to the lower surface of the *Fomes*, so that it might be described as loosely adherent. On grasses it encircles the stalk, or runs along projecting from one side. Its upper surface is continuous and usually somewhat nodular, the latter character probably depending upon inequalities in the under surface of the *Fomes*. Its substance is soft and loose, being built up of radiating, fern-like, superposed strands of mycelium, entirely red-brown. The lower surface is beautifully adorned with repeatedly-pinnate veins radiating from a common centre, like the fronds of a large *Hypnum*: to this feature the fungus owes its name.

In Berkeley and Broome's specimens, and in those recently collected, the whole of the tissue of the fungus is crowded with spores; but these are not the spores of the *Thelephora*, but the spores of the *Fomes*, which have fallen while the *Thelephora* was growing and have been entangled in the loose tissue. Further, both the recent specimens and those which Thwaites gathered are parasitized by *Hypomyces chrysostomus*.

When Berkeley and Broome received Thwaites 266, they separated part of it as the type of *Thelephora dendroidea*, and part as the type of *Hypomyces chrysostomus*. But a third part they named *Reticularia apiospora*. The latter is part of the thallus of the *Thelephora*, containing the spores of *Fomes australis* and the conidia of *Hypomyces chrysostomus*. Massee's measurement is that of the spores of the *Fomes*, but they are not subhyaline.

90.—Eurotium diplocystis B. & Br.

This was described by Berkeley and Broome (Jour. Linn. Soc., XIV., p. 137) as follows:—"Irregulare, subglobosum vel elongatum, flavum, demum aurantiacum; ascis globosis pedunculatis e floccis decumbentibus oriundis; sporidiis octonis ellipticis (No. 291). The ascus itself is soon absorbed as in the genus *Badhamia*; the peduncle is long and flexuous, several arising from decumbent branched threads. This may possibly be a distinct genus; but we have scarcely sufficient materials to decide."

The supposed co-type of this species (Thwaites 291) in the Peradeniya Herbarium contains only a sterile sclerotium resembling that which I have previously referred (in error) to *Sclerocystis coremioides*. As it seemed impossible that species should have furnished the description quoted above, the identity of *Eurotium diplocystis* was left in abeyance until the Kew specimens had been examined. Recently, however, a gathering of the *Sclerotium* made at Peradeniya was found to contain another species as well, which might be *Eurotium diplocystis*, from which it appeared probable that the same thing might have occurred when Thwaites collected the latter species. Examination of the type specimens of *Eurotium diplocystis* at Kew has confirmed this supposition; at least six of the nine specimens agree with the species recently collected in company with the *Sclerotium*. This species is *Onygenopsis Engleriana* P. Henn.

The type specimen at Kew is labelled *Diplocystis flava* B. & Br., while the cover is labelled (*Eurotium*) *flavum*. Apparently neither of these names was published. The description evidently refers to the *Onygenopsis*, not to the specimens which were returned to Peradeniya.

As *Onygenopsis Engleriana* has only been described from dried specimens, the following notes may be of use. This species grows on dead leaves or twigs to which the fructification is attached by a white basal weft of hyphæ. It is sessile, hemispherical or subglobose, 2–6 mm. in diameter, sometimes pulvinate, elongated, up to 6 × 3 mm., rough, white or yellowish, becoming ochraceous in drying. It consists of a central core of interwoven hyphæ which form a loose pseudoparenchymatous tissue, surrounded by an outer zone of asci with a few hyphæ intermingled. The asci are borne singly, the ends of branching hyphæ; they are oval, 30 × 45 μ, or globose, 30 × 45 μ diameter; most of them are sixteen-spored, but some are eight-spored; the spores are smooth, hyaline, internally granular, oval or globose, 13–21 × 10–19 μ. There is scarcely any peridium; here and there a few hyphæ overrun the mass of asci. The whole fructification appears rough when magnified, because the individual asci are then evident. The name will now stand as *Onygenopsis diplocystis* (B. & Br.).

91.—Sclerocystis coremioides B. & Br.

In the Annals of Botany, Vol. 22, p. 116, I published a re-description of *Sclerocystis coremioides*, and stated that it was merely a sterile sclerotium, basing that opinion upon the herbarium specimens at Peradeniya, and numerous fresh collections of what appeared to be the same species. Recently von Höhnel has pointed out that the co-type at Kew is not a sterile sclerotium, but is identical with *Sphærocreas javanicum* v. Höhnel, and *Xenomyces ochraceus* Ces., and co-generic with *Ackermannia* Pat. A re-examination of the Peradeniya specimens has confirmed von Höhnel's identification. Apparently the gathering contained at least one sterile sclerotium, and that chanced to be examined on the previous occasion. The remainder, though similar in size, appearance, and habit, prove on microscopic examination to be identical with the Kew specimens.

92.—Helicoma binale B. & C.

This species, although assigned to Berkeley and Curtis, was published in the Fungi of Ceylon by Berkeley and Broome. It was said to occur " with *Reticularia fuliginosa* No. 247." *Reticularia fuliginosa* was attributed to Berkeley and Broome, and was said to grow on the leaves of some palm. Unfortunately the type specimen of *Reticularia fuliginosa* appears to have been lost ; it is not in the Kew or British Museum Herbarium ; and Lister (Mon., p. 161) stated that he did not meet with it in the herbaria of Paris, Leyden, Strasburg, &c. It was hoped to find it under *Helicoma binale*, but the type specimens of the latter at Kew are all from South Carolina, on Liquidambar, Curtis, No. 1775, and the British Museum specimens are from the same locality. This Curtis's number, however, provided the type of *Helicoma Berkeleii* Curt. (Grevillea, Vol. III., p. 106), to the description of which Berkeley added the note ; " These were sent out as *Helicoma binale* and its variety *apertum*, but were published by Curtis under the above name." Apparently Berkeley intended to convey the idea that the two names referred to the same species, a fact which may also be surmised from the reference of *Helicoma binale* to Berk. and Curtis. But the descriptions are so brief that, in the absence of the Ceylon specimen, no comparison can be made.

93.—Hypomyces chrysostomus B. & Br.

Central Province, Dec., 1868, parasitic upon *Thelephora dendroidea*. Also Peradeniya, 1910, on the same host; and Hakgala, 1910, on a *Polystictus*.

Subiculum white, feathery; conidiophores of the *Verticillium* type; conidia, elliptic or globose, hyaline, continuous, smooth, 11–14 × 7–11 μ.

Perithecia clustered, hyaline at first, then amber, conical, up to 0·25 mm. high, and 0·2 mm. diameter. Asci cylindric, 110–120 × 6–7 μ, eight-spored, spores uniseriate. Spores narrow-oval, sometimes slightly cymbiform, one-septate, not constricted, verrucose, with coarse warts, 17–24 × 5–6 μ, with apparently a solid tip, about 3 μ long, at each end.

94.—Hypomyces chromaticus B. & Br.

"Apparently on some decayed *Stereum*. Jan., 1869."—Thwaites. On a *Polystictus*, Hakgala, May, 1910.

Subiculum at first white, then bright yellow, finally orange. Conidia, oblong-oval, hyaline, one-septate, straight or slightly curved, 14–20 × 5–6 μ.

Perithecia generally crowded, sunk in the subiculum, hyaline at first, orange when dry, 0·25 diameter, spherical, with a rather darker cylindric ostiolum about 120 μ high. Asci cylindric, 130–140 × 5–6 μ, eight-spored, spores uniseriate. Spores spindle-shaped, one-septate, constricted at the septum, hyaline, verrucose, usually apiculate at both ends, 13–17 × 4–5 μ.

95.—Hypomyces pæonius B. & Br.

On *Polypori*, Thwaites. On a *Polyporus*, Hakgala, May, 1907. On *Hirneola hispidula*, Peradeniya, 1910.

Conidiiferous subiculum white; then collapsing and forming a thin felt which varies in colour from pink to purple-red. In an extensive cultivation of this species on *Hirneola* for several months, the mycelium became red when on the upper surface, *i.e.*, exposed to the light, but ochraceous when on the under surface of the *Hirneola*. Conidiophore of the *Verticillium* type; conidia narrow-oval or clavate, usually one-septate, sometimes two-septate, hyaline, smooth, with a large blunt apiculus, 15–28 × 5–6 μ.

Perithecia semi-immersed, deep red, globose, almost smooth, up to 0·25 mm. diameter, with a papillæform or cylindric ostiolum, 0·05 mm. high. Asci cylindric, almost linear, 140–175 × 6–7 μ, apex truncate, spores uniseriate. Spores narrow-oval, hyaline, one-septate, scarcely constricted, strongly verrucose, 25–30 × 5–7 μ, with an apparently solid tip, sometimes curved, 3–5 μ long; some spores are only 19 × 6, obtuse, with the tip scarcely apparent.

96.—Ophionectria trichospora (B. & Br.) Sacc.

Nectria trichospora B. & Br., Jour. Linn. Soc., XIV., p. 115.

Ophionectria trichospora (B. & Br.) Sacc., Michelia, I., p. 323.

Perithecia scattered or in small clusters on a thin, radiating, reddish-brown or whitish byssoid stroma, blood red, 0·25 mm. diameter, 0·4 mm. high, ovoid, apex subtruncate, rugose, ostiolum minute, scarcely evident. Asci 200–250 × 20–25 μ, cylindric, eight-spored. Spores 180–240 × 6–8 μ, pluri-septate, not constricted, vermiform, either of uniform diameter or tapering somewhat to either end, ends rounded.

This clearly belongs to the genus *Tubeufia* Penz. and Sacc., but as it is the type species of the genus *Ophionectria*, *Tubeufia* would appear to be superfluous.

97.—Hypocrea lenta (Tode) B. & Br.

Hypocrea lenta Fr. in B. & Br., Fungi of Ceylon, No. 992.

A Ceylon *Hypocrea* was listed by Berkeley and Broome in the Fungi of Ceylon as *Hypocrea lenta* Fr. In Ellis and Everhart, North American Pyrenomycetes, p. 78, there appears *Hypocrea lenta* (Tode), with the synonym *Hypocrea lenta* B. & Br., Fungi of Ceylon, No. 992; Ellis and Everhart stated that they had only one specimen, which was obtained from California. Finally, in Die Hypocreaceen von Rio Grande do Sul (Annales Mycologici, IX., p. 59), Theissen records *Hypocrea Schweinitzii* (Fr.) E. & E., and cites among the synonyms *Hypocrea lenta* (Tode) B. & Br., Ceylon Fungi, p. 112. But *Hypocrea Schweinitzii* is brown, then black, white internally, with hyaline spores, while the Ceylon species (type and fresh specimens examined) is dark green, flesh-coloured, or sometimes with a purple tinge internally, with yellowish-green spores. It is evident therefore that all this synonymy is incorrect, and that while *Sphæria lenta* Tode may perhaps be the same as *Hypocrea Schweinitzii* (Fr.) E. & E., the latter is certainly not the same as the "*Hypocrea lenta* Fr." of Berkeley and Broome. What the latter really is has not been determined ; it appears to be undescribed. But it seems scarcely worth while to institute new species of *Hypocrea* while there exist so many doubtful descriptions of tropical species with hyaline spores most probably based on immature specimens.

98.—Ustulina zonata Lev.

This species was originally recorded from Java on a dead palm stem. The specimens were apparently immature, since no spore measurements have been made on the type specimen ; and hence all recent determinations of the species are based on macroscopic characters only. It was collected again in Java by Penzig and still more recently by von Höhnel. Von Höhnel states that it has not been found elsewhere, but it has for some years been well known as the cause of root disease of several plants in Ceylon. Thwaites sent numerous specimens to Berkeley, who referred them all to *Ustulina vulgaris* Tul. Whether it is really distinct from that species is a matter of doubt : but there seems no doubt that the various recorded collections of *Ustulina vulgaris* from South America are the same as what is known in the East as *Ustulina zonata*.

In Ceylon it attacks the roots of tea, *Albizzia moluccana*, *Citrus* sp., *Cassia nodosa*, and *Lafœnsia Vandelliana*. In the case of tea, it does not attack the roots directly, but only through the agency of a neighbouring tree stump, usually *Grevillea*. *Grevillea robusta* is planted among tea as a wind-break or for green manuring ; when these trees are cut down *Ustulina* develops upon the stump and spreads along the roots to the roots of the surrounding tea bushes. On the other plants named, however, the attack is direct. *Ustulina zonata* is commonly found on dead coconut palms, but only, so far as has been ascertained, as a saprophyte.

During investigations into the above-mentioned root disease, numbers of examples of *Ustulina* have been grown in the laboratory, and their development carefully watched. Because of its polymorphic character, it was intended to write a special account of this species with illustrations of its various forms, but as the prospect of doing that becomes yearly more remote, the following note must suffice.

The mycelium of the fungus runs between the wood and the cortex in white fan-shaped patches which often acquire a black edge. When about to produce the fructification it bursts through the cortex, forming a white pustule only two or three millimetres in diameter. Its subsequent growth varies, probably according to external conditions.

In producing the form which is most widely different from *Ustulina vulgaris*, the white hyphæ spread out over the surface of the host and form a thin, resupinate, more or less circular plate, attached only at the centre. It is this form in which the zones, which represent stoppages in growth, are most clearly developed. This occurs on tea, and is the commonest form on coconut. I have observed plates, 9·5 cm. long and 4 cm. broad, only 3 mm. thick in the centre.

In other cases, the hyphæ on emerging from the cortex grow out in an upright column, which expands into a flat-topped turbinate structure, sporiferous on its upper surface only. I have measured such, 1·5 cm. high and 1 cm. diameter across the top. These have the appearance of a *Poronia*, or, when several such structures arise close together, of *Kretzschmeria*. But frequently, when several arise near one another, the discs fuse together, so that the ultimate production is a flat plate supported at several points ; or when the fusion is incomplete the appearance is that of Möller's *Hypoxylon symphyton ;* the latter exactly resembles, macroscopically, some forms of our *Ustulina*, but its spores are much smaller.

Finally, there is a form which is indistinguishable from the European species. This is specially found when the fructification develops on the host plant at the collar and on the surrounding soil. In such situations the plates are curved and convoluted, fused to each other in all manner of ways, and forming irregular crusts, sometimes a foot or more in breadth.

When first developed the fructification is soft and pure white, and bears hyaline conidia, 6–8 × 2–3 μ, narrow-oval or slightly clavate, on close-packed, erect, parallel, simple basidia. It then becomes greenish owing to the development of the hard crust beneath the conidial layer. In sheltered situations the mature stroma may remain permanently white, owing to the persistence of the remains of the conidial layer, but in general it becomes violet-gray, or purple-gray, dotted with black ostiola. Old weathered specimens are black. The perithecia are globose, about 1 mm. diameter, and distant; and the ostiola scarcely project. The asci are cylindric, long-stalked, about 250 × 10 μ, eight-spored; the apex turns blue with iodine. There are numerous filiform paraphyses. The spores are opaque, black-brown, cymbiform, ends obtuse; measurements on different collections gave 30–38 × 10–13 μ, 34–36 × 10 μ, 30–38 × 9–10 μ. Penzig and Saccardo give the spores of the Java species 33–36 × 10–12 μ, while von Höhnel states that in his specimens they were 45–48 × 8–8·5 μ.

Compared with English specimens collected in Norfolk, the Ceylon species differs in colour, and is usually thinner; its ostiola are less prominent; its perithecia are smaller and more globose; and its spores are, on the average, broader. But the differences are not great. Biologically the Ceylon species appears to differ in its parasitic habit, though information regarding the European species is wanting on that point.

The Ceylon species appears to agree fairly well with von Höhnel's re-description of *Ustulina zonata* Lév., except in the size of the spores. But as that author does not consider the difference between his measurements and those of Penzig and Saccardo important, no stress need be laid on that point.

But von Höhnel found with his specimens a *Graphium*, which he regards as the conidial stage. He states that it resembled a dwarf *Thelephora*, and grew either on the upper or under side of the *Ustulina*. The synnemata are brittle, dark red-brown below, violet-brown above, and reddish-white at the obtuse apex. They are nodular, bent, simple or slightly branched, up to 3 mm. long and 200 to 300 μ broad. At the apex they bear a white head, 200 to 300 μ broad, of hyaline, elliptic conidia, 5–6 × 3 μ. The conidia are borne singly on the tips of the hyphæ, not in chains.

According to von Höhnel's account, *Ustulina zonata* differs completely from *Ustulina vulgaris* in its conidial stage. This is completely at variance with the experience of numerous cultivations of the Ceylon species, and if it is correct the latter is evidently not *Ustulina zonata*. But in view of the close resemblance of the Ceylon and Javan forms in other respects, it would seem more probable that the *Graphium* is a parasite on the *Ustulina*, not a conidial stage of it. It may be pointed out that one would not expect to obtain the conidial and ascigerous stages of *Ustulina* on the same stroma at the same time.

99.—Otthia lignyodes (B. & Br.) Sacc.

Sphæria (*Cæspitosæ*) *lignyodes* B. & Br., Journ. Linn. Soc., XIV., p. 128.

Perithecia superficial, scattered, or crowded in large groups, covering several centimetres, on a thin stroma, clavate, up to 2 mm. high and 0·8 mm. diameter, fleshy, black, minutely roughened, ostiolum not elevated. The lower half of the "perithecium" forms a solid "parenchymatous" stalk; the cavity in the upper half is oval, about 0·8 × 0·5 mm., with a wall about 0·1 mm. thick. Asci clavate, apex truncate, pedicel long and tapering, sporiferous part 80–90 × 12–16 μ, eight-spored: spores at first obliquely uniseriate, then biseriate above, uniseriate below. Paraphyses numerous, filiform. Spores varying from narrow-oval to subcymbiform and slightly curved, ends rounded, at first greenish hyaline and three-guttulate, finally fuscous and one- to three-septate. The immature, or just mature, perithecia become cup-shaped when drying; the perithecia which have extruded their spores do not collapse.

On dead wood, Peradeniya, January, 1912.

100.—Fracchiæa brevibarbata (B. & C.) Sacc.

In Grevillea, XX., p. 113, Cooke states that *Fracchiœa brevibarbata* (B. & C.) Sacc. "was found on *Acer rubrum*, in South Carolina, on bark in Ceylon, and *Rhus copallina*, Santee Canal, S. Carolina." In response to my inquiry the Kew authorities inform me that under *Fracchiæa brevibarbata* at Kew there is a Ceylon specimen labelled " *Sphæria Broomeiana* Berk. Ceylon, G. H. K. T., Sept. 10, 1850." The latter should be the type of *Coronophora Broomeiana* (Berk.). Evidently Cooke considered *Coronophora Broomeiana* to be identical with *Fr. brevibarbata*, though he did not employ the earlier name, and in his Synopsis Pyrenomycetum he included the latter under *Fracchiæa* and the former under *Coronophora.*

Fracchiæa brevibarbata has been described and figured by Berlese (Icones Fungorum, III., p. 27, Pl. XXXV., Fig. 2) from a specimen supplied by Cooke. It is evidently quite distinct from *Fracchiæa hystricula*, which is the only *Fracchiæa* re-discovered in Ceylon up to the present. But it is difficult to understand from the figure and description how Berkeley could style it " minutissime tomentosa," and give it the name *brevibarbata*. In view of the apparent confusion of Ceylon and American species, it would be interesting to determine whether the two are really identical, and which of them is represented by Berlese's figure.

101.—Fracchiæa hystricula (B. & Br.) Petch.

Sphæria (*byssisedæ*) *hystricula* B. & Br., Jour. Linn. Soc., XIV., p. 125.

Rosellinia hystricula (B. & Br.) Sacc., Sylloge Fungorum, I., p. 274.

Chætosphæria hystricula (B. & Br.) Cooke, Grevillea, XV., p. 124.

Superficial : perithecia scattered or crowded, on a feebly-developed, byssoid stroma, 0·5 mm. diameter, globose, black, wall membranous, collapsing when old, clothed with rigid hairs, 140–260 μ long, 13 μ diameter, black, dark brown and opaque when mounted, slightly inflated at the base, tapering rather abruptly at the apex. Asci broadly clavate, with a long thin pedicel, 90–130 × 12–14 μ, polysporous, soon diffluent. No paraphyses. Spores hyaline, narrow-oval, continuous, 2–3 guttulate, curved in one aspect, 8–11 × 2–3 μ.

On dead *Hevea*, Gampola, Nov., 1909 ; Bentota, Jan., 1912.

102.—Phyllachora Pongamiæ (B. & Br.) Petch.

Rhytisma Pongamiæ B. & Br., Jour. Linn. Soc., XIV., p. 130.

Cryptomyces Pongamiæ (B. & Br.) Sacc., Sylloge Fungorum, VIII., p. 708.

Stromata black, embedded in the leaf and visible on both sides, up to 1 cm. diameter, irregularly circular, shining, covered with minute conical ostiola on the under surface of the leaf. Loculi 150–220 μ diameter. Paraphyses numerous, linear, shorter than the asci. Asci cylindric or clavate, 60–90 × 8–18 μ, eight-spored. Spores oval, hyaline, continuous, 12–16 × 5–8 μ.

The asci are very variable. Raciborski (Parasitische Algen und Pilze Java's, pt. III., p. 18) gives asci 80–94 × 18 μ, spores 14 × 8–9 μ. Fresh specimens collected at Peradeniya showed cylindric asci 60 × 8 μ. The co-type in Herb. Peradeniya has clavate asci 70 × 10 μ, with spores obliquely uniseriate below and biseriate above, and inflated elliptic asci, 90 × 18, spores all obliquely uniseriate, in the same stroma.

On leaves of *Pongamia glabra* Vent., Peradeniya, &c.

In Fungi Indiæ Orientalis, pt. III. (Ann. Myc., IX., p. 376), H. and P. Sydow and E. J. Butler list this species, with a figure, under the name *Cryptomyces Pongamiæ.* It appears to me to be an indisputable *Phyllachora.*

103.—Diatrype russodes B. & Br.

Diatrype russodes B. & Br., Jour. Linn. Soc., XIV., p. 123.

Stromata erumpent, pulvinate, circular or oval, up to 4 mm. diameter, crowded, black, somewhat soft, rough with projecting cylindric ostiola, up to 0·3 mm. high and 0·2 mm. diameter. Asci clavate with a long tapering pedicel, eight-spored, 44–60 × 8 μ; spores uniseriate below, biseriate above. Spores greenish hyaline, cylindric, slightly curved, 8–10 × 3 μ.

On dead twigs, Peradeniya, Dec., 1911. On bark (Thwaites).

104.—Herpotrichia cirrhostoma (B. & Br.) Petch.

Sphæria (Villosæ) cirrhostoma B. & Br., Jour. Linn. Soc., XIV., p. 126.

Lasiosphæria cirrhostoma (B. & Br.) Sacc., Sylloge Fungorum, II., p. 201.

Leptospora cirrhostoma (B. & Br.) Cooke, Grevillea, XV., p. 125.

Perithecia superficial, gregarious, about 0·5 mm. diameter, black, clothed (except on the disc) with lax, radiating, simple, black, or black-brown septate hyphæ up to 2 mm. long and 4 μ diameter, crowned by a naked disc, about 0·2 mm. diameter, which is orange in the centre and pale yellow towards the margin ; peritheeial wall leathery, not carbonaceous ; ostiolum depressed. Asci clavate, eight-spored, 110–150 × 14–15 μ, spores biseriate above, uniseriate below. Paraphyses numerous, filiform. Spores fusoid, slightly curved, greenish hyaline with hyaline acute tips about 4 μ long, at first one-septate, constricted at the septum, and inflated on one or both sides of it, ultimately 3–4 septate, 32–42 × 7 μ. In the available material, *i.e.*, the herbarium specimens collected by Thwaites, and others recently collected at Peradeniya, all the mature spores have one septum, and the majority show indications of two or three additional septa, but completely three- or four-septate spores are rare.

Berkeley and Broome cite, as Thwaites's collection numbers, 171 and 1073. This does not mean that Thwaites sent two collections, but that 1073 was part of 171, separated by Berkeley and Broome. They add : " In No. 171 some of the hairs are lancet-shaped," and " in the same group are specimens externally just the same, but with very small hyaline very strongly curved sporidia. Apparently another form of fructification of the same species." They appear to have forgotten that they had already described this form, with lancet-shaped hairs, and curved sporidia, as *Sphæria hystricula* (Thwaites 1074, 171 in part).

105.—Berkelella stilbigera (B. & Br.) Sacc.

Stilbum tomentosum Schrad.

This species was described by Berkeley and Broome under the name *Hypomyces stilbiger* B. & Br. (Jour. Linn. Soc., XIV., p. 113) as follows :—

" Peritheciis obovatis acutis ; ascis elongatis, membrana interiore capitata ; sporidiis fusiformibus multiseptatis, conidiiferis stilbiformibus (no. 83 bis). *On Trichia.* Sporidia ·006 long, ·0005 wide; conidia ·0003–·0004 long. It is very interesting to ascertain that *Stilbum tomentosum* Schrad. is merely a conidiophore of a *Hyphomyces* (*sic*) parasitic on *Trichiæ*." The measurements are in inches. The *Trichia* (Thwaites 83) is *Hemitrichia serpula* Rost.

Saccardo (Sylloge Fungorum, II., p. 475) placed this species in a subgenus of *Hypomyces*, which he named *Berkelella*. Subsequently (Sylloge, IX., p. 989) he created a new genus *Berkelella*, in which he placed *Hypomyces caledonicus* Pat., which has four-septate spores, and *Hypomyces stilbiger* B. & Br. The genus is characterized as "Perithecia *Hypomycetis*, sporidia fusoidea vel oblonga 3-pluriseptata, subhyalina." This is wider than the subgenus *Berkelella*, which had simply "sporidiis pluriseptatis."

Berkeley's note appears to have been overlooked. It is clear that he supposed that the conidial stage of *Hypomyces stilbiger* was identical with *Stilbum tomentosum* Schrad., or in other words that he had succeeded in finding the ascigerous stage of the latter. Whether that is true or not obviously depends upon whether the *Stilbum* parasitic on *Trichia* in Ceylon is identical with that parasitic on *Trichia* in Europe.

In the Transactions of the British Mycological Society for 1902 (pp. 25–26) Miss A. L. Smith has traced the history of the name *Stilbum tomentosum*, and has shown that in all the descriptions the spores are said to be globose. Specimens from Hampshire (England) and Devonshire (England) were found to have globose spores, but a specimen from Egham in Surrey (England), in all other respects identical with *Stilbum tomentosum*, had oval spores up to 5×2 μ. On examining the specimens of *Stilbum tomentosum* in the Herbarium of the British Museum, Miss Smith found a specimen from Ceylon in the Broome collection, the spores of which had been drawn and measured by Broome; they are figured as oval in form and 5 μ long. (It may be noted here that this does not agree with the measurements published by Berkeley and Broome.) Miss Smith considers that the difference between the spores of the two kinds of *Stilbum* amounts almost to a specific distinction, but that the plants are otherwise so much alike that it seems better to distinguish the second as a variety. Accordingly she has named the oval-spored form, var. *ovalisporum*.

The Stilbum stage of *Hypomyces stilbiger*, parasitic on *Trichia*, is very common in the up-country districts of Ceylon. It occurs on *Trichia varia*, *Trichia affinis*, *Hemitrichia serpula*, &c., but is especially abundant on *Trichia botrytis*. Whole sheets of the latter may be found, every head bearing up to half a dozen specimens of the *Stilbum*. The perithecial stage is rarer, but I have found it on *Trichia botrytis* and *T. affinis*. Berkeley and Broome's specimen in the Peradeniya Herbarium is on *Hemitrichia serpula*. The *Stilbum* stage has been found at Peradeniya on *Perichæna depressa*.

The *Stilbum* is white, erect, up to 0·75 mm. high. The stalk is 30–40 μ diameter, beset with rounded processes: it expands above into a globose head, 120–160 μ diameter, which, when the spores are all removed, exhibits a globose core 70–90 μ diameter. The stalk is composed of parallel hypha, and either arises direct from the sporangium of the *Trichia* or is furnished with a slight white stroma at the base. The conidia are minute, oval, and hyaline, and measure 1·5–2 × ·75 μ. Another measurement gave 1·5–3 × ·75–1 μ.

The perithecia are scattered, superficial, flask-shaped, about 0·3 mm. high and 0·2 mm. diameter below, amber coloured, translucent, clothed below with white hyphæ which bind it to the substratum, but glabrous above. The perithecial wall is thin and subtransparent. The asci are cylindric, tapering below, 180–200 μ long and 5–7 μ diameter: the apex is rounded and thickened, with a central pore. There are no paraphyses. The spores are at first eight in number, and about 160 μ long: *they divide within the ascus into cuboid part-spores which round off and become spherical, greenish hyaline, 1–1·5 μ diameter.*

Broome's measurement of the conidia, according to the inscription on his specimen in the British Museum, was 5 μ. But the measurement published by Berkeley and Broome in the "Fungi of Ceylon" was 7·5–10 μ, and it is usually supposed that Broome was responsible for the microscopic measurements published by the joint authors. Examination of the type specimen of *Hypomyces stilbiger* in the Peradeniya Herbarium shows that it does bear conidia which reach 10 μ. or more, but that these are not the spores of the *Stilbum*. The *Stilbum* is parasitized by a *Cylindrocephalum*; this fungus consists of a few hyaline, septate hyphæ, about 3 μ. diameter, which twine round the *Stilbum* stalk and head, and produce solitary oval heads up to 13 × 7 μ., each containing up to eight conidia in a parallel bundle; these conidia are cylindric, hyaline, and when mature measure 10–12 × 2 μ., but immature conidia may be only 4–5 μ. long.

This may be identical with *Cylindrocephalum stellatum* (Harz) Sacc., recorded as parasitic upon *Stilbum bulbosum* and *Stilbum vulgare*, but the spores of that species are said to be only 5 μ. long. It is evident from Broome's measurements that he measured the spores of the *Cylindrocephalum*, an error which may easily be made by any one who is not aware of the possible presence of that species. After careful examination of specimens of the Ceylon *Stilbum* to make sure of the absence of *Cylindrocephalum*, I have found that the *Stilbum* spores are really oval, but measure 1·5–2 × 0·75 μ.. In that respect it differs from *Stilbum tomentosum* Schrad.

Since Berkeley and Broome describe the ascospores as multiseptate, it is evident that their specimens were immature. Indeed, it is somewhat a difficult matter to find ripe perithecia, though unripe specimens are fairly common. But they gave a figure (Jour. Linn. Soc., XIV., tab. 6, fig. 29 c) which shows an ascospore partly broken up into subglobose spores. The co-type in the Peradeniya Herbarium is immature. When mature, the spores are not multiseptate, but divided into innumerable part-spores.

Hypomyces stilbiger B. & Br. was the only species of the subgenus *Berkelella*. Saccardo, in instituting *Berkelella* as a genus, (1) refers to its former publication as a subgenus, (2) describes *Berkelella caledonica* (Pat.) Sacc., and (3) adds "ad hoc genus spectat quoque *Berk. stilbigera* (B. & Br.)." But these two species are generically distinct. Under such circumstances, what is the type species of the genus *Berkelella?* Are we to amend *Berkelella* to fit *Hypomyces stilbiger*, and so exclude *Berkelella caledonica*, which has four-septate spores, and *Berkelella stromaticola* (P. Henn) v. Höhnel, which has three-septate spores, or are we to retain *Berkelella* for these last-named species, and institute a new genus for *Hypomyces stilbiger*? It would appear that, in spite of the prior subgeneric application, Saccardo's order of publication leaves no option, and that we must accept *Berkelella* as at present defined, with the type species *Berk. caledonica*, thus excluding *Berkelella stilbigera*. For the latter species I would propose a new genus *Byssostilbe*—perithecia *Hypomycetis*; sporidia filiformia, multiseptata, in articulos globosos dilabentia; conidiophoræ Stilbiformes. *Chilostilbe* Penz. and Sacc. (Malpigia, XI., p. 508) differs in having the asci polysporous initially.

In "Icones Fungorum Javanicorum," tab. XXXIII., fig. 4, p. 48, Penzig and Saccardo described *Ophionectria* (*Ophiostilbe*) *Trichiæ*, which was discovered in Java, parasitic on *Trichia verrucosa* Berk. Their specimens were evidently immature, and in all probability had been preserved in alcohol as so many of that collection were; when allowance is made for those points, it is, I think, clear that their species is identical with *Hypomyces stilbiger* B. & Br. They describe the perithecia as parasitic, superficial, globosoconoid, whitish, rather villous, 130–140 μ diameter, with a rather long papillate ostiolum: asci cylindric, shortly stalked, apex rounded, 70–80 × 4–4·5 μ, eight-spored; no paraphyses; spores filiform, pluriseptate, 60–65 × 0·7–1 μ hyaline. The conidiophore is said to resemble *Stilbum tomentosum* Schrad.: its stalk is cylindric, "exquisite papilloso-asperulo." 270–300 × 30–35 μ, whitish; head subglobose, 60–65 μ diameter, conidia not seen. They state that this species probably constitutes a new genus, which stands in the same relation to *Ophionectria* as *Sphærostilbe* to *Nectria*, and they suggest the name *Ophiostilbe* for it. They did not, however, make use of the latter name except as a subgeneric distinction. Unfortunately, the spores are not filiform when mature, and therefore it is impossible to accept Penzig and Saccardo's suggestion; for the prefix *Ophio* is usually reserved for the names of genera in which the spores are filiform. It may, however, be admitted that very little is known about the ultimate condition of the spores of most of the species of *Ophionectria*, and it is most probable that many of the species included in that genus have spores similar to those of *Hypomyces stilbiger* B. & Br. Still, that is a reason for splitting the genus *Ophionectria*, rather than for perpetuating the error by the name *Ophiostilbe*. The synonymy of the species is as follows :—

Byssostilbe stilbigera = *Hypomyces stilbiger* B. & Br.
= *Berkelella stilbigera* (B. & Br.) Sacc.
= *Ophionectria Trichiæ* Penz. & Sacc.

It would appear that the conidiophore of *Byssostilbe stilbigera*, which has always been recorded from the Tropics as *Stilbum tomentosum* Schrad., is in reality quite a different species, characterized by its minute oval spores, but the solution of that question would rest on more certain evidence if a perithecial stage of *Stilbum tomentosum* could be found in temperate climates. Whether the Egham specimen recorded by Miss A. L. Smith is another species or variety, or owes its larger spores to the presence of *Cylindrocephalum*, must be decided by a re-examination of it.

106.—Thread Blight (Stilbum nanum Massee).

" Thread Blight " is the name applied to a white mycelium which runs in well-defined strands along living branches and leaves, often at a considerable height from the ground. It is probable that several species of fungi produce such mycelium, indeed such would be expected from the differences in habit exhibited by different examples, but up to the present only two names have been allotted to the tropical forms. In one form, or set of species, the mycelium is certainly parasitic upon the branches and leaves over which it runs. In another group the mycelium originates in a dead stub or " canker," and the spreading strands do not appear to cause any injury to the bark over which they run ; *Hirneola polytricha* belongs to this group. Another type, which should also be classed here, forms a white cushion which binds together the stems of jungle shrubs where they happen to touch one another.

A species which is parasitic upon nutmeg in Ceylon has been under observation for several years, and it is hoped to publish a full account of it shortly. Its fructification consists of small sessile pilei, which appear to have been described as a *Cyphella* by Berkeley and Broome. It is closely related to *Marasmius scandens* Massee, which grows on cacao in West Africa, but in the latter the white strands are rather thicker. Unfortunately, specimens sent to me from West Africa by Mr. W. S. D. Tudhope do not bear any fructification, and I was not able to find the type specimen of *Marasmius scandens* in the Kew Herbarium. The Ceylon species appears to be identical with that recorded as parasitic upon tea in India, under the name of *Stilbum nanum*. But an examination of the type specimens of *Stilbum nanum* shows that the white thread blight has no connection with the *Stilbum*; the twigs which bear the latter show no Thread Blight, and, except that both are on tea, there is no reason why they should have been thought to be stages of the same fungus.

Stilbum nanum is a small red or pinkish *Stilbum* which is common on dead twigs of tea, Hevea, &c. It appears to be identical with the later *Stilbum* (*Stilbella*) *Heveæ* Zimm. It was described as "flavidum," but to any one who knows the changes which tropical fungi undergo in drying, it is evident that it was originally red. As far as is known, it is purely saprophytic.

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NOTICE.

Volumes I., II., III., and IV. are now complete, and are published at Rs. 15 or £1 each unbound. A few copies of Parts I. (Ceylon Botanic Gardens, &c.), III., and IV. (Podostemaceæ, &c.) of Vol. I. can still be had. The following reprints are also for sale at the prices marked :—

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DEPARTMENT OF AGRICULTURE, CEYLON.

ANNALS

OF THE

ROYAL BOTANIC GARDENS, PERADENIYA.

VOLUME V., PART V., MARCH, 1913.

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Termite Fungi: a Résumé.

BY

T. PETCH, B.A., B.Sc.

IN 1906 the present writer published an account of the fungi which were then known to grow in and on termite nests in Ceylon. Since that date additional information concerning the Ceylon species has been communicated in various articles, and the subject has received the attention of naturalists in other countries also. Moreover, bibliographical research has brought to light, in unexpected quarters, earlier records relating to these fungi, which appear to have been completely forgotten. Details of the fungus flora of termite nests are now available from India, Ceylon, Java, and Madagascar, and it would appear that a comparison of the mycological results of different investigators might be of service.

In the following pages the word "nest" is employed as an equivalent of "termitarium." This is the most natural use of the term, but it is difficult to define it satisfactorily. If it is defined as the whole collection of structures associated with a single fertile queen, one is met by the objection that there may be two or more queens in the royal cell; on the other hand, if the definition is made dependent upon the royal cell, there is the objection that in some nests, *e.g.*, *Eutermes monoceros*, there is no royal cell.

The subterranean nests (including the mound nests, which are really mainly subterranean) in Ceylon consist of numerous chambers, or cavities in the soil, each of which contains one or more structures, which have been aptly likened to coarse bath sponges. These structures are composed of finely divided wood or other vegetable matter which has been eaten by the termites; they are built, in all cases, of excrement. For these the name "comb" is used, a term which has been applied to them for nearly a century. A termite hill in Ceylon may be regarded as a series of clay walls enclosing and protecting a large number of combs.

From the above type of nest it is an easy transition to those built in hollow trees or in decayed timber. In these the timber, or the part of the tree trunk still alive, takes the place of the clay wall, the comb being built inside it. In such nests there is usually only one comb. Finally, there is the "Carton nest," which is built in the open, and consists of a single comb enclosed by a continuous layer, the whole constructed of the same material.

The object of the comb would appear to be merely to utilize the existing space to the best advantage; it provides a greater superficial area in a given volume. In some nests, *e.g.*, those of the mound dwellers in Ceylon, the combs produce fungi, and hence have been called fungus gardens. But from the literature it appears that the name "fungus garden" has been extended to all structures of this type whether they produce fungi or not; and hence it is impossible to conclude from published descriptions that a given termite is really a fungus grower simply because its nest is said to contain "fungus gardens." The need of a term to denote all these homologous structures is obvious. But they cannot be called "fungus gardens," because the term has to be applied to many, *e.g.*, those of *Eutermes monoceros*, which never produce fungi. Neither can they be called "nests," as is sometimes done, because they are not independent units. The term "comb" seems a fairly suitable one, and at least does not involve the errors of the others. A fungus garden, in all the cases known, is a comb; but a comb is not necessarily a fungus garden. And in some cases a single comb may constitute a nest; while, on the other hand, there are nests which, according to the descriptions, do not contain any combs. In the case of termites which cultivate fungi all the combs, as far as Ceylon experience goes, are fungus gardens, actual or potential.

Early Records.

The first record of the occurrence of fungi in termite nests was made by König in 1779. According to Wheeler, König examined termite nests in Tanjore, and stated that the combs were "covered with little knots on their outer and inner surfaces, like chagrin skin. This texture is most clearly seen at their margins near the openings and entrances. Under a magnifying glass they appear fibrous or woolly." That statement hardly affords sufficient evidence that König saw fungi on the comb, since the " chagrin skin " appearance is not due to fungi, but to small inequalities caused by the pellets of excrement, of which the comb is built. But Escherich, quoting from the same paper, states that König found on the combs a species of mould, " mucor stipulatus capsulis globosis compositis niveis," which was doubtless the common white, spherical, conidial fungus.

In 1781 Smeathman published an account of his investigations into termite nests in West Africa ; he refers to the combs as nurseries. Wheeler quotes the following from his paper :—" There is a remarkable circumstance attending the nurseries. They are always slightly overgrown with mould, and plentifully sprinkled with small white globules about the size of a small pin's head. These at first Mr. S. took to be the eggs ; but on bringing them to the microscope they evidently appeared to be a species of mushroom, in shape like our eatable mushroom in the young stage in which it is pickled. They appear, when whole, white like snow a little thawed and then rozen again, and when bruised seem composed of an infinite number of pellucid particles, approaching to oval forms and difficult to separate : the mouldiness seems likewise to be the same kind of substance. The nurseries are inclosed in chambers of clay, like those which contain the provisions, but larger."

Smeathman's observations were confirmed in 1850 by Savage, who examined the same nests in West Africa. Savage stated that Kirby and Spence considered the fungus a *Mucor*, but he himself thought it was a *Trichia*.

Early Records in Ceylon.

Among the consignments of fungi which Gardner forwarded from Ceylon to Berkeley, *circa* 1846, was one, *Lentinus cartilagineus* Berk., which was said to grow " from about four feet below the surface of the earth from the comb of termites." The stalks were stout, 20 to 26 cm. long, with a thick, cartilaginous wall. This is the common termite agaric, which is eaten by the natives in all the countries in which it occurs.

The same species was also sent by Gardner under another number, without any note of its connection with termite nests, and was given another name, *Lepiota albuminosa* Berk. ; while a third collection of the same was named *Armillaria eurhiza* Berk.

In a letter to Hagen, Nietner described the nest of a Ceylon termite, said to be *Termes fatalis*. He referred to the combs as " nests," and stated : " These nests are always found to be full of minute microscopic fungi, the finest and most beautiful imaginable. The corpuscles, as large as a fine pin's head and composed of small beads, grow in clusters on a network of roots and young brood, all resembling crystals of ice or silver." By " roots " he evidently meant hyphæ, and by " young brood " the small, just developing spheres or " corpuscles."

When Thwaites sent fungi to Berkeley about 1870, he included the agaric which Gardner had collected, but without any note as to habitat. On that occasion it was named *Collybia sparsibarbis* B. & Br. Berkeley noted its resemblance to *Armillaria eurhiza*, but said that it differed in the absence of a long root, the underground part of the stem having been cut off.

Among the other specimens sent by Thwaites were two gatherings, said to occur on the nests of termites when exposed to the light. They were included among indeterminable conidial forms of *Xylaria*. One of them is a conidial *Xylaria*, while the other consists of aborted specimens of the developing agaric.

It is curious that neither Thwaites nor Gardner sent the minute white fungus which is so common on the termite comb. At least it cannot be traced in the records of their consignments. Berkeley would most probably have attributed it to *Ægerita*, but the only species of *Ægerita* he recorded for Ceylon are *Ægerita candida* P., the specimens of which grew on wood, and *Ægerita mellea* B. & Br., which grew on lichens.

India.

In the " Transactions of the Linnæan Society," XXIII. (1862), p. 91, Berkeley recorded a sclerotium under the name of *Sclerotium stipitatum* Berk. & Curr., which had been found in termite nests in Travancore. In his description he stated: "They look at first sight extremely like some neat variety of *Xylaria polymorpha*, with a slender stem and pointed barren apex. There are, however, no perithecia beneath the jet black cuticle; and the structure is not delicately filamentous, as in *Xylaria*. On the contrary, the mass consists of very irregular, swollen, and sometimes constricted, more or less anastomosing, and more or less densely compacted threads. Towards the margin the substance is firm, but looser in the centre, so that the individual threads easily separate." They were forwarded to Berkeley by Dr. E. J. Waring, who described them as occurring in termite cavities, hanging down from the sides in clusters of from four to ten, of various sizes and shapes; the natives called them "puttu-manga" (white ant mango), and informed him that they were produced by the termites, and were highly valued for medicinal purposes. Currey's figures show that they were ovoid or spherical bodies, 1·5 to 2·7 cm. long, with a narrow stalk; only on one of three specimens, which constituted the whole sample, does he figure what may be regarded as a barren pointed apex.

A further account of this sclerotium was given by Shortt in 1867; he states that it grows only in old and deserted nests, never in chambers which are inhabited by the termites.

These sclerotia have been collected in Ceylon; and I have recently received, per Mr. C. G. Lloyd, specimens collected by the Rev. J. Gillet in termite nests in Africa.

Edible fungi have for a long time been known to grow on termite nests in India. In the "Gardeners' Chronicle" for 1869, p. 813, under the heading "Mushrooms from White Ant Soil," Berkeley quoted an extract from a letter from a correspondent at Bangalore, who stated that he was trying to grow mushrooms from white ant soil, and asked for instructions. His correspondent stated that he was making beds for trial and getting the soil where the mushrooms grew spontaneously brought in, and added that indications of success were apparent.

In his comments Berkeley stated that there was a species of *Podaxon* which grew very commonly on ants' nest soil, but that he had no other information as to any other fungus which is developed upon it likely at all to be esculent.

Apparently he had for the moment forgotten Gardner's *Lentinus cartilagineus*. The occurrence of *Podaxon* in such situations in South Africa appears to have been common knowledge ; in "Hooker's London Journal of Botany," II. (1843), pp. 200–205, Berkeley stated that *Podaxon carcinomalis* grew on ant-hills in South Africa, but I have not been able to trace any earlier reference. The habitat is not stated in the original description of that species in Linn. fil. Supplement, p. 453 ; and, as far as I am aware, *Podaxon* has never been associated with termite nests in India.

The letter referred to above elicited several comments. In the "Gardeners' Chronicle," 1869, p. 896, W. Clifford, who claimed acquaintance with Bengal, wrote : "I have had to deal with vast numbers of white ants in my time. From what I know of the soil of their nests, I should think it valueless for growing mushrooms." He was followed by C. H., also of Indian experience, who wrote (*loc. cit.*, p. 920) : "I cannot conceive white ant earth being any use in gardening . . . . . . The only growth I have ever observed on it, or in the nests, was that of a very small fungus, less in size than an ordinary pin head, and often mistaken for the egg of the termites, in shape resembling a button mushroom of a white colour." Meanwhile, Berkeley's correspondent was justifying his statements, and in the "Gardeners' Chronicle," 1869, p. 1306, Berkeley was able to make the following communication :—

"A good deal of interest has lately been excited in India, especially about the Neilgherries, as to the possibility of raising mushrooms artificially. It was known that an esculent fungus is occasionally developed on white ants' nests, and experiments have been made at Bangalore with white ants' nest soil. We have just received a quantity of agarics, preserved in alcohol, which have appeared on it, but we have no information as to whether they have proved to be useful esculents or not. The species is certainly undescribed, but approaching in some respects one of which we have a drawing transmitted from Ceylon by the late Dr. Gardner, with strong twisted gregarious stems arising from a common base. It does not, however, appear among the numerous figures which have been sent us by Mr. Thwaites, so that Dr. Gardner's agaric is probably not a common species in Ceylon. The species before us probably belongs to the subgenus *Armillaria*, and may be called *Agaricus termitigena*, the characters of which, so far as they can be elicited without dried specimens, for those before us may have lost their colour, may be given as follows :—

"Pilcus 1–2 inches across, strongly and obtusely umbonate, smooth centre, or notched at the margin, which is thin and even, or slightly striate ; edge at first slightly inflexed.

"Stem 8 inches high, ½ inch thick, solid, cartilaginous, not twisted, darker than the pileus, especially towards the base, slightly tomentose or fibrillose ; ring ascending, permanent, situated near the top of the stem, with a more or less lacerated margin.

"Gills rather narrow, very much crowded, quite free, rounder behind ; edge entire."

There is no doubt that this species, which has escaped inclusion in "Saccardo," is identical with *Lentinus cartilagineus*. I may state that I have seen numerous specimens from various parts of India, which were included in a collection of Indian edible fungi forwarded to Kew from the Indian Museum, Calcutta. As the fungus is common in India, it has no doubt received many other names. It is most probable that Berkeley's implied suggestion that his specimens had been grown on artificially prepared beds was incorrect, for the agaric does not grow on white ant soil, but on the combs.

The above-mentioned communications evoked similar criticisms in India, and one letter from W. T. Gibbon, Goruckpore, which was published in the Proceedings (?) of the Agri-Horticultural Society of India, was republished in the "Gardeners' Chronicle," III., n. s. (1875), p. 376, and again in "Grevillea," III., p. 165. The following extracts are taken from that letter :—

"I now send you a bottle containing mushrooms I extracted a few days ago from the centre of a white ant hillock. When I collected them they were in appearance like asparagus, over fourteen inches in length, and the people about here consider them particularly good eating, partaking of them both raw and cooked, and call them 'bhuephor.'

"When I read the above article in your Society's Journal somewhat over a year ago, I was then aware that mushrooms existed in the interior of ant-hills, for I had often seen them, but I did not know their season of sprouting, and whenever I searched was unsuccessful until the other day. I have now ascertained the season they sprout is the end of August or the beginning of September, and I believe all ant-hills produce them then. These mushrooms appear to me to proceed from a peculiar substance always found in ant-hills in this country (whether white or black), generally called ants' food, a bluish gritty substance, like coarse wheat flour turned mouldy and adhesive. In dry weather brittle, and in damp weather like soft leather. It is this substance, under the combined influence of heat, damp, and darkness, from which the mushrooms grow. As my experience is at variance with the writer in the 'Gardeners' Chronicle,' you may care to record it."

The specimens referred to were submitted to Dr. D. D. Cunningham, who replied that they apparently belonged to some species of *Lepiota*, and were chiefly remarkable for the extreme length and coarse fibrous contents of the stem.

These specimens were undoubtedly immature *Lentinus cartilagineus*. The "ant food" is the termite comb. The production of the agaric is dependent upon the condition of the comb, not on the time of the year, though, of course, they cannot penetrate the soil and appear above ground when it is baked hard in the dry seasons.

In the "Gardeners' Chronicle," XVII. (1882), p. 401, Berkeley published another article on the subject, entitled "Fungi of Ants' Nests," from which the following extracts are taken :—

"The fungi which occur in tropical countries on ants' nests are for the most part very peculiar, but no fungologist has yet made a special study of them in the countries where they abound. Specimens of one or two species of *Podaxon* are frequently gathered by botanists ...... and an esculent agaric has once been found on them in abundance, while a very singular form, to which the provisional name of *Lentinus cartilagineus* was given, was found by Mr. Gardner four feet below the surface of the earth on the comb of the termites ;

and the same botanist also gathered in Ceylon what appears to be a form of the common *Xylaria hypoxylon* on the combs of the white ant. But doubtless many interesting, though less attractive, forms would reward closer researches. We therefore received with great interest specimens of a minute white fungus sent by Dr. Duthie from Saharunpore, which he found, to use his own phrase, ' in some white ant runs about two feet below the surface of the ground.'

" The portions of earthy crust, though extremely fragile, arrived in perfect order, and with a common lens showed little white globules which had all the appearance of Persoon's *Ægerita candida*, and on closer examination it was found that the appearance was not deceptive, as the structure was clearly very much the same with what is figured in the ' Notices of British Fungi ' as the real formation of that fungus, but with the addition of conidia which show a material difference, though not sufficient to constitute a distinct genus...... We give a figure, under the name of *Æ. Duthei*. The little white globose bodies consist of a compact mass of threads with swollen joints, which are often branched, and bear at their upper end one or two globose smooth spines, which, according to Mr. Broome's observations, sometimes form little chains; mixed with these threads and proceeding from them are much more slender threads with oblong joints, the ultimate points falling off, and which must therefore be regarded as conidia."

The article is illustrated by two figures, which show that the Indian fungus is identical with that which occurs in the same habitat in Ceylon.

With Berkeley's article this period of activity in India appears to have ceased. In the Proceedings of the Agri-Horticultural Society of India, 1889, a communication is recorded from Mr. J. Cleghorn, Balasore, in which he states that the white ant combs produce fungus spores, and that these spores on exposure to the light produce very handsome fungoid growths. In an editorial note it is stated that Mr. Cleghorn had forwarded several letters on the subject, but as his researches were still in progress, and would probably be embodied in a paper, they were not then reproduced. I have not been able to trace any further communication from

Cleghorn. If such exists reference to it will probably be found in later numbers of the Proceedings of the same Society. The fungoid growths referred to would certainly be those of the *Xylaria* which is associated with termite nests.

Malaysia.

The termite nest fungi have not yet been traced in the early records from Java, &c., and the available information relating to termite nests in those regions is of recent date. In 1879 Cesati published descriptions and figures of the fungi collected by Beccari in Borneo, from which it is clear that one of them, *Tricholoma subgambosum*, is the termite agaric, though it was not said to grow on termite nests. In 1897 Penzig and Saccardo described a *Xylaria*, *X. torrubioides*, which was found on an exposed termite comb in Java ; and in the two succeeding years Holtermann published the results of his investigations into termite nests in Ceylon, Singapore, Java, and Borneo.

In " Mykologische Untersuchungen " (1898) Holtermann figured an agaric growing upon a termite comb, which he called the sclerotium of the fungus. In a brief note he stated that he found it in Ceylon, Java, Singapore, and Borneo. From Holtermann's later accounts it is evident that he found the termite nest agaric in all the countries mentioned, but the figure in question cannot be considered a good representation of that species, since it is only 3 cm. high, and therefore could not have developed, as shown and as it invariably does, on a termite comb *in situ*.

In " Botanische Untersuchungen, Schwendener-Festschrift " (1899), Holtermann gives a full account of his researches. He observed the small white spheres on the comb and describes them fairly fully, though he is in error in stating that the outer cells, or sphere-like bodies, form a peridium, and in his description of the mode of production of the oblong spores. When a comb was placed in a glass dish, it developed a large quantity of white mycelium, which completely covered it and extended in white strands, as thick as one's finger, up to the top of the dish ; in a week the sides and cover of the dish were completely overgrown by a thick white sheet of mycelium. Holtermann apparently regarded that as an exuberant growth of the mycelium which produces the spheres; but in reality it is the mycelium of the *Xylaria*, and no connection between the two has yet been proved. His description of the agaric leaves no room for doubt that he had before him the common Ceylon form, but he considered it a new species and named it *Pluteus rajap*, the specific name being that by which it is known in Malaya. Subsequently Hennings and Nyman re-described Holtermann's agaric as *Pholiota Janseana*, and later as *Flammula Janseana*, with full knowledge that it was the same species, and also as *Flammula filipendula*, *Pluteus Treubianus*, and *Pluteus bogoriensis*, under the belief that the specimens of these three were different species.

The agaric was afterwards recorded from Java by Patouillard, under the name of *Collybia radicata*; as he mentions that a small sponge-like mass was attached to the base of the stalk of his specimen, there can be no doubt in the matter, for the sponge-like mass was surely part of the termite comb.

In 1907 von Höhnel examined termite nests in Java, and confirmed the accounts already published in Ceylon. He regarded the *Xylaria*, however, as two, not forms of the same species; and described another pyrenomycete, *Neoskofitzia termitum*, which he found on a termite comb which had been dug up and left lying on the ground.

I have recently received a specimen of the termite agaric, per C. G. Lloyd, from the Straits Settlements, with the information that it was found on a termite nest.

Haviland described a number of termites from Malaya and Africa as fungus growers, but he did not furnish any further particulars with regard to the fungi in their nests.

Karawaiew, in 1901, published in Russian an account of the white spheres which he discovered on a termite comb at Buitenzorg, Java (*fide* Wheeler). Wheeler reproduces a part of one of his figures showing the conidial heads on the comb, which is quite typical.

South America.

Little appears to be known with regard to the fungus flora of the termite nests in South America. Hennings has described an agaric, *Pluteus termitum*, from termite nests in Brazil, which does not seem to differ from the Ceylon species, and Theissen has recorded a *Xylaria* from the same habitat. This *Xylaria* was originally figured and described as *Xylaria scotica* Cooke, var. *brasiliensis* Theiss., and subsequently as *Xylaria arenicola* Welw. & Curr., var. *brasiliensis* Theiss., but Theissen has since decided that it is *Xylaria nigripes* Klotzsch ; according to his measurement, however, the spores are greater (6–10 × 4–5 μ) than those of *Xylaria nigripes* (4–5 × 3 μ). *Xylaria arenicola* will probably be found to be the African form of *X. nigripes*.

Australia.

In a list of fungi found near Brisbane, Queensland, Berkeley states that *Podaxon carcinomalis* is found on ant-hills in that district. I have not been able to find any other records of fungi connected with termite nests in Australia.

Africa.

For the following details relating to recent work in Africa, I am indebted chiefly to Wheeler's paper.

Sjöstedt has added a number of species to the list of fungus-growing termites from Africa. In an extract from his monograph on the African termites, quoted by Wheeler, it is stated : " The nest or fungus garden itself is rather fragile, and made up of morel-like, folded, and rounded disks, separated by a labyrinth of long, ventricose, or more rarely rounded cavities. The surface is lumpy, and shows that the whole consists of spherical particles." The species to which this refers is *Eutermes heterodon*. It will be seen that Sjöstedt does not mention any fungus, and it would appear probable that there is some confusion here between " fungus gardens," *i.e.*, combs which produce fungi, and ordinary or non-fungus-producing combs, more specially since the habit of growing fungi is not a characteristic of *Eutermes*.

Trägardh, in 1904, published an account of fungus-growing termites in the Sudan. Of one of them, *Termes natalensis*, he states : " Under the microscope the surface of the substratum is seen to be covered with a fine feltwork of mycelium, and under still higher magnification small hyphæ may be detected. These are aggregated here and there to form small round plates as much as 1 mm. in diameter, and consisting of dense branched hyphæ. These apparently correspond to the structures mentioned and described by Holtermann, but differ from these, so far as I have been able to observe, in not having the tips of the hyphæ swollen. Here and there on the inner walls, usually not in any great abundance, but more sporadic, at least in the gardens I have examined, there are small round bodies, which may be as much as 2·5 mm. in diameter. They are of a brilliant white colour, and are unlike those mentioned by Holtermann in always lacking a peduncle. These spherules are of rather solid consistency and have an external tougher envelope, the whole forming a compact mass of very much branched and contorted hyphæ. The formation of the oidia, or process, whereby, according to Holtermann, the hyphæ in the interior of the spherules breaks up almost completely into very short oval cells, is by no means so complete in our species. To be sure, the hyphæ are constricted in the interior, so that they appear as rows of short oval cells, completely filled with protoplasm; but these cells, even in the largest spherules which have reached their full development, remain attached to one another, so that when a thin section is pressed under the cover glass only a few of the cells escape. In the spherules described by Holtermann, on the contrary, slight pressure on the cover glass sets free thousands of oidia."

Of the fungus on the combs of *Termes vulgaris*, Trägardh states : " The spherules are much smaller than in *natalensis*, are like these non-pedunculate, and occur in great numbers on the walls and especially on the roofs of the cavities and galleries in the peripheral portions of the gardens ...... The spherules are unlike those of *T. natalensis* in structure, since, as shown in figs. 2 and 3, Pl. III., the cells in the outer layer of the spherules are larger than those in the interior. Both the inner rows of cells, which branch dichotomously, and the outer ones are in part empty, in part filled with finely granular protoplasm."

The figures, which are reproduced by Wheeler, show that the structure of the " spherule " of *T. vulgaris* is identical with that of the white spheres of the Ceylon nests examined by Holtermann. With regard to the fungi found on the combs of *T. natalensis*, it would seem clear that the bodies described are sclerotia. In that case their occurrence in termite nests would be no new feature, though in nests of other species they have never been found to be *white*. This author had evidently been misled by Holtermann's account, which, as far as regards the formation of the oidia, is quite inaccurate.

In 1906 Prof. F. E. Weiss wrote, in a description of a journey in South Africa : " The monotony of the grass-veld was also broken by the nests of white ants (termites) dotted about over the plain. . . . . . . Occasionally we saw growing from the top of a ruined or forsaken nest a tuft of agarics, due no doubt to the exuberant growth of the fungus which many of the termites cultivate for food." In the absence of any examination of these fungi, this record is not of much value, except that it serves to show the need of further investigation in South Africa.

I have recently received, per C. G. Lloyd, specimens of a sclerotium, apparently identical with *Sclerotium stipitatum*, which had been found by the Rev. J. Gillet in termite nests in the Congo.

Ceylon.

In 1905 Doflein published a description of termite nests in Ceylon, chiefly from the zoological standpoint. He noted the white spheres, and stated that when the comb is placed under a bell glass it develops numerous, long, cylindrical " fructifications." As in Holtermann's experiment, these were incomplete *Xylaria* stromata, not agarics as Doflein states. The agaric never develops from the comb under such conditions.

In the following year the present writer published an account of the fungi found in termite nests in Ceylon. The white spheres, the agaric, the *Xylaria*, and the sclerotium were described, and in addition a *Peziza* was recorded. In later papers it was shown that *Sclerotium stipitatum* Berk. & Curr. is the sclerotium of the termite *Xylaria*, and that the *Peziza* commonly grows from deserted termite nests.

Madagascar.

A very full account of the fungi found in termite nests in Madagascar has been given by Jumelle and Perrier de la

Bathie. In their earlier communications these observers considered that the internal fungi were connected with a *Podaxon* which occurred in the neighbourhood of some nests, but in their final paper that view was discarded. They find that, in Madagascar, the terrestrial nests may be divided into two classes, those in or near woods and those in the open ; the former contain fungi, the latter do not, so far as has been ascertained. The species of termite to which their work relates is *Termes perrieri*.

The combs of *Termes perrieri* bear white conidial spheres, up to 1 mm. in diameter, similar to those found in other countries. These spheres arise from a mycelium which permeates the substance of the comb, and runs also over its surface. Jumelle and Perrier de la Bathie call the superficial mycelium the " forme rase." Towards the base of the comb the mycelium may assume a different character. In that region the comb bears numerous small protuberances, which the authors regard as supports. From these supports the mycelium may grow out in a tuft of hyphæ, from which there emerges a thick, cylindric, brownish cord, up to 3 or 4 mm. in length. These are considered to be abortive attempts to produce the form of mycelium which grows when the comb is abandoned. No other form appears so long as the nest is inhabited.

When the nest is abandoned, the scanty covering of mycelium on the comb immediately gives rise to numerous hyphæ, which form a thick felt, 4 to 5 mm. thick, and also spread from the comb to the walls of the chamber. This form is styled by the authors the " forme envahissante." After a few days it builds sclerotia of varying size and shape. In the dry season these sclerotia remain sterile, but in the wet season they develop a *Xylaria*.

Jumelle and Perrier de la Bathie consider that the " forme envahissante " is merely a further stage of the " forme rase." Their reasons are :—

(1) Un developpement aussi rapide d'un mycelium nouveau sur un mycelium qui recouvre deja toute la surface de culture dans un milieu qui lui convient tout specialement est invraisemble.

(2) Il y a continuite manifeste entre les filaments dresses et les filaments rampants.

(3) Lorsque, comme l'un de nous l'a fait sur place, on met dans un tube sterilise, des pelotes-conidies et des fragments de meule bouillis, les pelotes, qui incontestablement appartiennent a la "forme rase," donnent la "forme envahissante."

With regard to these reasons, it may be remarked that as the authors state that they were unable to obtain any germination of the conidia of the "pelotes" (spheres), the mycelium must have developed from that of the sphere, and under such conditions it is impossible to be certain that the mycelium of one species only was transferred to the tube. The second reason is based on an observation which would be impossible in the cases examined in Ceylon, while the first applies equally well to any of the three mycelia which must be always present in the combs of the Ceylon species.

The sclerotia obtained from the nests of *Termes perrieri* were always small, and no attempt appears to have been made to grow anything from them. But a *Xylaria* was found growing from abandoned termite nests, and that is regarded by the authors as the fructification of the sclerotium, and hence of the "forme envahissante" of the mycelium, a view which is no doubt correct. Jumelle and Perrier de la Bathie name their *Xylaria*, *X. termitum*, but from their figures and description it is certainly *Xylaria nigripes*. Probably a further search would result in the discovery of larger sclerotia, from which the *Xylaria* could be developed in the laboratory.

It is to be noted that according to this view the spheres on the comb are a conidial form of the *Xylaria*. That the "forme envahissante" of the mycelium is the mycelium of a *Xylaria* agrees with Ceylon experience, but that it is merely a continuation of the "forme rase" is open to question.

Collected Observations.

From the foregoing brief summaries of the work of the different mycologists and entomologists who have recorded observations on the fungi of termite nests, it will have been gathered that these fall under six species, or groups of species, which may be classified as follows :—

A.—Species which develop on the comb within the nest while the nest is inhabited by the termites :—

(1) A white "conidial" sphere.
(2) *Agaricus* spp.

B.—Species which develop on the comb after the nest has been abandoned by the termites, or when the comb is taken from the nest and placed under a bell jar :—

(3) *Xylaria* spp. (including *Sclerotium*).
(4) *Peziza epispartia* B. & Br.

C.—Species which occur in the neighbourhood of termite nests but have not been traced down to the comb, and species found on exposed combs, probably purely adventitious :—

(5) *Podaxon* spp.
(6) *Neoskofitzia termitum* v. Höhnel.

(1) *The "Conidial" Sphere.*

The mycelium on and in the comb is composed of interwoven hyphæ 3–4 μ diameter, often united into strands 5–15 μ broad, with frequent septa sometimes only 5 μ apart. From the superficial hyphæ short erect branches arise and unite into small columns, which expand above into a head, which is at first oval, and subsequently, through continued growth, spherical. These spherical heads measure up to 1.25 mm. diameter, and may be either situated on a stalk or almost sessile. Within the galleries there may be as many as 120 to the square centimetre.

When the spheres are viewed under a low magnification, they appear to be clusters of spherical conidia on short stalks. On teasing one out, it is found that the stalk hyphæ separate above and terminate in an oval expansion, up to 60 × 20 μ, on which the conidia are produced. Each oval apex gives rise, as a rule, to two repeatedly-dichotomous chains of spore-like bodies, which are of two distinct kinds. On the exterior hyphæ globose or spherical cells up to 20 μ diameter only are produced, but in the interior of the sphere the chains consist of oval or cylindrical cells 8–20 × 5 µ. As a rule, the chains of spherical cells increase by budding at the apex only, while the chains of oval cells are able to produce in addition new branches immediately below each septum. The two primary branches which arise from one stalk hypha may produce spherical and oval cells respectively, or a branch which is producing spherical cells may give rise to side branches which form oval cells only. But once a branch has begun the production of the latter, it does not revert to spherical cell formation. It is quite certain that the two kinds of cells arise from the same mycelium, and therefore that the white sphere is not a mixture of two different fungi. Jumelle and Perrier de la Bathie state that the oval cells measure 12 × 6 µ and the globose cells 18–20 µ.

When the sphere is crushed, the chains of oval cells dissociate, and the preparation is filled with innumerable "conidia"—like bodies. Since these bodies readily germinate and produce mycelium in water or nutrient media, the application of the term "conidia" to them may be regarded as correct. On the other hand, the spherical cells do not separate and do not produce hyphæ in nutrient media. The conidia of the spheres found in termite nests in Madagascar are said to be incapable of germination, but it would appear that the experiment was attempted in France with dried material, since it is stated elsewhere that a growth of mycelium was obtained when the whole sphere was placed in a nutrient medium.

Holtermann regarded these spheres as identical in all the nests he examined, whether in Ceylon, Java, Singapore, or Borneo. It is, I think, clear from the description and figures of the Madagascar species that the latter is identical with that found in Ceylon; and from Berkeley's figures the Ceylon species is certainly the same as that found in India. Furthermore, Trägardh's description and figures of the fungus on the combs of *T. vulgaris* in the Sudan agree well with the Ceylon species. I have not been able to find any reference, in the literature at my disposal, to any similar fungus in termite nests in Australia or America, but in all the countries in which the fungus on the termite comb has been carefully examined the species is the same, as far as can be determined from a conidial form only.

Berkeley named this fungus *Ægerita Duthei*, and apparently it has escaped re-christening. But it differs widely from *Ægerita candida* Pers., especially in the occurrence of two kinds of spore-like bodies in the head, and the more regular division of the hyphæ into conidia. However, pending the discovery of a higher form of fructification, the name may be retained for convenience of reference.

It is to be noted that *Ægerita Duthei* does not occur in all termite nests. In Madagascar it is found in the mound nests within or near forests, but not in those on the open plain, nor in nests situated in trees. In Ceylon it apparently occurs in all subterranean nests, including the mounds, but not in nests within hollow timber, nor in those in standing trees, *e.g.*, *Eutermes monoceros*, nor in carton nests on rocks, &c. Similarly, the other fungi dealt with below occur only in connection with those nests which contain *Ægerita Duthei*.

(2) *The Agaric.*

The occurrence of agarics in or around termite nests has been recorded from Ceylon, India, Singapore, Java, Borneo, and Brazil. The species in question is usually regarded as edible, and for that reason it has frequently been included in collections of tropical agarics; it is, for example, due to that fact that we have the records relating to termite nests in India. The names under which the agaric has been described differ in different countries, and even from the same country it has had several names bestowed upon it, but from a comparison of the descriptions, and the type specimens in some cases, it is quite certain that the species which develops from termite nests is the same in all the countries in which it has been found up to the present.

The following represents the synonymy of this species, so far as is known. It is probable that there are many other names for it in Indian records, since it occurs all over India, and it should surely be represented by some of the names of Singapore agarics; while there may be prior names in the earlier lists relating to Java, the Philippines, &c. The earliest name known at present is *Lepiota albuminosa* Berk., but as the general opinion is that it should be included under *Collybia*, this must be changed to *Collybia albuminosa*. Hence we have—

Collybia albuminosa (Berk.) Petch.
= *Lepiota albuminosa* Berk. 1847. Ceylon.
= *Armillaria eurhiza* Berk. 1847. Ceylon.
= *Lentinus cartilagineus* Berk. 1847. Ceylon.
= *Armillaria termitigena* Berk. 1869. India.
= *Collybia sparsibarbis* Berk. & Broome. 1870. Ceylon.
= *Tricholoma subgambosum* Ces. 1879. Borneo.
= *Pluteus rajap* Holtermann. 1899. Java, Ceylon, &c.
= *Flammula Janseana* Henn. & Nym. 1899. Java.
= *Pholiota Janseana* Henn. & Nym. 1899. Java.
= *Pluteus bogoriensis* Henn. & Nym. 1899. Java.
= *Pluteus Treubianus* Henn. & Nym. 1899. Java.
= *Flammula filipendula* Henn. & Nym. 1899. Java.
= *Collybia radicata* Pat. non Rehl. 1898. Java.
= *Pluteus termitum* Henn. 1904. Brazil.
= *Volvaria eurhiza* (Berk.) Petch. 1906.
= *Collybia eurhiza* (Berk.) v. Höhnel. 1908.

With regard to these names, the type specimens of the Ceylon species have been examined and found to be identical with the species known to grow on termite nests at the present day. *Armillaria termitigena* is certainly the stout-stalked form which was named *Lentinus cartilagineus* twenty years previously; *Tricholoma subgambosum* was described from a figure only, no specimen being preserved, and the figure is a good representation of our common termite agaric; *Pluteus rajap* links the Ceylon with the Javan names, since Holtermann found it in both Ceylon and Java; and *Pholiota Janseana* and *Flammula Janseana* were admittedly synonyms of *Pluteus rajap*. The only doubtful synonym is *Pluteus termitum*; and that is doubtful, not because the description does not agree with the Eastern agaric, but because in so many instances what may be termed specialized fungi in the Eastern tropics have proved to be different from similar fungi of identical habit in the Western. (For example, "Horse-hair blight," a *Marasmius* mycelium which runs over the branches of living trees and shrubs, is *Marasmius equicrinis* in the Eastern tropics, but a totally different species, *Marasmius sarmentosus*, in the West Indies ; the leading herbaria do not contain any specimen of *Marasmius equicrinis* from the Western, nor of *Marasmius sarmentosus* from the Eastern Hemisphere). With the exception of three (two of which are now published for the first time), these synonyms were given in "The Fungi of certain Termite Nests," &c. ; in Saccardo, Sylloge Fungorum, XXI., they are erroneously attributed to von Höhnel.

The agaric arises from the nest while it is still inhabited by the termites. It seldom appears on the actual termite hill, but usually among the grass round the base. At Peradeniya it is more frequently found growing from subterranean nests which have not yet attained the hill stage, and whose presence is indicated by a few small chimneys only. Holtermann states that he was guided to the termite nest by observing the agaric ; that is quite possible, since in many instances there is no chimney to betray the existence of an underground nest, and even when a chimney exists, the chambers may extend to a considerable distance (up to ten yards) from it. The stalk is easily traced down to the nest, and in all the cases examined the nest has been found to be inhabited. In one instance a cluster of unexpanded agarics was observed, and by digging near them their stalks were found to spring from a single comb. These were left *in situ* with the object of obtaining a photograph when the pilei were fully developed, but during the night the termites ate up all traces of the agarics and sealed up the broken chamber and the holes in the soil which the stalks had left. Holtermann states that he traced the stalk of the agaric down to the nest in hundreds of cases ; considering the labour involved, his numbers are no doubt not intended to be taken literally, but it could certainly be done if one cared to devote the necessary time to it. At Peradeniya the stalk has been traced down to the nest so many times that there is no further doubt about the matter.

The stalk of the agaric is always found to spring from the actual comb. It does not, as the *Xylaria* sometimes does, pass in the soil into mycelium whose connection with the comb is doubtful, but is continued through the wall of the chamber to the comb itself. When in the agaric-producing stage, the substance of the comb is densely permeated with hyphæ, has a stronger fungus smell than usual, and appears to be in process of decay ; but its passages are quite free, and not filled with hyphæ as they may be when the *Xylaria* is produced. The mycelium of the agaric within the comb is confined to the substance of the comb ; it does not fill the passages nor involve the whole comb in a weft of hyphæ. As a rule, combs which are producing agarics do not contain larvæ.

In view of several misconceptions, due to a too exclusive reliance on reviews and abstracts in place of a reference to the original papers, it must be emphasized that (1) the agaric undoubtedly arises from the termite comb, not merely from the soil in the neighbourhood of the nest, (2) it grows from the comb while the nest is inhabited, and (3) it has never been found in any other situation.

The agaric occurs in two forms, identical so far as their pilei are concerned, but differing in the character of their stalks. The pileus is at first conico-campanulate, then almost plane with a strongly developed umbo, smooth or radially rugose, with a cartilaginous surface layer, glabrous, viscid when moist, blackish-brown at the umbo, becoming gray towards the edge, sometimes wholly livid brown, sometimes gray. The margin is usually irregular, and the pileus may be split almost to the centre. The white flesh is differentiated from the stalk, and is very thin towards the margin. The diameter of the pileus varies from 6 to 15 centimetres. The gills are free, equal, crowded, about 5 mm. broad, for a long time white, but finally pink from the spores, and pinkish yellow in decay. The spores are pale pink in mass, elliptic, $8–10 \times 4–5\,\mu$.

The first indication of the agaric on the comb is a small white patch, 1–3 mm. in diameter, composed of erect, rather thick-walled hyphæ, which have a diameter of $4–5\,\mu$ when they emerge from the comb, but increase rapidly to $6–8\,\mu$ and terminate in clavate heads $10–12\,\mu$ in diameter. As growth proceeds other hyphæ are added exteriorly and a conical mound is formed.

From that point the development varies. In one form the mound of hyphæ acquires a thick cartilaginous coat, and as it elongates assumes a flask or bottle-like shape, sometimes attaining a height of 4 cm. or more within the comb chamber. The cartilaginous outer coat constitutes the universal veil, and the gills begin to be differentiated within it at an early stage. With further growth the apex of the immature agaric is forced into the soil and gradually bores its way to the surface. During this process the stalk increases in thickness throughout its whole length to a diameter of 1–2 cm., and the cartilaginous coat becomes thinner upwards. Finally, this outer coat ruptures, usually below the ground level and below the level of the developing pileus. The apical portion of it is carried up entire, so that, when the agaric emerges from the ground, it consists of a white stalk with an oval head, the head being covered with a cartilaginous layer which sheathes the upper part of the stem and terminates in a free, often recurved, edge below. The resemblance of this to a *Podaxon* raises some doubt whether it has not been regarded as such in some cases, though there are, of course, valid records of *Podaxon* from the neighbourhood of termite nests. Finally, the covering of the head splits circumferentially at the margin of the pileus, and the sheathing portion is left as a ring on the stem.

The stalk, in the form described, is almost of uniform diameter throughout, brown with a cartilaginous coat below, white and longitudinally fibrillose above, solid, fibrous internally, furnished with a cartilaginous ring which has a free margin above and below, and often with a few scattered adherent patches of the same texture. This form is Berkeley's *Lentinus cartilagineus*. The length of the stalk depends on the distance of the comb below the ground; specimens up to 50 cm. long have been found, but Gardner's "4 feet" is probably an exaggeration.

While all stages of this "*Lentinus*" or "*Armillaria*" form, from the first tuft of hyphæ to the fully-expanded agaric, have been obtained, the same has not been possible with the second, the stages within the soil not having been observed in the latter. The original mound of hyphæ is the same, but instead of developing a cartilaginous coat over the whole, it produces a thin stalk from the apex. This stalk is only about 2 mm. diameter, with an outer cartilaginous coat which turns black. As it ascends through the soil it expands up to 1–2 cm. in diameter. When the agaric emerges, it has apparently no universal veil, but only a viscid cartilaginous layer on the pileus; its stalk is white and fibrillose, without a ring, but on tracing it downwards its colour changes to black a short distance below the surface, where there is sometimes a sudden swelling. The course of events in this case would appear to be as follows. When the stalk enters the soil from the comb chamber it expands and produces the immature agaric, the outer cartilaginous coat forming the universal veil. As it approaches the surface, rupture of the universal veil occurs at the margin of the pileus, so that the agaric emerges destitute of a ring, as a rule. That the covering of the pileus and the black external layer of the lower part of the stalk formed part of the same layer cannot be doubted; and the explanation given is supported by several black-stalked specimens which actually possess a ring, *e.g.*, Berkeley's *Armillaria eurhiza*. This form of the agaric is Berkeley's *Collybia sparsibarbis*, and the *Pluteus* of other authors; it is also Berkeley's *Lepiota albuminosa*, the figure of which shows a stalk black below, and fragments of the universal veil projecting over the margin of the pileus in continuation of the outer layer. The difference between the "*Lentinus*" and the "*Pluteus*" forms depends on the fact that in the former the immature agaric is developed to the gill stage in the comb chamber, while in the latter it is developed within the soil; this is not dependent on the depth of the comb below the surface.

The "*Lentinus*" form grows in large numbers from a single comb. I have gathered ten fully-expanded specimens which grew from one comb, while more than twenty immature examples were present in the comb chamber. On the other hand, only one "*Pluteus*," as a rule, grows from a comb, and on digging down to the chamber the others are found to be aborted and in course of decay. It is owing to that circumstance that it is possible to obtain all stages of the former, but not of the latter. Evidently the conditions under which the first form is produced are the more favourable for the development of the agaric; and the black (instead of brown) base of the stalk of the second form, as well as the condition of the aborted specimens, suggests that the development of that form is much slower than that of the "*Lentinus*." The second form is the commoner, but the other is by no means rare.

The list of synonyms illustrates the difficulty experienced in classifying this agaric. Berkeley's specimens had been collected when the gills were still white, and hence he placed it among the *Leucosporæ* under *Armillaria*, *Lepiota*, *Collybia*, and *Lentinus*, while Cesati attributed a similar example to *Tricholoma*. On the other hand, specimens gathered when the gills were pink, or pinkish-yellow when old, have been assigned to *Pluteus*, *Flammula*, and *Pholiota*. The spore-print is pink, with a tinge of yellow. It is certainly not the typical colour of the *Rhodosporæ*, and von Höhnel is probably correct in placing it as a rosy-spored form of the *Leucosporæ*. If that be granted, it must be included under *Collybia*. The ring, when one is present, is not a ring in the usual sense, but an annular fragment of the universal veil. The objection to including it under *Collybia* is that *in all its forms* it possesses a universal veil, whereas in the species of *Collybia* which have been critically examined, *e.g.*, *Collybia velutipes*, no such structure is present. However, as few species have been investigated, the evidence is insufficient to afford any basis for generalization.

The aborted agarics form more or less conical columns up to 2 cm. high and 6 mm. diameter at the base. They are brown and slightly tomentose below, but become black at the apex. They often occur in large numbers on a single comb, especially towards the lower edge, as shown on Plate VIII., Ann. Peradeniya, Vol. III. Jumelle and Perrier de la Bathie describe similar structures on the comb of *Termes perrieri*, which they state occur on the under surface of the comb, and especially somewhat laterally at the lower edge; they form brown columns, from the middle of which is developed a thick, cylindric, brown cord, 3–4 mm. long. These authors attribute them to the *Xylaria*, considering them to be abortive attempts to produce the rhizomorphs of the latter, though they did not develop the *Xylaria* from them. They appear to have drawn their conclusions from the fact that the *Xylaria* does produce rhizomorphs. But in Ceylon experience it is always possible to develop the *Xylaria*, at least the conidial form, from the rhizomorph, whereas nothing can be obtained from the aborted agaric; moreover, these structures occur in inhabited nests, whereas one never finds any trace of the *Xylaria* under such conditions. It would seem probable that these structures in the Madagascar nests are really aborted agarics, though, if so, it would have been expected that the fully-developed agaric would have been discovered during an investigation which extended over several years. Yet it is quite possible that it could have been overlooked, if attention was given exclusively to large mound nests, for the agaric arises most frequently from nests which have not attained the mound stage.

(3) *The Xylaria.*

When a comb is removed from the nest and placed under a bell glass, it rapidly develops a thick loose covering of mycelium, which is at first white, but soon becomes smoky gray. If the termites have not been removed from the comb, development is slower, but as the insects die the fungus gradually gains the upper hand. The character of the growth depends on the amount of moisture present. If the comb is very damp, or if it is wetted, the mycelium climbs up the sides of the bell glass and ultimately fills the whole interior, but as a rule the weft of mycelium covers the comb and produces loose upright columns, up to 15 cm. high and 5 mm. in diameter, which undergo repeated dichotomous branching at the apex. By drying the comb a little at first, and supplying water when necessary, more compact columns, which soon turn black below, may be obtained. Numerous figures of these structures have been given previously. Sometimes, especially when the comb is somewhat dry, small black sclerotia, from the size of a mustard seed to that of a pea, are produced in the weft of mycelium.

If the comb is buried to a depth of 2 or 3 inches in soil in a plant pot the same stromata appear, but they are usually small, not more than 2 or 3 cm. high, and compact. Most of them branch dichotomously, but sometimes simple stromata occur. Sclerotia have not been developed under these conditions.

These stromata are conidial Xylarias. The sclerotium is that of a *Xylaria* also, for if it is cleaned of all adhering hyphæ and placed on damp blotting paper it produces a conidial stroma. No trace of these stromata can be found in inhabited nests, but as soon as the nest is abandoned by the termites, they appear above ground in hundreds. The chambers of the nest are then filled with loose gray mycelium, which grows up through the soil and produces the stromata at the surface. Under certain conditions this mycelium forms thick black rhizomorphs, which, similarly, develop Xylarial stromata when they reach the surface. The stromata can be obtained whenever desired by killing the termites by means of a Universal Ant Exterminator. They occur in large patches, up to 4 or 5 yards in diameter.

In the most general case dichotomously branched conidial Xylarias, from 2 to 10 cm. high, first appear, and are followed in a day or so by thin simple conidial forms, up to 15 cm. high. Shortly afterwards thicker, usually simple, forms appear, which may be at first conidial, then ascigerous, or ascigerous from their first formation. This sequence is not universal: sometimes only the first two forms appear, sometimes only the third; while I have observed cases in which all possible forms occurred at the same time. Most of the branched conidial forms die off, but a few survive and subsequently develop perithecia; all the thin simple forms die without producing perithecia.

To simplify matters, we may for the present adopt von Höhnel's view, that there are two species of *Xylaria* present, viz., *Xylaria furcata* Fr. and *Xylaria nigripes* Klotzsch. *Xylaria furcata* is the dichotomously branched species, which occurs in a conidial form when the comb is placed under a bell glass; and the same form is usually the first to appear when the nest is abandoned. Very few of its conidial stromata ever develop further (never, in my experience, under bell glasses), and those that do frequently produce almost distinct perithecia, like a number of Sphærias on a filiform clava. In all cases the ascigerous clava is extremely rough, with perithecia, at the most, semi-immersed.

Xylaria nigripes is more variable than *X. furcata.* In its commonest form in Ceylon it is remarkable in having its ascigerous and conidial stromata quite separate. The conidial stroma is long, thin, cylindrical, tapering above, with a short regular black stalk, and a bluish-gray fertile portion; the conidia are narrow-oval, 4–6 × 2 μ. These stromata usually arise from a thin black rhizomorph. The ascigerous form is generally simple, but occasionally forked; it has a regularly-cylindric short black stalk, and an equally regular cylindrical clava with an obtuse apex; it is at first yellowish-gray, dotted with black ostiola which project only slightly, and only turns black when covered with the extruded spores; it is fleshy, not carbonaceous. It often attains a height of 15 cm., and its stalk is continued below into a thick black rhizomorph, which is attached to the comb, or to sclerotia in the comb chamber. The connection between the conidial and the ascigerous stromata has not been traced in the soil, but it may be demonstrated by cutting the rhizomorph of the ascigerous form into small lengths and placing them on damp filter paper, where they produce conidial stromata.

In another form of *Xylaria nigripes* the stroma is intermediate in thickness between the conidial and ascigerous forms just referred to, and is at first conidial and subsequently ascigerous. In the latter stage it is distinguished by the presence of a short pointed barren tip. von Höhnel states that only weakly developed forms of *Xylaria nigripes* exhibit a sterile tip, but its occurrence really depends on the fact that, in contradistinction to the commoner form, the stroma was at first conidial. All the forms of *Xylaria nigripes* referred to have a black central core, which is lacking in *Xylaria furcata*. The rhizomorph in both forms frequently branches at or just below the surface, so that the stromata are produced in clusters.

H. and P. Sydow and Butler have noted the differences in form of *Xylaria nigripes* in India. They distinguish the following forms :—

(*a*) Clava simple, rarely dichotomously branched, cylindrical, apex obtuse or slightly tapered, colour gray to deep black; spores 3–5 × 3·5 μ.

(*b*) Smaller, with a softer rhizome; clava short and not so regularly cylindric, often branched; rhizome frequently branched; gray, rarely completely black; spores up to $7 \times 3\text{–}4{\cdot}5\ \mu$.

(*c*) Generally regular as in (*a*), but with a branched rhizome as in (*b*), characteristically possessing a narrow sterile apex up to 1·5 cm. long; spores $3{\cdot}5\text{–}5 \times 2{\cdot}5\text{–}3{\cdot}5\ \mu$.

Of these, (*a*) is the common ascigerous form, (*c*) is the conidial-ascigerous form, while (*b*) would seem to approach *X. furcata*.

On digging down to deserted nests one sometimes finds large black sclerotia in the comb chambers. They occur in deserted nests under buildings, and probably are only formed in dry situations, or when the nest in the open is abandoned in the dry season. Sometimes they are irregularly fig-shaped, and are attached at one end to a weft of mycelium on the comb; in other cases, apparently the more usual, they are attached to thick black rhizomorphs, and are regularly spherical or ovoid, up to the size of a hen's egg. These are *Sclerotium stipitatum* Berk. & Curr. When kept moist they produce the ascigerous form of *Xylaria nigripes*. They are known to occur in India, Ceylon, Africa, and Java.

The question now arises whether there are two Xylarias or only one. Apparently there are two, but there are several facts which make it probable that these are forms of one species. von Höhnel maintains that the two forms are differentiated by their shape and consistency (*X. furcata* being softer); and he also contends that they differ in the size of the spores, those of *X. nigripes* being $4\text{–}5 \times 2{\cdot}5\text{–}3\ \mu$ and those of *X. furcata* being $4 \times 2\ \mu$. The latter distinction is certainly not valid; spores of both forms are identical, and measure $4\text{–}5 \times 2\text{–}3\ \mu$, and it is often difficult to decide to which species a given specimen is to be assigned, even though the typical forms differ so widely in shape.

The following circumstances give occasion for doubt. The two species occur in the same peculiar habitat, and their association is practically constant. The spores and asci are identical, the differences in the ascigerous stage lying in the structure of the clava. Although the *furcata* form is the first to develop under ordinary conditions, sclerotia when formed in the nest are invariably sclerotia of *X. nigripes*. And when, under a bell glass, the comb produces sclerotia, these again are always *X. nigripes*, though the mycelium is, or has been, producing an abundance of conidial stromata of *X. furcata*.

But the chief difference between *Xylaria nigripes* and *X. furcata* is in the conidiophore. The conidia of the former are borne singly on short parallel conidiophores (or basidia) closely arranged side by side along the clava in the typical *Xylaria* fashion. But the conidial stage of *X. furcata* is not typical ; its ultimate components arranged along the clava consist of somewhat flattened spheres, each sphere being formed by a compound conidiophore, which terminates in a lobed head, on which are borne flask-shaped basidia with catenulate spores, 4–5 μ diameter. Thus, the component conidiophores in the conidial stroma of *Xylaria furcata* resemble to a great extent a *Botrytis*. That is the case whether it is developed in the open, or whether it is grown from the comb under a bell glass. It has occurred to me, as a possible explanation of this, that the *furcata* conidial stromata may really be *nigripes* stromata parasitized by a hyphomycete, the conidiophores observed being those of the parasite, but I have not been able to carry out experiments to test that suggestion.

When the simple termite *Xylaria* was sent to Berkeley by Gardner, he named it *Xylaria Gardneri*, and it received the same name when sent by Thwaites ; the specimens of these consignments are the typical form, usually simple, with separate conidial and ascigerous stromata. But Berkeley had previously described it, among the specimens collected by König in Ceylon, as *Sphæria escharoidea*, the type examples of that, in Herb. British Museum, being simple, but with a short, barren, pointed apex. According to Cooke, *Xylaria escharoidea* is identical with *Xylaria nigripes* Klotszch ; the latter is the prior name, but I have not seen the type. Cooke gives *X. mutabilis* Curr., *X. flagelliformis* Curr., and *X. piperiformis* Berk. as further synonyms ; of these, *X. mutabilis* is the ascigerous stage, and *X. flagelliformis* the conidial stage, but *X. piperiformis* would be better referred to *X. furcata*. *Xylaria* *melanaxis* Ces., from Borneo, appears from the description to be *Xylaria nigripes*, but Cooke states that its spores are 35 × 2; this species is said in "Saccardo" to grow on wood, but that is not recorded in the original description.

Penzig and Saccardo described *Xylaria torrubioides* from Java, where it was found growing on a termite comb. I have recently found this species in abundance on combs which had been dug up and left exposed. The specimens were 1–2 cm. high, and resembled small examples of *X. nigripes*, rougher than usual; but as they lacked the central black core, they are probably better referred to *X. furcata*.

Theissen's *Xylaria nigripes* from termite nests in Brazil has larger spores, 6–10 × 4–5 μ, and would seem to be a different species; but *Xylaria termitum* Jumelle and Perrier de la Bathie, from Madagascar, is certainly *Xylaria nigripes*. Sydow and Butler state that, from an examination of the type, *X. peperomoides* P. Henn., from India, is *X. nigripes*.

Summing up, we find that *Sclerotum stipitatum* has been found in termite nests in India, Ceylon, Java, and Africa; *Xylaria nigripes* occurs in the same situation in Ceylon, Java, Madagascar, and probably Brazil; and *Xylaria furcata* in Ceylon and Java. *X. nigripes* has been recorded from other countries also, without any reference to its connection with termite nests. But in all such cases it is said to grow on the ground, not on wood. In Ceylon neither *X. nigripes* nor *X. furcata* are found except growing from termite nests.

The synonymy of these species, as far as is known at present, is as follows:—

Xylaria nigripes Klotzsch.
= *Xylaria* (*sphæria*) *escharoidea* Berk.
= *Xylaria Gardneri* Berk.
= *Xylaria mutabilis* Curr.
= *Xylaria flagelliformis* Curr.
= *Xylaria peperomoides* P. Henn.
= *Xylaria termitum* Jumelle et Perrier de la Bathie.
= (*Xylaria melanaxis* Ces.) ?

Xylaria furcata Fr.
= *Xylaria torrubioides* Penz. & Sacc.
= *Xylaria piperiformis* Berk.

(4) *The Peziza.*

When a termite comb which bears *Ægeriia Duthei* is allowed to dry, say by exposure on the verandah, it usually develops small, red or yellow, depressed or subglobose tufts of mycelium up to 3 mm. diameter, on the under surface. The same tufts can be developed on combs under bell glasses, provided that they have previously been dried a little, so that the growth of the *Xylaria* mycelium is retarded. From these tufts a yellow mycelium spreads over the comb and the surface of the bell glass, and ultimately produces yellow spheres which split equatorially, leaving small yellow Pezizæ. The Peziza has now been grown on combs placed under bell glasses, on combs left on the verandah and covered with a box, and from combs planted in pots: moreover, it has been collected on numerous occasions, and in every case in connection with a termite nest. There is no trace of it on the combs when the nest is inhabited, but it occurs commonly when the nest has been deserted. From the universal occurrence of the red and yellow tufts on combs removed from the nest, it must be decided that the mycelium of the *Peziza*, like that of the *Xylaria*, must always be present in the combs. That it has not been noticed by other observers is doubtless due to the fact that when the comb is placed under a bell glass as soon as it is taken from the nest, the *Xylaria* mycelium obliterates everything else.

On one occasion this *Peziza* appeared in abundance, together with the *Xylaria*, from a nest, the inhabitants of which had been destroyed by the injection of sulphur dioxide; the nest was situated beneath a bungalow verandah, and the fructifications appeared in clusters between the bricks of the floor. In another instance, where the nest was situated in dense shrubbery, the yellow mycelium spread over the surface covering of dead leaves and climbed up the stems of trees and shrubs, producing its fructifications everywhere. In a third case several hundred specimens of *Peziza*, and all possible stages of the *Xylaria*, covered an area of bare soil measuring six yards by five. Superficial mycelium is produced only in densely shaded situations; under ordinary conditions the

Peziza is developed as soon as the mycelium reaches the surface of the soil.

The ascophores are scattered or clustered, united to the soil by yellow mycelium ; they are first globose, and split off a hemispherical cap, the shrivelled remains of which are often attached to one side. The disc when fully expanded is plane or undulating, up to 1·5 cm. diameter, glabrous, pale yellow or bright orange-yellow when fresh, becoming orange-red when dry. It is rather fleshy, and yellow internally. The exterior is paler than the disc and somewhat scurfy. The asci are narrow-cylindric, 85–120 × 6–7 μ., with a slight curved pedicel and eight uniseriate spores. The spores are oval, hyaline, continuous, 6–7 × 3·5–4 μ. The paraphyses are few in number, as long as the asci, filiform, slightly inflated at the top, septate, and sometimes branched.

This species was collected three times by Thwaites, and his gatherings were given three names by Berkeley and Broome, viz., *Peziza epispartia*, *P. flavotingens*, and *P. radiculosa*. Berkeley and Broome described *P. radiculosa* as "sending down a long root or threads into the soil"; Cooke, in Micrographia, Pl. 28, fig. 107, figures it with a long, thick, yellow stalk, after the fashion of *Peziza tricholoma*, but Massee correctly states (Jour. Linn. Soc., XXXI., p. 480) that the ascophores when expanded lie flat on the soil. *Peziza flavotingens* was said to grow among fragments of herbs which were bound together by the mycelium, as it does in damp shrubberies, and Cooke's figure (Micrographia, fig. 38) is a good representation of a cluster of ascophores ; the type specimens of *P. flavotingens* are immature. The type specimens of *P. epispartia* are identical with *P. radiculosa ;* Massee's re-description of *epispartia* was based on the dried specimens, and his colours are incorrect. *Peziza epispartia* is the earliest name known at present.

The *Peziza* has not been recorded from termite nests in any other country, nor do there appear to be any other records of the occurrence of these three (supposed) species except from Ceylon. The latter fact is scarcely surprising, since the published figures and descriptions do not bear much relation to the actual fungus. From Java Penzig and Saccardo have described and figured *Peziza citrina* Penz. and Sacc., which appears from their account to be identical with *P. epispartia* B. & Br., but I have not seen the type.

(5) *Podaxon*.

The occurrence of species of *Podaxon* round (? on) termite nests has been known for very many years. The fact was well known to Berkeley, apparently on the evidence of specimens from South Africa in the Linnæan Herbarium. He subsequently recorded the same species, *Podaxon carcinomalis* Fr., from " ant-hills " in Queensland. In Ceylon *Podaxon* is rare, at least over the central and southern parts of the Island, and I have never collected it. But it occurs in the dry northern and eastern regions, specimens having been sent to me from Mannar and Trincomalee, where it grows in sandy soil. As the investigations of Ceylon termite nests have been carried on chiefly in the Central Province, there is nothing to record with regard to *Podaxon*. In certain parts of India *Podaxon* is common, but it has never been associated with termite nests.

In Madagascar Jumelle and Perrier de la Bathie found a species which they named *Podaxon termitophilum*, round and at a little distance from termite hills. It never appeared further than 1 or 2 m. from the hill. These authors reject the idea that the *Podaxon* is in any way connected with the fungi in the termite nest, but they rightly remark that its occurrence is unexpected, since *Podaxon* is supposed to favour sandy soils, whereas their species grows on very compact laterite. In their latest paper, however, they record that the *Podaxon* grows in the neighbourhood of nests which do not contain fungi, *i.e.*, the nests in the open, not the nests in or near woods, a fact which definitely precludes any association of *Podaxon* with the fungi in the nest.

(6) *Neoskofitzia termitum* v. Höhnel.

This species was discovered by von Höhnel in Java on pieces of termite comb lying on the ground. He states that he subsequently obtained it constantly on combs under bell glasses, and hence regards it as a termite fungus, *i.e.*, one the mycelium of which is constantly present in the combs. In that his experience differs from results obtained in Ceylon.

The fungus forms small superficial perithecia, either scattered or in clusters, at first red, then dirty brown, 300–400 μ diameter. Its asci are cylindric, 44×4 μ, and its spores (*i.e.*, part-spores) oval, yellowish olive green, 3–3·5 μ.

Until quite recently this species had not been observed on termite combs in Ceylon, in spite of the enormous number which have been subjected to examination by various workers during the last seven years. A short time ago, however, specimens of a termite with its comb were sent to Peradeniya from Jaffna, and on arrival this fungus was found to be growing on the comb. As the parcel had been three or four days in the post, it is probable that the fungus had developed in transit. The termite in question was *Termes redemanni*, a species which is common at Peradeniya, and one whose nests have been examined on many occasions; hence it would appear quite certain that *Neoskofitzia termitum* is at least not invariably associated with the combs of *Termes redemanni*.

This fungus does not appear to differ from *Neoskofitzia monilifera* (B. & Br.) v. Höhnel = *Nectria monilifera* B. & Br. An examination of the co-type of the latter species in Herb. Peradeniya shows that it grew on sandy soil, not on a termite comb, though it is of course possible that specimens found on the soil might have their origin on termite combs under ground.

From the evidence available at present it appears that a conidial fungus of the same type, and apparently the same species, occurs in the nests of all the fungus-growing termites of the Eastern Hemisphere. Over the same region, too, *Xylaria nigripes* constantly develops from deserted termite nests, while in Asia an agaric, *Collybia albuminosa*, arises from them while they are still inhabited.

It has been the aim of all mycologists who have studied the subject to establish a connection between the conidial fungus (*Ægerita Duthei*) and one of the other termite fungi, but so far all these attempts have proved fruitless. In that respect the termite fungi do not differ from the fungi in the nests of the leaf-cutting ants investigated by Möller, nor from the Ambrosia fungi which are found in the galleries of various boring beetles ; in no instance has any connection been proved between the fungus cultivated by the insect and any " higher " form.

Jumelle and Perrier de la Bathie consider that *Ægerita Duthei* is a conidial stage, or a form of the mycelium, of *Xylaria nigripes*, their chief reason being that the *Xylaria* mycelium constantly appears in great abundance as soon as the termites are removed from the comb.

In " The Fungi of certain Termite Nests " the writer urged that the balance of probability pointed to the agaric rather than the *Xylaria* as the higher form of *Ægerita Duthei*, the chief reasons being (1) that the agaric is the only other fungus which grows from the inhabited nest, and (2) that another Ceylon agaric, *Entoloma microcarpum* B. & Br., arises from a mycelium composed of spheres, which to some extent resemble those on the termite comb.

However, neither of these views is supported by experimental evidence, and at the present *Ægerita Duthei* can only be regarded as independent of the other fungi which occur in termite nests.

Exception has been taken to the statement that the termites " weed out " the *Xylaria* and the *Peziza* from the cultivation of *Ægerita Duthei*. The phrase is, perhaps, open to objection, but there can be no doubt that the mycelia of these two species are present in termite combs, and that their development is in some way prevented so long as the combs are inhabited.

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THE following list includes articles relating to Ceylon mycology and plant pathology (excluding insect injuries) published prior to January 1, 1911, so far as these can be ascertained from the literature available. This limitation is no doubt responsible for many omissions, and notice of any such will be welcomed.

Through the labours of Koenig, Gardner, and Thwaites, Ceylon fungi formed a large percentage of the older collections of tropical fungi in European Museums. Consequently Ceylon species figure largely in systematic mycological literature, and the majority of the monographs of special groups contain references to some Ceylon forms. Furthermore, certain Ceylon diseases have achieved a world-wide reputation. Under these circumstances it became a problem what to include in a list which is intended to afford assistance to future students of mycology in Ceylon. It is obviously useless to cite the hundreds of references to coffee leaf disease in Ceylon which have been published in British and Foreign Journals ; nor is there any value in distributional records and theories when these are based merely on the records cited in "Saccardo." It was ultimately decided to enumerate only such works as furnished additional information, *based upon Ceylon material*, thus excluding (1) papers which merely cite previous Ceylon records ; (2) papers or monographs which contain supposed further information concerning Ceylon species, but not based upon an examination of Ceylon specimens ; (3) reviews and abstracts of Ceylon work, unless these contain corrections or additions.

1. ANON. (References to disease in Cinchona, chiefly "Canker" of unknown origin, by various writers are grouped here.) Tropical Agriculturist, I, p. 711 ; II, pp. 38, 39 ; p. 192 ; p. 613 ; p. 634 ; p. 767 ; pp. 849, 850 ; p. 963 ; p. 1005 ; III, p. 124 ; VIII, p. 75 ; IX, p. 575.

2. ANON. Disease on Broad Beans in Nuwara Eliya. Tropical Agriculturist, II, p. 745.

3. ANON. Canker in Tea Plants. Tropical Agriculturist, III, p. 514.

4. ANON. (References to death of plants round *Symplocos* stumps). Tropical Agriculturist, I, p. 711 ; IV, 566 ; 659 ; VI, 593 ; VII, 465 ; XVII, p. 274.

5. ANON. Coffee Leaf disease. Tropical Agriculturist, II, p. 122.

Report of Discussion on Marshall Ward's lecture before the Linnean Society.

6. ANON. Coffee Leaf disease. Tropical Agriculturist, I, pp. 717, 718 ; p. 731 ; pp. 733, 734 ; 742 (reference to root disease) ; &c. ; II, pp. 103–105 ; p. 721 ; &c.

7. ANON. The Coffee Leaf fungus and Storck's carbolic acid treatment in Ceylon. Tropical Agriculturist, II, pp. 100, 101 ; pp. 716, 717 ; p. 721.

8. ANON. (References to leaf diseases of Tea.) Tropical Agriculturist, II, p. 221 ; p. 707.

9. ANON. Fungus on roots of Tea bushes. Tropical Agriculturist, V, p. 695.

A red fungus on tea roots.

10. ANON. The Blue Gum Leaf disease. Tropical Agriculturist, II, pp. 301, 302 ; pp. 460, 461 ; p. 465 (A. M. Ferguson) ; p. 485 ; pp. 521–523 ; pp. 523–525 ; p. 613 ; pp. 695, 696.

11. ANON. Pith disease in Cinchonas and Jungle Plants. Tropical Agriculturist, III, p. 97.

12. ANON. Bug and Fungus. Tropical Agriculturist, VII, p. 156.

Fungus attacking *Lecanium viride.*

13. ANON. Coconut Leaf disease. Tropical Agriculturist, VIII, p. 654 ; p. 655 ; p. 701 ; pp. 714, 715 ; p. 722 ; p. 728 ; p. 746 ; p. 748 ; p. 751 ; IX, pp. 13, 14 ; p. 39 ; p. 140 ; pp. 193, 194 ; p. 207 ; p. 340 ; pp. 421, 422 ; p. 424 ; p. 642 ; p. 700 ; p. 779.

14. ANON. Enemies of the Cacao Tree. Tropical Agriculturist, XIV, p. 422.

Refers to root disease in Cacao, and the destruction of large numbers of trees yearly by *Tomicus perforans* which causes the bark to turn claret coloured. The latter is apparently the first record of what is now known as cacao canker (*Phytophthora Faberi*) in Ceylon.

15. ANON. Enemies of Cacao. Tropical Agriculturist, XVI, p. 748.

Stem disease of Cacao.

16. ANON. Cacao disease. Tropical Agriculturist, XVI, p. 764 ; pp. 801, 802 ; p. 856 ; XVII, p. 101 ; p. 104 ; p. 202 ; p. 627 ; p. 646 ; XVIII, p. 351 ; p. 415 ; p. 439 ; p. 503 ; pp. 541, 542 ; XIX, 548.

17. ANON. Cryptogamist for Ceylon. Tropical Agriculturist, XVII, p. 469.

Engagement of J. B. Carruthers.

18. ANON. Coffee leaf disease and Manuring. Tropical Agriculturist, XVIII, p. 116.

Criticism of article in Queensland Agricultural Gazette, April, 1898.

19. ANON. Gray Blight on Tea. Tropical Agriculturist, XVIII, p. 392 ; XIX, pp. 259–261.

20. ANON. The Cultivation of Tea. Measures to prevent disease. Tropical Agriculturist, XIX, pp. 305–306.

21. ANON. Rubber Canker in Ceylon. Tropical Agriculturist, XXIV, p. 157.

22. ANON. The Coconut Bleeding disease. Tropical Agriculturist, XXX, p. 194 ; p. 197 ; p. 588 ; XXXI, p. 180.

23. ANON. The Disposal of Tea Prunings. Tropical Agriculturist, XXXII, p. 103.

24. ANON. ET ALII. The Northway Tapping System. Tropical Agriculturist, XXXII, pp. 593, 594.

25. ANON. Coffee in Ceylon. Gardeners' Chronicle, XI (1879), p. 88.

Note on an insect which feeds on *Hemileia.*

26. ANON. Coffee in Mysore and Ceylon. Gardeners' Chronicle, XI (1879), p. 564.

Account of Morris' Experiments.

27. ANON. Results of Mr. Morris' experiments on Coffee leaf disease. Gardeners' Chronicle, XII (1879), pp. 240, 531.

28. ANON. Forty-third Annual Report of the Ceylon Planters' Association (1897).

Refers to "cacao trees dying out in rather a wholesale way by the ravages of a small borer beetle."

29. ANON. *Hemileia.* Nature, Vol. XV (1887), p. 479.

30. ABBAY, R. Leaf disease. Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1879, pp. CVIII–CXI.

31. ABBAY, R. Observations on *Hemileia vastatrix,* the so-called Coffee-leaf disease. Jour. Linn. Soc., XVII (1880), pp. 173–184 ; 2 plates.

32. ALEXANDER, J. Coffee Leaf disease in Ceylon. Gardeners' Chronicle, X (1878), p. 570.

Objecting, on behalf of the Ceylon Chamber of Commerce, to statements *re Hemileia*.

33. ANDERSON, F. W. Notes on certain *Uredineæ* and *Ustilagineæ*. Journal of Mycology, VI, pp. 121–127.

States that the American *Triphragmium clavellosum* Berk. is distinct from the Ceylon *Triphragmium clavellosum*, and that the latter is probably referable to *T. Thwaitesii*.

34. BAMBER, M. K. Advice on treatment of Tea Blights to Dikoya Planters' Association. Tropical Agriculturist, XIX, p. 550.

35. BAMBER, M. K. The Burial of Tea Prunings. Tropical Agriculturist, XXIII, pp. 427–429.

36. BARBER, J. H. The Cacao disease. Tropical Agriculturist, XVI, p. 795.

37. BARTHOLOMEUSZ, C. W. Market Gardening in Nuwara Eliya. Tropical Agriculturist, XXVII, pp. 88–91.

Contains a reference to Club Root at Nuwara Eliya.

38. BERKELEY, M. J. Notices of Fungi in the Herbarium of the British Museum. Ann. Nat. Hist., X (1842), pp. 369-384 ; 4 plates.

Records the following species from Ceylon :—*Lentinus connatus, Polyporus agariceus, Polyporus xanthopus, Polyporus crenatus, Polyporus Kœnigii, Trametes læticolor, Polyporus dubius, Polyporus zonalis, Polyporus zeylanicus, Polyporus nigrocinctus, Dædalea inæquabilis, Hexagonia Kœnigii, Stereum pusillum, Guepinia palmiceps, Exidia rufa, Sphæria escharoidea.* These are species collected by König.

39. BERKELEY, M. J. Three new Fungi from Ceylon. Hooker's London Journal of Botany, V, p. 534 ; 2 plates.

Lysurus Gardneri, *Simblum gracile*, and *Aseroe zeylanica*.

40. BERKELEY, M. J. Decades of Fungi. Decades XV–XIX. Ceylon Fungi. Hooker's London Journal of Botany, VI, pp. 479–514 ; 1 plate.

Enumerates 135 gatherings sent by Gardner, including 50 new species. The paintings which accompanied this collection were contained in a small octavo volume which is now in the Kew Library.

41. BERKELEY, M. J. Notice of a mould attacking the Coffee Plantations in Ceylon. Journal Royal Horticultural Society, IV (1849), p. 7.

Not seen.

42. BERKELEY, M. J. Decades of Fungi, XXV to XXX. Sikkim-Himalayan Fungi, collected by Dr. J. D. Hooker, Hooker's London Journal of Botany, II (1850), pp. 42–51.

Under *Lepiota deliciolum;* states that a very nearly allied species, at present undescribed, occurs in Ceylon.

43. BERKELEY, M. J. Decades of Fungi, XXXII, XXXIII. Sikkim-Himalayan Fungi, collected by Dr. Hooker. Hooker's London Journal of Botany, III (1851), pp. 39–49.

Under *Lentinus subdulcis;* states "I have what I believe to be the same species, but in a bad state, from Ceylon."

44. BERKELEY, M. J. Decades of Fungi, XXXIV. Sikkim-Himalayan Fungi, collected by Dr. Hooker. Hooker's London Journal of Botany, III (1851), pp. 77–84.

Under *Polyporus zonalis;* notes that it was originally found by König in Ceylon.

45. BERKELEY, M. J. Decades of Fungi; Decade XXXV. Sikkim-Himalayan Fungi, collected by Dr. Hooker. Hooker's London Journal of Botany, III (1851), pp. 167–172.

Under *Lycoperdon sericellum;* states "The Ceylon plant which I have referred to *L. saccatum* is probably the same." The Ceylon plant was subsequently named *L. Gardneri.*

46. BERKELEY, M. J. Decades of Fungi; Decades XLVII, XLVIII. Indian Fungi. Hooker's London Journal of Botany, VI (1854), pp. 204–212.

Reference to an *Aschersonia* from Ceylon *aff. A. oxystoma;* size of spores of *Ustilago endotricha* from Ceylon; description of *Cladosporium congestum* on *Litsea*, Ceylon; *Asterina nubecula*, Ceylon (name only).

47. BERKELEY, M. J. Decades of Fungi; decades XLIX, L. Indian Fungi. Hooker's London Journal of Botany, VI (1854), pp. 225–232.

Describes *Polyporus Thwaitesii, Hexagonia brevis, Favolus manipularis, Favolus multiplex* Lév., var *Thwaitesii, Didymium zeylanicum, Æcidium rhytismoideum, Æcidium Pavettæ, Æcidium echinaceum, Sphæria Broomeiana, Dothidea repens* var. *catervaria* and var. *aspidia, Dothidea incarcerata, Dothidea filicina* Mont. Mss. var. *nervisequia, Dothidea exsculpta, Dothidea Thwaitesii;* and records *Graphiola phœnicis* for Ceylon. Berkeley notes that he has distributed, under the name *Sphæria tetrantheræ,* a form which he considers should be united to *Dothidea repens* var. *catervaria.* Also that the fungus distributed under the name *Sphæria Guatteriæ* is identical with *Dothidea incarcerata.*

48. BERKELEY, M. J. Vegetable Pathology, No. CXXXIV. Gardeners' Chronicle (1856), p. 565.

Reference to *Antennaria* on coffee in Ceylon.

49. Berkeley, M. J. Parasitic fungi on *Hedera Vahlii*. Gardeners' Chronicle (1865), p. 196 ; fig.

Records a *Triphragmium* on *Hedera Vahlii* from Ceylon, which B. regarded as a variety of *Triphragmium echinatum* Lév.

50. Berkeley, M. J. Hemileia Vastatrix. Gardeners' Chronicle, 1869, p. 1157 ; fig. Reprinted in Quarterly Journ. Microscopical Science (1873), pp. 79–81.

51. Berkeley, M. J. Australian Fungi, received principally from Baron F. von Mueller and Dr. R. Schomburgk. Jour. Linn. Soc., XIII (1875), pp. 155–177.

Records *Stereum sparsum* B. for Ceylon (p. 169). This record appears to be an error ; *Corticium sparsun* B. & Br. from Ceylon is not identical with *S. sparsum* B. from Australia.

52. Berkeley, M. J. Fungus in Coffee Plantations. Gardeners' Chronicle (1872), p. 425.

Notes on *Hemileia*, with extracts from a letter from Thwaites.

53. Berkeley, M. J. Coffee fungus in Ceylon. Gardeners' Chronicle (1872), p. 605.

Reports "on the authority of Dr. Thwaites, that the Coffee fungus in Ceylon was dying out." (The copy in the Peradeniya Library bears the following endorsement by Thwaites:—"I hardly made so positive an assertion ; my letter should have been quoted verbatim.")

54. Berkeley, M. J. Notices of North American Fungi. Grevillea, I (1872–3).

Records *Trametes lactinea* B. (p. 66), *Hydnum glabrescens* Berk. & Rav. (p. 97), and *Stereum sulfureum* Fr. (p. 164), for Ceylon.

55. Berkeley, M. J. *Oidium* and *Cicinnobolus* on Orange in Ceylon. Gardeners' Chronicle, I, n.s. (1874), p. 477.

Thwaites 1,230, received too late for inclusion in Fungi of Ceylon.

56. Berkeley, M. J. Notices of North American Fungi. Grevillea, III (1874–5).

Records *Diplodia circinans* B. & Br. (p. 3) for Ceylon.

57. Berkeley, M. J. Fungi, the causes of disease, real and supposed. Gardeners' Chronicle, III, n.s. (1875), p. 182.

Report of lecture to Roy. Hort. Soc., Feb. 3. "With reference to diseases caused by fungi on rice, the lecturer stated that some years ago he had requested Dr. Thwaites...... to send him all the known forms of disease in rice, but on examination it was found that only one minute fungus was peculiar to that plant."

58. BERKELEY, M. J. Australian Fungi, II. Received principally from Baron F. von Mueller. Jour. Linn. Soc., XVIII (1881), pp. 383–389.

States (p. 388) that *Peziza emarginata* Berk. (? B. & Br.) belongs to the new genus *Philippsia*.

59. BERKELEY, M. J. Fungi of Ants' nests. Gardeners' Chronicle, XVII (1882), p. 401.

Refers to Gardner's discovery of *Lentinus cartilagineus*, and "what appears to be a form of the common *Xylaria hypoxylon*," on termite combs in Ceylon.

60. BERKELEY, M. J. and BROOME, C. E. On some species of the Genus *Agaricus* from Ceylon. Trans. Linn. Soc., XXVII (1871), pp. 149–152 ; 2 plates.

Figures of *Amanita hemibapha*, *Lepiota manicata*, *Volvaria diplasia*, and *Volvaria terastia*, with descriptions of ten species.

61. BERKELEY, M. J., and BROOME, C. E. The Fungi of Ceylon (Hymenomycetes, from *Agaricus* to *Cantharellus*). Jour. Linn. Soc., XI (1871), pp. 494–567.

62. BERKELEY, M. J., and BROOME, C. E. Enumeration of the Fungi of Ceylon. Part II, containing the remainder of the Hymenomycetes, with the remaining established tribes of Fungi. Jour. Linn. Soc., XIV (1875), pp. 29–140 ; plates 2–10.

63. BERKELEY, M. J., and BROOME, C. E. Supplement to the Enumeration of Fungi of Ceylon. Jour. Linn. Soc., XV (1877), pp. 82–86 ; 1 plate.

64. BERKELEY, M. J., and BROOME, C. E. Notices of British Fungi. Ann. Nat. Hist., 5th Ser., XII (1883), p. 370.

Institute *Laccaria* B. & Br., with the Ceylon species *Laccaria spodophora* (B. & Br.), *Laccaria sublaccata* (B. & Br.), *Laccaria porphyrodes* (B. & Br.), *Laccaria vinosofusca* (B. & Br.).

65. BERKELEY, M. J., and CURTIS, M. A. Fungi Cubenses. Jour. Linn. Soc., X (1869), pp. 280–392.

Contains several Ceylon records not given in the "Fungi of Ceylon," viz., *Trametes lactinea*, *Laschia tremellosa*, *Polyporus grammocephalus*, *Hirneola polytricha*, *Lycoperdon rugosum*, *Stilbum tomentosum*, *Sphærostilbe lateritia*.

66. BERLESE, A. N. Icones Fungorum omnium hucusque cognitorum ad usum Sylloges Saccardianæ adcommodatæ. 1894–1905.

Contains figures of the following Ceylon species :—*Schizostoma pachythele* (B. & Br.) Sacc., *Chætosphæria bihyalina* (B. & Br.) Sacc., *Melanomma vesuvius* (B. & Br.) Berl., *Rhynchosphæria irpex* (B. & Br.) Berl., *Lasiosphæria hemipsila* (B. & Br.) Sacc., *Eutypella russodes* (B. & Br.) Berl., *Diatrype chlorosarca* B. & Br.

67. Beven, A. W. Coconut Bleeding disease. Tropical Agriculturist, XXX, p. 188.

68. Beven, A. W. The Coconut Stem disease. Tropical Agriculturist, XXX, pp. 282, 283.

69. Beven, A. W. The Lecture on Coconut Stem disease, and newspaper criticism. Tropical Agriculturist, XXX, p. 384.

70. Beven, A. W. Coconut Stem disease and the disagreement of doctors. Tropical Agriculturist, XXX, p. 491.

71. Beven, F. The Coconut Bleeding disease. Tropical Agriculturist, XXX, p. 92.

72. Beven, F. The Coconut Bleeding and other disease. Tropical Agriculturist, XXX, p. 283.

73. Beven, F. The Coconut Palm Stem disease and its Treatment. Tropical Agriculturist, XXX, pp. 385, 386.

74. Beven, F. Coconut Stem disease. Tropical Agriculturist, XXX, p. 387.

75. Biffen, R. H. A Fat-destroying Fungus. Annals of Botany, XIII (1899), pp. 363–376; plate XIX.

An account of a fungus found within a coconut from Ceylon.

76. Borron, A. G. K. Coffee Leaf disease and Mr. Ward's Sulphur and Lime Experiment; the financial impossibility of gathering and destroying diseased leaves. Tropical Agriculturist, I, p. 59; p. 552; pp. 750, 751.

77. Bresadola, J. Adnotanda in fungos aliquot exoticos regii Musei lugdunensis. Annales Mycologici, VIII, pp. 585–589.

Contains numerous notes on the synonymy of Ceylon polyporoids.

78. Brick, C. Einige Krankheiten und Schädigungen tropischer Kulturpflanzen. Jahresbericht der Verein. f. angewandte Botanik, VI, pp. 223–258.

Lasiodiplodia nigra Appel et Laub., on *Hevea* stumps from Ceylon.

79. Broome, C. E. See Berkeley and Broome, Nos. 60–64.

80. Cameron, A. Canker in Para Rubber Trees. Tropical Agriculturist, XXVIII, pp. 412, 413.

81. Carruthers, J. B. Interim Report on Cacao disease investigations. Re-published in Tropical Agriculturist, XVII, pp. 851–854; and in Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1899.

82. CARRUTHERS, J. B. Final Report on Cacao disease. Reprinted in Tropical Agriculturist, XVIII, pp. 359–362; and in Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1899.

83. CARRUTHERS, J. B. Leaflet on Cacao disease. Reprinted in Tropical Agriculturist, XVIII, p. 437; and in Proceedings of the Planters' Association for the year ending February 17, 1899, pp. CCXLII, CCXLIII.

84. CARRUTHERS, J. B. Cacao disease. Tropical Agriculturist, XVIII, p. 438.

85. CARRUTHERS, J. B. Additional Report on Cacao disease. Reprinted in Tropical Agriculturist, XVIII, pp. 505–507; and in Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1899.

86. CARRUTHERS, J. B. Report on Tea disease. Tropical Agriculturist, XVIII, pp. 712, 713.

Said to be due to a Uredine, but from the description was evidently a *Cephaleuros*.

87. CARRUTHERS, J. B. Report of the Government Mycologist and Assistant Director for 1900.

Pestalozzia guepini; *Cladosporium herbarum*; *Cephaleuros mycoidea*; *Rosellinia radiciperda*; Lichens; Cacao canker; *Pythium*; miscellaneous fungi.

88. CARRUTHERS, J. B. Report of the Mycologist for 1901.

General statement of work.

89. CARRUTHERS, J. B. Government Mycologist's Report, 1902.

General.

90. CARRUTHERS, J. B. Report of the Government Mycologist and Assistant Director, 1903. Reprinted in Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, II, No. 16.

Gray Blight; *Rosellinia radiciperda*; Horsehair Blight (*Marasmius sarmentosus*); Lichens; Stem canker in tea; *Hevea* fruit disease; Betel disease; miscellaneous fungi.

91. CARRUTHERS, J. B. Report of the Government Mycologist and Assistant Director for 1904. Reprinted in Circulars, &c., III, No. 8.

Gray Blight; Branch canker of tea; *Rosellinia radiciperda*; Canker of *Hevea*; betel disease.

92. CARRUTHERS, J. B. Cacao Canker in Ceylon. Circulars, Royal Botanic Gardens, Ceylon, Ser. I, No. 23 (Oct., 1901).

A summary of previous work and reports.

93. CARRUTHERS, J. B. Annual Report of the Government Mycologist and Assistant Director for 1901. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, Vol. II, No. I (April, 1902).

An extension of No. 88. Diseases of Tea, Cacao, *Grevillea*. *Plasmodiophora ;* spore distribution experiments ; miscellaneous fungi.

94. CARRUTHERS, J. B. Root disease in Tea (*Rosellinia radiciperda* Massee). Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, II, No. 6 (June, 1903).

95. CARRUTHERS, J. B. Branch Canker in Tea. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, II, No. 28 (January, 1905), 2 plates.

[These figures are Indian, not Ceylon specimens.]

96. CARRUTHERS, J. B. Canker (*Nectria*) of *Hevea brasiliensis*. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, II, No. 29 (January, 1905).

97. CARRUTHERS, J. B. Lecture on Tea Blights. Tropical Agriculturist, XXI, pp. 388, 389.

98. CARRUTHERS, J. B. Good cultivation and Disease. Tropical Agriculturist, XXII, p. 604.

99. CARRUTHERS, J. B. The Canker Fungus in Rubber. Tropical Agriculturist, XXIII, pp. 372, 373.

100. CARRUTHERS, J. B. Tea Diseases and Pests. Tropical Agriculturist, XXIV, p. 165.

101. CARRUTHERS, J. B. Disease of the Cacao Tree. Tropical Agriculturist, XXIV, pp. 449–452.

102. CARRUTHERS, J. B. Cacao disease legislation. Yearbook of the Planters' Association of Ceylon, 1902–03, pp. LXVI–LXIX.

103. DE CESATI, V. Mycetum in itinere Borneensi a cl. Beccari lectorum enumeratio. Atti. Acc. Sci. Fisich. e Matem. di Napoli, VIII (1879), 28 pp. ; 4 plates.

Enumerates 88 Ceylon species.

104. DE CESATI, V. Intorno ai Myceti raccolti dal Beccari nelle isole di Borneo e di Ceylon. Att. Acc. Sci. Fisich. e Matem. di Napoli, VIII (1880).

Not seen.

105. CEYLON GOVERNMENT. An Ordinance to make provision for preventing the introduction and spread of Insect or Fungous Pests or Plant Diseases. Ordinance No. 5 of 1901.

106. CEYLON GOVERNMENT. Regulations *re* import of Cacao plants. *Government Gazette*, No. 5,804 of September 20, 1901.

107. Ceylon Government. Regulations *re* Import of Pepper. *Government Gazette*, No. 5,932 of July 17, 1903.

108. Ceylon Government. An Ordinance to provide for the destruction of Plant Pests and for the sanitation of Plants in this Colony. Ordinance No. 6 of 1907.

109. Ceylon Government. Regulations *re* Destruction of Dead Coconut Palms. *Government Gazette*, No. 6,233 of March 13, 1908.

110. Ceylon Government. Regulations *re* Coconut Bleeding disease. *Government Gazette*, No. 6,230 of February 21, 1908.

111. Ceylon Government. Regulations *re* Import of Tea Seed. *Government Gazette*, No. 6,348 of December 31, 1909.

112. Christie, T. H. Appointment of a Specialist to investigate Cacao disease. Tropical Agriculturist, XVI, p. 719; Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1899.

113. Clark, P. D. G., Northway, C., Williamson, D. B., &c. Subcortical Rubber Pads and the Northway system. Tropical Agriculturist, XXXIII, pp. 77–80.

114. Coleman, L. C. Diseases of the Areca Palm (*Areca catechu* L.). I. Koleroga or Rot-disease. Annales Mycologici, VIII, pp. 591-626, 3 plates.

Contains description and cultural details of the cacao *Phytophthora* of Ceylon, *Phytophthora Faberi* Maubl.

115. Coleman, L. C. Diseases of the Areca Palm. I. Koleroga. Mycological series, Bulletin No. II, Department of Agriculture, Mysore State.

116. Collett, O. Notes of observations of some Tea diseases. Tropical Agriculturist, XIX, pp. 824, 825.

117. Cooke, M. C. Carpology of *Peziza*. Grevillea, III, p. 128; fig. 198.

Figures spores and ascus of *Peziza similtima* B. & Br.

118. Cooke, M. C. Carpology of *Peziza*. Grevillea, IV, p. 168; fig. 311.

Figures spores, ascus, and paraphyses of *Peziza lechria* B. & Br.

119. Cooke, M. C. Germination of the spores of *Hemileia vastatrix*. Grevillea, IV, p. 136.

Records experiments by Thwaites and Abbay.

120. Cooke, M. C. On *Peniophora*. Grevillea, VIII, pp. 19–21; plates 122–126.

Transfers *Stereum papyrinum* Mont., *Corticium Habgallæ* B. & Br., *Corticium lilacinum* B. & Br., *Corticium sparsum* B. & Br., to *Peniophora*.

121. COOKE, M. C. The subgenus *Coniophora*. Grevillea, VIII, pp. 88, 89.

Transfers *Thelephora submembranacea* B. & Br. to *Coniophora*.

122. COOKE, M. C. Fungi of India. Grevillea, VIII, pp. 93–96.

Records *Uredo Balsaminæ* Cooke on *Impatiens rosmarinifolia* for Ceylon, collected by Morris.

123. COOKE, M. C. Observations on *Peziza*. Grevillea, VIII, pp. 129–141.

Records *Peziza badioberbis* B. for Ceylon.

124. COOKE, M. C. On *Hymenochæte* and its Allies. Grevillea, VIII, pp. 145–149.

Gives measurements of *Hymenochæte strigosa* B. & Br., *Hymenochæte rigidula* B. &. Br., *Hymenochæte tenuissima* B., *Hymenochæte spadicea* B. & Br., *Hymenochæte fuliginosa* (Lév.) Berk., *Hymenochæte corrugata* Berk., *Hymenochæte floridea* B. & Br., *Hymenochæte depallens* B. & Br., *Hymenochæte pellicula* B. & Br., &c. ; transfers *Hymenochæte crocicreas* B. & Br. to *Veluticeps* ; states that *Hymenochæte ramealis* B. & Br. does not possess setæ ; and transfers *Hymenochæte dendroidea* B. & Br. to *Thelephora*.

125. COOKE, M. C. The *Perisporiaceæ* of Saccardo's Sylloge Fungorum. Grevillea, XI, pp. 35–39.

States (p. 37) that *Dimerosporium molle* (B. & Br.) Sacc. has the appendages of a *Meliola*, and that the information furnished to Saccardo with regard to *Meliola triseptata* B. & Br. was inaccurate (p. 38).

126. COOKE, M. C. On *Xylaria* and its allies. Grevillea, XI, pp. 81–94.

Spore measurements of *Xylariæ* ; synonymy of *X. tabacina* and *X. escharoidea* ; transfers *Hypoxylon ceramichroum* B. & Br. to *Glaziella* ; institutes *Rhopalopsis* for *Hypoxylon canopus* Mont., *Hyp. micropus* Berk., *Hypoxylon congestum* B. & Br., &c.

127. COOKE, M. C. *Hypoxylon* and its allies. Grevillea, XI, pp. 121–140.

Spore measurements of *Hypoxylon* ; removes from that genus *Hypoxylon lycogaloides* B. & Br., *Hypoxylon ceramichroum* B. & Br., *Hypoxylon glebulosum* Ces. ; notes on *Hypoxylon eterio* B. & Br., *Hypoxylon chalybeum* B. & Br. ; transfers *Sphæria hypoleuca* B. & Br. to *Hypoxylon*.

128. COOKE, M. C. *Nummularia* and its allies. Grevillea, XII, pp. 1–8.

Describes *Xylaria Thwaitesii* Berk. & Cooke (Ceylon) ; Spore measurements of *Rhopalopsis* ; describes *Rhopalopsis Berkeleyanum* Cooke (Ceylon).

129. COOKE, M. C. The genus *Anthostoma*. Grevillea, XII, pp. 49–53.

Transfers *Hypoxylon lycogaloides* B. & Br. to *Sarcoxylon*.

130. COOKE, M. C. New British Fungi. Grevillea, XII, pp. 65–70.

Records the institution of *Laccaria* by Berkeley and Broome. Ann. Nat. Hist., December, 1883.

131. COOKE, M. C. Notes on *Hypocreaceæ*. Grevillea, XII, pp. 77–83.

Note on *Cordyceps dipterigena* B. & Br.; description of *Hypocrea umbrina* Cooke (Ceylon); *Nectria fenestrata* Berk. & Curt. (Ceylon); transfers *Peziza dorcas* B. & Br. to *Dialonectria*.

132. COOKE, M. C. Sphæriaceæ imperfectæ cognitæ. Grevillea, XIII, pp. 37–40.

Note that *Sphæria griseotecta* B. & Br. is not a *Diatrype*.

133. COOKE, M. C. Synopsis Pyrenomycetum. Grevillea, XIII, pp. 41–45.

States that *Dothidea conspurcata* Berk. and *Dothidea Barringtoniæ* B. & Br., in Herb. Berk., are without fruit.

134. COOKE, M. C. Synopsis Pyrenomycetum. Grevillea, XIII, pp. 61–72.

Describes *Phyllachora infectoria* Cke., *Phyllachora Guatteriæ* Berk. from Ceylon. *Phyllachora Guatteriæ* = *Sphæria Guatteriæ* Berk., *fide* specimen in Herb. Kew (see Berkeley, No. 47).

135. COOKE, M. C. Præcursores ad Monographia Polyporum. Grevillea, XV, pp. 19–27.

Describes *Polystictus siennæcolor* Berk.

136. COOKE, M. C. Præcursores ad Monographia Polyporum. Grevillea, XV, pp. 50–60.

List of synonyms.

137. COOKE, M. C. Synopsis Pyrenomycetum. Grevillea, XV, pp. 80–86.

Sporidia not found in *Byssosphæria* (*Rosellinia*) *epileuca* Berk. (= *Sphæria albofulta* B. & Br.), Ceylon, 1079, and *Byssosphæria* (*Rosellinia*) *epixantha* B. & Br.

138. COOKE, M. C. Some Exotic Fungi. Grevillea, XVI, pp. 25, 26.

Describes *Stachybotrys asperula* Mass., "in company with *Chætomium*. On damp paper from Ceylon."

139. COOKE, M. C. Synopsis Pyrenomycetum. Grevillea, XVI, pp. 87–92.

Spore measurements of *Trematosphæria agnocystis* B. & Br.

140. COOKE, M. C. Exotic Agarics. Grevillea, XVI, pp. 105–106.

Describes *Lepiota microspila* Berk. in Herb. (Ceylon 1227 cum icone).

141. COOKE, M. C. New Exotic Fungi. Grevillea, XVII, pp. 42, 43.

Describes *Dialonectria* (*Nectriella*) *gigaspora* Cke. & Mass., *Botryosphæria inflata* Cke. & Mass., *Clypeolum zeylanicum* Cke. & Mass., from Ceylon.

142. COOKE, M. C. What is Lichenopsis ? Grevillea, XVII, pp. 94–96.

Institutes *Platysticta* for *Platygrapha magnifica* B. & Br.

143. COOKE, M. C. Memorabilia. Grevillea, XVIII, p. 19.

States that *Thecaphora inquinans* B. & Br. is *Cerebella paspali* Cke. & Mass., and that *Polycystis macularis* B. & Br. is *Cerebella andropogonis* Ces.

144. COOKE, M. C. Sclerodepsis. Grevillea, XIX, p. 49.

Sclerodepsis colliculosa (Berk.) Cooke = *Trametes colliculosa* Berk.

145. COOKE, M. C. Omitted diagnoses. Grevillea, XIX, pp. 71–75.

Describes *Phoma coryphæ* Cke. & Mass. (Ceylon 649).

146. COOKE, M. C. Trametes and its allies. Grevillea, XIX, pp. 98–103.

States that *Trametes versiformis* B. & Br. is subresupinate. *Polyporus isidioides* B. = *Polyporus scruposus* ; note on *Hexagonia subtenuis* Berk.

147. COOKE, M. C. Some omitted diagnoses. Grevillea, XIX, pp. 103, 104.

States that *Hebeloma micropyramis* B. & Br. is *Inocybe.*

148. COOKE, M. C. Memorabilia. Grevillea, XIX, p. 108.

States that *Thelephora suffulta* B. & Br. is a form of *Thelephora pedicellata* S.

149. COOKE, M. C. Species of Hydnei. Grevillea, XX, pp. 1–4.

Describes *Hydnum scariosum* B. & Br. ; states that *Hydnum luteovirens* Ces. appears to be an *Irpex.*

150. COOKE, M. C. Notes on *Clavariei.* Grevillea, XX, pp. 10, 11.

Records that Berkeley stated that *Lachnocladium Hookeri* Berk. was *Clavaria formosa* P. (Fungi of Ceylon, No. 673).

151. COOKE, M. C. Memorabilia, Grevillea, XX, p. 22.

Spegazzinia tessartha (B. & C.) Sacc. = *Triposporium cristatum* Pat. = *Sporodesmium tessarthum* B. & C. = *Tetrachia tessartha* Berk.

152. COOKE, M. C. Ceylon in Australia. Grevillea, XX, pp. 29–30.

Enumerates species common to both countries.

153. COOKE, M. C. Notes on *Thelephorei.* Grevillea, XX, pp. 33–35.

States that *Stereum modestum* Berk. in herb. = *Peniophora papyrina* (Mont.).

154. Cooke, M. C. Neglected Diagnoses. Grevillea, XX, pp. 81–85.

Describes *Physalospora asbolæ* B. & Br. (Ceylon 307), *Thyridaria crocosarca* B. & Br. = *Melogramma crocosarca* B. & Br. in herb. (Ceylon, Thwaites 131).

155. Cooke, M. C. Additional Fungi descriptions. Grevillea, XX, pp. 106, 107.

Describes *Zythia bicolor* (B. & Br.) Cke. & Mass. = *Ophiotheca bicolor* B. & Br., *Penicillium flavovirens* Cke. & Mass. (Thwaites 374), *Valsa tenebricosa* (B. & Br.) = *Sphæria tenebricosa* B. & Br. in herb. (Ceylon 636).

156. Cooke, M. C. Memorabilia. Grevillea, XX, p. 113.

States that *Fracchiæa brevibarbata* B. & Br. has been found on bark in Ceylon.

157. Cooke, M. C. Omitted diagnoses. Grevillea, XXI, p. 76.

Asterina crustosa Berk. & Cooke.

158. Cooke, M. C. Coffee Leaf disease. Tropical Agriculturist, 1, p. 17.

Comments on Marshall Ward's Report.

159. Cooke, M. C. Mycographia. Vol. I (all published), 1879.

Gives descriptions and figures of *Humaria globifera* Berk., *Humaria flavotingens* B. & Br., *Humaria ustorum* B. & Br., *Sarcoscypha radiculosa* B. & Br., *Peziza Hindsii* Berk., *Peziza insititia* B. &. C., *Peziza tricholoma* Mont., *Peziza lechria* B. & Br., *Peziza sarmentorum* B. & Br., *Peziza crenulata* B. & Br., *Peziza harmoge* B. & Br., *Peziza epispartica* (*sic.*) B. & Br., *Humaria læticolor* B. & Br.

160. Cooke, M. C. Vegetable Wasps and Plant Worms. London, 1892.

Descriptions of *Cordyceps dipterigena*, *Cordyceps myrmecophila*, *Cordyceps Barnesii*, from Ceylon ; and records of *Cordyceps sobolifera* and *Cordyceps militaris*.

161. Dambawinne, H. E. A disease of Crotalaria. Tropical Agriculturist, XXIV, p. 484.

162. Dietel, P. Die Gattung *Ravenelia*. Hedwigia, XXXIII, pp. 22–69 ; 5 plates.

Includes full descriptions of Ceylon species.

163. Dietel, P. Monographie der Gattung *Ravenelia* Berk. Beihefte z. Botanische Centralblatt, XX (1906), pp. 343–413 ; 2 plates.

Includes descriptions of Ceylon species, with *Ravenelia zeylanica* n. sp.

164. Dietel, P. Monographie der Gattung *Ravenelia* Berk. Autor-Referat in Botanische Centralblatt, 104 (1907), pp. 208, 209.

Withdraws *Ravenelia zeylanica* Diet., which is really *R. sessilis*, the host plant being incorrectly determined.

165. DRIEBERG, C. Report on Coconut Leaf disease. Tropical Agriculturist, VIII, pp. 842, 843; IX, pp. 785–788.

166. DRIEBERG, C. Locust fungus. Tropical Agriculturist, XVIII, p. 656.

Records the introduction of the "locust fungus" from South Africa.

167. DRIEBERG, C. A note on the Rice Diseases of America. Tropical Agriculturist, XXV, pp. 185–188.

Contains a reference to a smut fungus on Paddy in Ceylon, known as "Rukmal Pedima."

168. DYER, W. T. THISELTON. Coffee Leaf fungus of Ceylon (*Hemileia vastatrix*). Quarterly Journ. Microscopical Science, XIII, n. s. (1873), pp. 79–81; fig.

169. DYER, W. T. THISELTON. Coffee Leaf disease. Gardeners' Chronicle, I, n. s. (1874), p. 804.

Exhibits bush attacked by *Hemileia* at meeting of Scientific Committee, Roy. Hort. Soc.

170. DYER, W. T. THISELTON. Coffee Culture in Ceylon: a disclaimer. Gardeners' Chronicle, X (1878), p. 664.

Contradicts statements attributed to him *re* extinction of the coffee industry.

171. DYER, W. T. THISELTON. The Coffee-leaf disease of Ceylon. Quarterly Journ. Microscopical Science. XX, n. s. (1880), pp. 119–129; 6 plates.

172. DYER, W. T. THISELTON. Correspondence *re* Reward for a Remedy for Leaf disease. Tropical Agriculturist, II, pp. 8, 9.

See also No. 422.

173. DYER, W. T. THISELTON, and HOLMES, E. M. The causes of Leaf disease. Tropical Agriculturist, II, p. 170 (ex. The Planters Gazette).

174. DYER, W. T. THISELTON. Coffee-leaf disease in Central Africa. Kew Bulletin, 1893, pp. 361–363.

Contains statements concerning the supposed dissemination of *Hemileia* from Ceylon.

175. DYER, W. T. THISELTON. See Thwaites, No. 469.

176. DYER, W. T. THISELTON. See Planters' Association, Nos. 422, 423.

177. ELLIS, J. B., and EVERHART, B. M. *Mucronoporus* E. and E. Jour. Myc., V, pp. 28, 29.

Transfers *Polyporus setiporus* B. to *Mucronoporus*, and gives measurement of spines (25–30 × 4 μ).

178. ENGLER, A., and PRANTL, K. Die naturlichen Pflanzenfamilien' Teil 1, Abt. 1 (1897) ; Teil 1, Abt. 1** (1900).

Contains numerous generic changes of Ceylon species.

179. VON FABER, F. C. Die Krankheiten und Schädlinge des Kaffees I. Centralblatt für Bakt., &c., II, Abt., Bd. XXI (1908), pp. 97–117.

States that *Hemileia* occurs in Ceylon on *Diplospora sphærocarpus*, citing Tropical Agriculturist, 1889–1890, p. 139. This statement and reference are incorrect.

180. VON FABER, F. C. Die Krankheiten and Parasiten des Kakaobaumes. Arbeit. der Kaiserl. Biolog. Anstalt, VII, pp. 195–351.

181. FAWCETT, W. Coffee-Leaf disease. Bull. Bot. Dept. Jamaica, No. 22, July, 1891, p. 3.

Gives proclamation relative to destruction of coverings of tea chests to prevent introduction of the fungus spores from Ceylon.

182. FELSINGER, E. O. The Coconut Bleeding disease. Tropical Agriculturist, XXX, p. 194.

183. FISCHER, E. Untersuchungen zur vergleichenden Entwicklungsgeschichte und Systematik der Phalloideen. Denkschr. der Schweizerisch. naturforsch. Ges., XXXII, 1 (1890), 103 pp.; 6 plates.

184. FISCHER, E. Neue Untersuchungen zur vergleichenden Entwicklungs-geschichte und Systematik der Phalloideen. Denkschr. der Schweizerisch. naturforsch. Ges., XXXIII, 1 (1893), 51 pp.; 3 plates.

185. FISCHER, E. Untersuchungen zur vergleichenden Entwicklungsgeschichte und Systematik der Phalloideen. III Serie ; mit einem Anhang, Verwandtschafts-verhaltnisse der Gastromyceten. Denkschr. der Schweiz. Naturforsch. Ges. XXXVI, 2 (1900), 84 pp. ; 6 plates, 4 figures.

186. FISCHER, E. *Genea Thwaitesii* (B. & Br.) Petch und die Verwandtschafts-verhaltnisse der Gattung *Genea*. Ber. d. Deutsch. Bot. Gesellsch., XXVII (1909), Hft. 5, pp. 264–270 ; 1 plate.

187. FISCHER, E. Beitrage zur Morphologie und Systematik der Phalloideen. Annales Mycologici, VIII (1910), pp. 314–322 ; 1 plate.

Contains details of the development of *Clathrella delicata*.

188. FISCHER VON WALDHEIM, A. Aperçu Systématique des Ustilaginées, leur plantes nourricières et la localisation de leurs spores. 4to., Paris, 1877.

Includes *Thecaphora inquinans* B. & Br., and *Urocystis macularis* (B. & Br.) Fischer = *Polycystis macularis* B. & Br.

189. Fischer von Waldheim, A. Les Ustilaginées et leurs plantes nourricières. Ann. Sci. Nat., Ser 6, IV, pp. 190.

Thecaphora Berkeleyana Fisch. = *Polycystis macularis* B. & Br.

190. Fraser, J., Petch, T., &c. Burying vs. Burning of Tea Prunings. Tropical Agriculturist, XXXII, pp. 289–296.

191. Fries, E. M. Elenchus fungorum, sistens Commentarium in Systema Mycologicum. 1828.

Records *Fomes levissimus*, " In Zeylonia " ?

192. Gaillard, A. Le Genre Meliola. 8vo. Paris. 1892.

Records (p. 40) *Meliola ganglifera* Kalch., on *Hippocratea indica*, Ceylon, Collect. Desmazières, Herb. Mus. Paris; and (p. 115) *Meliola mollis* B. & Br. = *Dimerosporium molle* (B. & Br.) Sacc., among *species excludendæ*.

193. Gardner, G. Report on the " Brown Scale," or " Coccus," so injurious in the Coffee plants in Ceylon. Hooker's London Journal of Botany, II (1850), pp. 353–360; III (1851), pp. 1–9.; plate.

Notes the occurrence of an *Antennaria* on the affected trees, with figures.

194. Giesenhagen, K. Ueber Hexenbesen an tropischen Farnen. Flora, Bd. 76 (1892), pp. 130–156; 2 plates

Taphrina Cornu-cervi on *Aspidium aristatum*, and *Taphrina Laurencia* on *Pteris quadriaurita* from Ceylon.

195. Green, E. E. Cacao disease. Tropical Agriculturist, XVII, p. 124; p. 160; p. 201.

196. Green, E. E. See Willis, J. C., No. 505.

197. Hariot, P. Sur quelques champignons de la Flore d'Oware et de Benin de Palisot Beauvois. Bull. Soc. Myc. France, VII, pp. 203–207.

Includes description of *Hexagona Deschampsii* n. sp. collected in Ceylon by Deschamps, 1891.

198. Hariot, P. See Karsten, P. A., No. 225.

199. Hennings, P. Fungi Australiæ occidentalis, I, a Cl. Diels et Pritzel collecti. Hedwigia, XL (1901), pp. (95)–(97).

States that *Puccinia pritzeliana* is quite distinct from *Puccinia tremandræ* from Ceylon.

200. Höhnel, F. von. Fragmente zur Mykologie (III Mittl.). Aus den Sitzungsberichten der kaiserl. Academie der Wissenschaften in Wien. Mathem.-naturw. Klasse; Bd. CXVI, Abt. 1, January, 1907.

Phyllachora dolichogena (B. & Br.) Sacc. (pp. 47, 48).

201. HÖHNEL, F. VON. Fragmente zur Mykologie (V Mittl.). Loc. cit., Bd. CXVII, Abt. 1, October, 1908.

Über Termitenpilze (pp. 1–14), *Oudemansiella apalosarca* (B. & Br.) v. H. (pp. 15–23).

202. HÖHNEL, F. VON. Fragmente zur Mykologie (VI Mittl.). Loc. cit., Bd. CXVIII, Abt. 1, April, 1909.

Oudemansiella apalosarca, *Mycena clavulifera* B. & Br., *Psalliota microcosmus* B. & Br., *Psalliota arginea* B. & Br., *Astrocystis mirabilis* B. & Br., *Neopeckia rhodosticta* (B. & Br.) Sacc., *Stromatographium stromaticum* (Berk.) v. H., *Sporocystis fulva* n. sp., *Physarum cinereum* Pers., *Diachæa elegans* Fr., *Diachæella bulbillosa* (B. & Br.) v. H., *Lepidodermopsis leoninus* (B. & Br.) v. H., *Stemonitis herbatica* Peck, *Comatricha longa* Peck.

203. HÖHNEL, F. VON. Fragmente zur Mykologie (VII Mittl.). Loc. cit., Bd. CXVIII, Abt. 1, June, 1909.

Sphæria rhodosticta B. & Br. (p. 25), *Lycogala affine* B. & Br. (p. 86).

204. HÖHNEL, F. VON. Fragmente zur Mykologie (VIII Mittl.). Loc. cit., Bd. CXVIII, Abt. 1, October, 1909.

Clypeolum zeylanicum C. & M. (p. 18), *Pisomyxa Amomi* B. & Br. = *Dimerosporiella Amomi* (B. & Br.) v. H. (pp. 20–22).

205. HÖHNEL, F. VON. Fragmente zur Mykologie (IX Mittl.). Loc. cit., Bd. CXVIII, Abt. 1, November, 1909.

Hypomyces chromaticus B. & Br. (p. 17), *Nectria gyrosa* B. & Br. (p. 19), *Micropeltis asterophora* B. & Br. (pp. 22, 23), *Rhytisma constellatum* B. & Br. = *Rhytisma spurcarium* B. & Br. (p. 25), *Rhytisma Pterygotæ* B. & Br. = *Dothidasteroma Pterygotæ* (B. & Br.) v. H. (pp. 48–50), *Rhytisma filicinum* B. & Br. = *Hysterostomella filicina* (B. & Br.) v. H. (pp. 55, 56), *Rhytisma spurcarium* B. & Br. = *Hysterostomella spurcaria* (B. & Br.) v. H. (pp. 56, 57), *Psilopeziza myrothecioides* B. & Br. (p. 67).

206. HÖHNEL, F. VON. Fragmente zur Mykologic (X Mittl.). Loc. cit., Bd. CXIX, Abt. 1, May, 1910.

Corticium salmonicolor B. & Br. (p. 3), *Sclerocystis coremioides* B. & Br. (pp. 6, 7), *Cocconia placenta* (B. & Br.) Sacc. (pp. 34, 35), *Rhytisma maculosum* B. & Br., *Asterina echinospora* v. H., n. sp. (pp. 48, 49), *Asterina pelliculosa* Berk. (pp. 56, 57), *Asterina pleurostyliæ* B. & Br. = *Meliola pleurostyliæ* (B. & Br.) v. H. (pp. 66, 67), *Meliola mollis* B. & Br. (pp. 69, 70).

207. HÖHNEL, F. VON. Fragmente zur Mykologie (XI Mittl.). Loc. cit., Bd. CXIX, Abt. 1, June, 1910.

Peziza hysterigena B. & Br. = *Encœliella hysterigena* (B. & Br.) v. H. (pp. 2, 3), *Peziza apicalis* B. & Br. = *Helotiopsis apicalis* (B. & Br.) v. H. (pp. 6, 7), *Pithomyces flavus* B. & Br. (pp. 52, 53).

208. HÖHNEL, F. VON. Fragmente zur Mykologie (XII Mittl.). Loc. cit., Bd. CXIX, Abt. 1, October, 1910.

Oudemansiella canarii (Jungh.) v. H. (pp. 7–10), *Oudemansiella subaurantiaca* (B. & Br.) Petch (p. 8), *Chitoniella trachodes* (Berk.) Petch (p. 10), *Dimerosporina Amomi* (B. & Br.) v. H. (p. 34), *Ophiodothella edax* (B. & Br.) v. H. (pp. 57, 58), *Balansia brevis* (B. & Br.) v. H. (p. 63).

209. HÖHNEL, F. VON, and LITSCHAUER, V. Beitrage zur Kenntnis der Corticieen (II Mittl.). Aus den Sitzungsberichten der kaiserl. Academie der Wissenschaften in Wien. Mathem.-naturw. Klasse; Bd. CXVI, Abt. 1, May, 1907.

Hymenochæte simulans (B. & Br.) v. H. et L. (p. 37), *Aleurodiscus sparsus* (Berk.) v. H. et L. (pp. 71, 72). The latter species is recorded for Ceylon in error.

210. HÖHNEL, F. VON, and LITSCHAUER, V. Beitrage zur Kenntnis der Corticieen (III Mittl.). Loc. cit., Bd. CXVII, Abt. 1, October, 1908.

Aleurodiscus Peradeniyæ (B. & Br.) v. H. (p. 16), *Aleurodiscus lepra* (B. & Br.) v. H. et L. (p. 18), *Peniophora sparsa* (B. & Br.) Cooke (pp. 19–21).

211. HÖHNEL, F. VON, and WEESE, J. Zur Synonymie in der Gattung Nectria. Annales Mycologici, VIII, pp. 464–468.

N. agaricicola Berk. = *Barya agaricicola* (Berk.) v. H., *N. aurantiicola* B. & Br. = *Corallomyces aurantiicola* (B. & Br.) v. H., *N. Bambusæ* (B. & Br.) = *Pseudonectria Bambusæ* (B. & Br.) v. H., *N. bicolor* B. & Br., *N. subquaternata* B. & Br., *N. monilifera* B. & Br. = *Neoskofitzia molinifera* (sic.) (B. & Br.) v. H.

212. HOLLOWAY, J. Cacao cultivation. Tropical Agriculturist, XVII, pp. 265, 266.

213. HOLTERMANN, C. Mykologische Untersuchungen aus den Tropen. Berlin, 1898.

Records *Laschia velutina* Lév., *L. tremellosa* Fr., *Gyrocephalus rufus*, *Ulocolla papillosa* n. sp., *Exidia carnosa* n. sp., *Tremella fuciformis*, *Tremella sylvestris* n. sp., *Dædalea citrina* n. sp., *Agaricus* on termite combs; with fig.

214. HOLTERMANN, C. Pilzbauende Termiten. Festschrift für Schwendener, Berlin, 1899, pp. 411–420; 1 fig.

215. HOLTERMANN, C. Fungus cultures in the Tropics. Preliminary note. Annals R. B. G., Peradeniya, I (1901), pp. 27–37; 1 plate.

216. HOOKER, J. D. Report on the progress and condition of the Royal Gardens at Kew during the year 1873.

On p. 5 reference is made to *Hemileia vastatrix* in Ceylon and Madras, and to the introduction of Liberian Coffee.

217. Hooker, J. D. Report on the progress and condition of the Royal Gardens at Kew during the year 1874.

On p. 7 note on *Hemileia vastatrix* in Ceylon.

218. Hooker, J. D., Thwaites, G. H. K., &c. Correspondence relating to the Coffee Leaf disease. Colombo. Sessional Paper XXXVI, 1876.

219. Hooker, J. D. Report on the progress and condition of the Royal Gardens at Kew during the year 1876. Reprinted in Gardeners' Chronicle, VIII (1877), p. 140.

Notes on *Hemileia vastatrix* in Ceylon, p. 10; pp. 18–20.

220. Hooker, J. D. Report on the progress and condition of the Royal Gardens at Kew during the year 1878.

Contains (pp. 32–34) an account of the Coffee disease in Ceylon, with two plates reproduced from Abbay's paper in Jour. Linn. Soc.

221. Hooker, J. D. Report on the progress and condition of the Royal Gardens at Kew during the year 1880.

Pp. 34, 35; note on Morris's and Marshall Ward's investigations in Ceylon.

222. Houttuyn, M. Handleiding tot de Plant- en Kruidkunde, benevens eene uitvoerige Beschrijving der Boomen, &c. Amsterdam. 1783.

XIV deel, p. 655 describes *Peziza Ceylonsche;* p. 660, *Peziza limbosa*, from Ceylon.

223. Hughes, J. The Disposal of Tea prunings. Tropical Agriculturist, XXVI, p. 295.

224. Jardine. Coffee Leaf disease. Gardeners' Chronicle, XX (1883), p. 470.

Extract from a letter by Mr. Jardine to the Ceylon Observer, *re* Storck's remedy.

225. Karsten, P. A., Roumeguere, C., and Hariot, P. Fungilli novi. Revue Mycologique, XII, pp. 79, 80.

Descriptions of *Fusicoccum microspermum* Har. et Karst., and *Cladosporium subcompactum* Roum. et Karst., from Ceylon.

226. Keissler, K. v. Micromycetes, in "Botanische und Zoologische Ergebnisse einer wissenschaftlichen Forschungsreise nach den Samoa-inseln, dem Neuguinea Archipel und den Salomons-inseln." Denkschr. Math.-Naturw. Klasse der Kais. Akad. d. Wissensch., Wien, LXXXV (1910), p. 182–192.

Records *Triphragmium clavellosum*, syn. *T. Thwaitesii*, on leaves of *Akebia* spec., Kandy, spores 36μ diameter without processes, 48μ with; *Phyllosticta Passifloræ* McAlp., on *Passiflora*. sp., Kandy, "Spots but no pycnidia, therefore determination not certain."

Triphragmium clavellosum is parasitic on *Heptapleurum stellatum* Gærtn. (*Araliaceæ*); *Akebia* (*Berberidaceæ*) does not occur in Ceylon.

227. Knight, C. Notes on the Stictei in the Kew Museum. Jour. Linn. Soc., XI (1871), pp. 243–246.

Refers to a *Stictina* collected by Dr. Maxwell in Ceylon, and a *Sticta*, also from Ceylon, both included under *Sticta punctulata* at Kew.

228. von Lagerheim, G. Uredineæ Herbarii Eliæ Fries. Tromso Museums Aarshefter, XVII (1894), p. 25.

Redescriptions of *Puccinia congesta* B. & Br., *Diorchidium flaccidum* (B. & Br.) Lag., *Puccinia Ruelliæ* (B. & Br.) Lag., &c.

229. Leighton, W. A. The Lichens of Ceylon collected by Thwaites. Trans. Linn. Soc., XXVII (1869), pp. 161–186 ; 2 plates.

230. Léveillé, J. H. Champignons Exotiques. Ann. Sci. Nat., ser. 3., II (1844), pp. 167–221.

Records *Polyporus crenatus, Favolus agariceus*, for Ceylon.

231. Léveillé, J. H. Descriptions des Champignons de l'herbier du Museum de Paris. Ann. Sci. Nat., 3 ser., V (1846), pp. 111–167.

Describes *Polyporus sericellus* and *Polyporus phæus* from Ceylon.

232. Lister, A. A Monograph of the Mycetozoa. London, 1894.

Numerous references to the Ceylon species in the Kew and British Museum herbaria.

233. Litschauer, V. See Höhnel, Nos. 209, 210.

234. Lloyd, C. G. Mycological notes, No. 18, July, 1904.

Lanopila bicolor and *Lasiosphæra Fenzlii* from Ceylon.

235. Lloyd, C. G. The Lycoperdaceæ of Australia, New Zealand, and neighbouring Islands. Mycological series, No. 3, April, 1905.

Geaster plicatus and *Geaster Thwaitesii* (pp. 17, 18).

236. Lloyd, C. G. Puff Ball Letters, No. 1, January, 1904.

Lasiosphæra Fenzlii from H. F. Macmillan, Ceylon. Notes on *Bovista bicolor, Geaster biplicatus*, and *Scleroderma columnare*.

237. Lloyd, C. G. Puff Ball Letters, No. 2, May, 1904.

Calvatia Gardneri from H. F. Macmillan, Ceylon.

238. Lloyd, C. G. Mycological notes, No. 20. The Genus Mitremyces, p. 238–241.

Mitremyces Junghuhni and *M. insignis* from Ceylon ; note on *Calostoma Berkeleyi* (= *Mitremyces lutescens* of B. & Br., Jour. Linn. Soc., XIV, p. 78 = *M. Junghuhni*).

239. Lloyd, C. G. Mycological notes, No. 21, p. 259–260.

Lasiosphæra Fenzlii ; *Disciseda velutina* (B. & Br.) Hollos is an unopened geaster.

240. Lloyd, C. G. Mycological notes, No. 23. The Genus Bovistella.

Note on *Lycoperdon citrinum* B. & Br. (p. 286).

241. LLOYD, C. G. Mycological notes, No. 24. Concerning the Phalloids.

Clathrus crispatus and *Clathrus delicatus*, Ceylon.

242. LLOYD, C. G. Mycological notes, No. 25. New notes on the Geasters.

Geaster mirabilis, Ceylon.

243. LLOYD, C. G. Mycological notes, No. 26. Concerning the Phalloids.

Phallus indusiatus, Ceylon. A scaly form of *Geaster triplex*, Ceylon. Specimens of *Nidula* from Ceylon.

244. LLOYD, C. G. Mycological notes, No. 28. Concerning the Phalloids.

Simblum gracile v. *Simblum texense* (p. 361).

245. LLOYD, C. G. Mycological notes, No. 30. Concerning the Phalloids.

Simblum gracile v. *Simblum texense* (p. 383). The genus *Matula* (pp. 390–392).

246. LLOYD, C. G. Mycological notes, No. 31.

Lysurus Gardneri (p. 407).

247. LLOYD, C. G. The Phalloids of Australasia.

Notes on *Lysurus Gardneri* (p. 14).

248. LLOYD, C. G. Letter No. 15.

Records of *Cyathus*, *Lycoperdon*, and *Nidula* from Ceylon.

249. LLOYD, C. G. Letter No. 17.

Records of *Matula*, *Cyathus*, *Geaster*, *Lycoperdon*, *Bovistella*, from Ceylon.

250. LLOYD, C. G. Letter No. 19.

Records of *Bovistella*, *Lycoperdopsis*, *Nidularia*, *Geaster*, *Sphærobolus*, *Lycoperdon*, from Ceylon.

251. LLOYD, C. G. Letter No. 23.

Record of *Scleroderma columnare* from Ceylon.

252. LLOYD, C. G. Letter No. 28.

Gastromycete (unknown Genus) from Ceylon.

253. LLOYD, C. G. Mycological notes. Polyporoid Issue, No. 2.

Polyporus rhipidium, Ceylon.

254. LLOYD, C. G. Mycological notes, No. 32.

States that cotypes of *Lysurus Gardneri* exist at Upsala.

255. LLOYD, C. G. Mycological notes, No. 33.

Notes on the genus *Matula*.

256. Lloyd, C. G. Mycological notes, No. 34.

Clautriavia merulina from Ceylon (figure).

257. Lloyd, C. G. Mycological notes, No. 35.

Phallus indusiatus, *Lysurus Gardneri*, *Clautriavia merulina*, acknowledgment of Ceylon photographs of.

258. Lloyd, C. G. Synopsis of the known Phalloids.

Includes descriptions and figures of Ceylon species.

259. Lloyd, C. G. Synopsis of the genus *Hexagona*.

Contains notes on all the Ceylon species.

260. Lloyd, C. G. Synopsis of the sections *Microporus*, *Tabacinus*, and *Funales* of the Genus *Polystictus*.

Notes on *Polystictus setiporus*, *Polystictus leoninus*, Ceylon.

261. Ludwig, F. Uber einige Richtungen abnormer Fruchtkörperentwicklung höherer Pilze. Festschr. Wetteranisch. Ges. Naturk. Hanau, 1908, pp. 112–117.

States that *Rhacophyllus* B .& Br. is *Coprinus*.

262. Martin, J. R. Cacao disease in the Matale District. Tropical Agriculturist, XVII, p. 98 ; p. 123.

263. Massee, G. E. New or imperfectly known Gastromycetes. Grevillea, XIX, pp. 94–98.

Describes *Mutinus proximus* Berk. in herb., and *Lysurus Gardneri*, Berk.

264. Massee, G. E. Notes on Exotic Fungi in the Royal Herbarium, Kew. Grevillea, XXI, pp. 1–6.

Thwaitesiella mirabilis (B. & Br.) Mass ; *Guepinia cochleata* B. & Br., *Guepinia fissa* Berk.

265. Massee, G. E. Notes on type specimens in the Royal Herbarium, Kew. Grevillea, XXI, pp. 77–82.

Measurements of spores, cystidia, &c., of *Rhodosporæ*, including Ceylon species ; *Entoloma retroflexus* B. & Br., and *Entoloma argilophyllus* B. & Br., said to be *Hebeloma*.

266. Massee, G. E. Revision of the genus *Triphragmium* Link. Grevillea, XXI, pp. 111–119.

Triphragmium Thwaitesii B. & Br. = *Triphragmium clavellosum* Berk.

267. Massee, G. E. Notice of R. Thaxter, on the *Myxobacteriaceæ*. Grevillea, XXI, pp. 123, 124.

Confirms Thaxter's suggestion that *Stilbum rhytidospora* B. & Br. = *Chondromyces aurantiacus* (B. & C.) Thaxter.

268. Massee, G. E. Revised descriptions of type specimens in the Kew Herbarium. Grevillea, XXII, pp. 12–16.

Gloniella drynariæ (B. & Br.) = *Hysterium drynariæ* B. & Br.

269. Massee, G. E. Revised descriptions of type specimens in the Kew Herbarium. Grevillea, XXII, pp. 33–35.

Gloniopsis orbicularis (B. & Br.) = *Glonium orbiculare* B. & Br.; *Gloniella atramentaria* (B. & Br.) Sacc. = *Hysterium atramentarium* B. & Br.; *Lophodermium Fourcroyæ* (B. & Br.) = *Hysterium Fourcroyæ* B. & Br.

270. Massee, G. E. Revised descriptions of type specimens in Kew Herbarium. Grevillea, XXII, pp. 99–107.

Peziza lobata B. & C. = *Peziza sarmentorum* var. *geophila* B. & Br.; *Peziza caroleuca* B. & Br.; *Peziza harmoge* B. & Br.; *Helotium alutaceum* B. & Br.

271. Massee, G. E. A Monograph of the genus *Lycoperdon*. Jour. Roy. Microscopical Soc., 1887, pp. 701–727; 2 plates.

Cites all the previous records for Ceylon.

272. Massee, G. E. On the type of a new order of fungi, *Matula poroniæforme* Mass. Jour. Roy. Microscopical Soc., London, 1888, p. 173; 1 plate.

Matula poroniæforme Mass. = *Artocreas poroniæforme* B. & Br.

273. Massee, G. E. A Revision of the Trichiaceæ. Jour. Roy. Microscopical Soc., 1889, p. 325.

274. Massee, G. E. Mycological notes. Journal of Mycology, V (1889), pp. 185–187.

Describes *Trichosporium Curtisii* Mass. = *Reticularia affinis* B. & C. = *Reticularia atro-rufa* B. & C. = *Reticularia venulosa* B. & C.; and *Trichosporium apiosporium* Mass. = *Reticularia apiospora* B. & Br.; with figures.

275. Massee, G. E. A Revision of the genus *Bovista*. Journal of Botany, XXVI (1888), pp. 129–137; 1 plate.

Cites all the previous records for Ceylon.

276. Massee, G. E. A Monograph of the genus *Podaxis* Desv. Journal of Botany, XXVIII (1890), pp. 69–77; 2 plates.

Records *Podaxis axata* (Bosc.) for Ceylon (Gardner).

277. Massee, G. E. New or Critical Fungi. Journal of Botany, XXXIV (1896), pp. 145–154.

Contains references to *Peziza dorcas*, *Hypocrella discoidea*, and *Hypocrella bambusæ*.

278. MASSEE, G. E. A Monograph of the Thelephoreæ. Part I. Jour. Linn. Soc., XXV, pp. 107–155 ; 3 plates.

Describes the following Ceylon species:—*Coniophora submembranacea* Cooke (= *Thelephora submembranacea* B. & Br.), *Coniophora peroxydata* Massee (= *Corticium peroxydatum* B. & Br.), *Coniophora murina* Massee (= *Corticium murinum* B. & Br.), *Coniophora Broomeiana* Massee (= *Thelephora Broomeiana* Berk. in Herb.), *Peniophora papyrina* (Mont.) Cooke, *Peniophora Habgallæ* Cooke (= *Corticium Habgallæ* B. & Br.), *Peniophora gigantea* (Fr.) Massee, *Peniophora lilacina* Cooke (= *Corticium lilacinum* B. & Br.), *Peniophora sparsa* Cooke (= *Corticium sparsum* B. & Br.), *Peniophora ambigua* Massee (= *Hydnum ambiguum* B. & Br.), *Asterostroma apala* Massee (= *Corticium apalum* B. & Br.) ; and states that *Corticium chlorascens* B. & Br. is an immature byssoid *Nectria*.

279. MASSEE, G. E. A Monograph of the Thelephoreæ, Part II. Jour. Linn. Soc., XXVII, pp. 95–205 ; 3 plates.

Describes the following Ceylon species:—*Hymenochæte rigidula* B. & C., *Hymenochæte subpurpurascens* Massee (= *Stereum subpurpurascens* B. & Br.), *Hymenochæte strigosa* B. & Br., *Hymenochæte ferruginea* Massee, *Hymenochæte crocata* Lév., *Hymenochæte dura* B. & C., *Hymenochæte pellicula* B. & Br., *Hymenochæte crocicreas* B. & Br., *Hymenochæte leonina* B. & C., *Hymenochæte barbata* Massee, *Hymenochæte fuliginosa* Lév., *Hymenochæte tristiuscula* Massee (= *Corticium tristiusculum* B. & Br.), *Hymenochæte rhabarbarina* Massee (= *Corticium rhabarbarina* B. & Br.), *Hymenochæte modesta* Massee (= *Corticium modestum* B. & Br.), *Corticium muscigenum* B. & Br., *Corticium salmonicolor* B. & Br., *Corticium scariosum* B. & Br., *Corticium tenuissimum* B. & Br., *Corticium simulans* B. & Br., *Corticium lepra* Massee (= *Stereum Lepra* B. & Br.), *Corticium alopecinum* B. & Br., *Corticium ambiens* B. & Br., *Corticium flavo-rubens* B. & Br. (no spec. in Herb Berk.), *Corticium emplastum* (*sic.*) B. & Br., *Corticium cæruleum* Fr., *Corticium flavo-virens* Massee (= *Corticium reticulatum* B. & Br.), *Corticium comedens* Fr., *Corticium hypochnoideum* B. & C. (species dubia), *Corticium suffultum* B. & Br. (species dubia) ; *Stereum elegans* Fr., *Stereum nitidulum* Berk., *Stereum partitum* B. & Br., *Stereum tuba* B. & Br., *Stereum pusillum* Berk., *Stereum lobatum* Fr., *Stereum percome* B. & Br., *Stereum rameale* Massee (= *Hymenochæte ramealis* Berk.), *Stereum rimosum* Berk., *Stereum rugosum* Fr., *Stereum notatum* B. and Br., *Stereum ruberrimum* B. & Br., *Stereum pruinatum* B. & C., *Stereum insulare* B. & Br., *Stereum albocinctum* B. & Br. (= *Stereum endoleucum* B. & Br. = *Stereum auriusculum* (*sic.*) B. & Br. = *Stereum annosum* B. & Br.), *Stereum strumosum* Fr., *Stereum sparsum* Berk. (error).

280. MASSEE, G. E. Redescriptions of Berkeley's Types of Fungi. Jour. Linn. Soc., XXXI, pp. 462–525 ; 3 plates.

Contains descriptions of most of the recorded Ceylon discomycetes.

281. MASSEE, G. E. Redescriptions of Berkeley's Types of Fungi, Part II. Jour. Linn. Soc., XXXV, pp. 90–119 ; 2 plates.

A continuation of the preceding : Discomycetes only.

282. MASSEE, G. E. A Monograph of the Genus *Calostoma* Desv. Annals of Botany, II, pp. 25–45 ; 1 plate.

Records *C. Berkeleyi* Mass., and *C. insignis* (Berk.) Mass., for Ceylon.

283. MASSEE, G. E. A revision of the Genus *Cordyceps*. Annals of Botany, IX (1895), pp. 1, &c. ; plate.

States that " *Cordyceps sobolifera* " from Ceylon is identical with *C. Barnesii* Thw.

284. MASSEE, G. E. A Revision of the genus *Coprinus*. Annals of Botany, X, pp. 123–184 ; 2 plates.

Quotes the records and descriptions of Ceylon species.

285. MASSEE, G. E. A Monograph of the *Geoglossæ*. Annals of Botany, XI (1897), pp. 225, &c. ; plates.

Excludes *Leotia brunneola* B. & Br.

286. MASSEE, G. E. A Monograph of the genus *Inocybe* Karsten. Annals of Botany, XVIII, pp. 459–504 ; 1 plate.

Transfers *Hebeloma micropyramis* B. & Br. to *Naucoria* (p. 501).

287. MASSEE, G. E. Tea and Coffee diseases. Kew Bulletin, Nos. 151–152, July and August, 1899, pp. 89–94 ; 1 plate.

Contains a description of Brown Blight (*Colletotrichum Camelliæ* Mass.) from Ceylon.

288. MASSEE, G. E. Fungi Exotici, III. Kew Bulletin, Nos. 175–177, July–September, 1901, pp. 150–169.

Description of *Leciographa Brownii* Massee (n. sp.), from Ceylon. " on dead bark, Brown " (p. 153).

289. MASSEE, G. E. Revision of the Genus *Hemileia*. Kew Bulletin, No. 2, 1906, pp. 35–42 ; 1 plate.

Assumes the identity of *H. vastatrix* and *H. Canthii*.

290. MASSEE, G. E. A Monograph of the Myxogastres. London, 1892.

Numerous references to Ceylon records and specimens.

291. MASSEE, G. E. A Text-Book of Plant Diseases. 8vo. London, 1899.

Cacao pod disease, p. 68 ; Cacao disease, p. 132 ; Coffee leaf disease, p. 231 ; Gray Blight of tea, p. 295.

292. MASSEE, G. E. Diseases of Cultivated Plants and Trees. 8vo. London, 1910.

Hemileia vastatrix, p. 22, p. 328; Cacao pod disease, p. 128; Cacao stem disease, p. 187; Stem disease of Tea, p. 245; Root disease of *Hevea*, p. 376; Bark disease of *Hevea*, tea, &c., p. 393; Gray Blight of Tea, p. 450.

293. MASSEE, G. E. Cacao Canker. See Willis, J. C., No. 506.

294. McMILLAN, CONWAY. Note on a new species of *Actinoceps* B. & Br. American Naturalist, XXIV, No. 284 (August, 1890), pp. 777–779.

Actinoceps Besseyi McM. compared with *A. Thwaitesii* B. & Br.

295. MEE, C. J. C. Report of the Experiment Station, Peradeniya, for 1907.

Details of spraying and canker excision.

296. DE MEL, F. J. The Coconut Stem disease. Tropical Agriculturist, XXXI, p. 180.

297. MILESE, M., and TRAVERSO, G. B. Saggio di una monografia del genere *Triphragmium*. Annales Mycologici, II, pp. 143–156; 1 plate.

Include *T. clavellosum*, Ceylon, and *T. Thwaitesii*, Ceylon, as distinct species.

298. MORRIS, D. Coffee Leaf disease. Results of Experiments carried out at Wallaha Estate, Lindula, January, 1879. Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1879, pp. CXIII–CXX.

299. MORRIS, D. Reports upon Experiments connected with the Coffee Leaf disease. Sessional Paper XII, Colombo, 1879; reprinted as Supplement to the *Ceylon Observer*, August 5, 1879.

300. MORRIS, D. Coffee Leaf disease in Ceylon and Southern India. Nature, XX (1879), pp. 557–559.

301. MORRIS, D. Leaf disease. Proceedings of the Planters' Association of Ceylon for the year ending February 17, 1880, pp. 97–113.

302. MORRIS, D. Note on the Structure and Habit of *Hemileia vastatrix*, the Coffee Leaf disease of Ceylon and Southern India. Jour. Linn. Soc., XVII (1880), pp. 512–517; 1 text fig.

303. (MORRIS, D.) The Campaign of 1879 against Coffee Leaf disease (*Hemileia vastatrix*) by the Coffee Planters of Ceylon, assisted and guided by D. Morris, Esq., M.A., F.G.S.

Reprint of letters and articles from the *Ceylon Observer*, January 9, 1879–August 7, 1879.

304. MORRIS, D. Further Correspondence on the Coffee Leaf disease. Colombo. Sessional Paper XIII, 1880. Reprinted in Proceedings of the Planters' Association of Ceylon for the year ending February 22, 1881, pp. XXXV–XXXVIII.

305. MORRIS, D. See Thwaites, G. H. K., No. 469.

306. MORRIS, D. Cacao Canker. See Willis, J. C., No. 506.

307. NIETNER, J. The Coffee tree and its enemies. 8vo. Colombo, 1872.

Contains references to a Black fungus on *Lecanium*, assigned to *Triposporium Gardneri* by Berkeley and *Syncladium Nietneri* by Rabenhorst ; a white mould on *Lecanium ;* white fungus on termite combs ; coffee leaf disease. *Syncladium Nietneri* appears to be *nomen nudum.*

308. NOCK, W. The effects of the Recent Frost near and at Nuwara Eliya. Tropical Agriculturist, XVIII, p. 713.

309. NOCK, W. Report of the Royal Botanic Gardens for 1890.

Note on the effects of frost at Sita Eliya, January, 1890 (p. H 4).

310. NORTHWAY, C. See Clark, P. D. G., No. 113.

311. NYLANDER, W. Lichenes Ceylonenses et additamentum ad Lichenes Japoniæ. Acta Soc. Scient. Fennicæ, XXVI, No. 10 (1900), pp. 1–13.

312. ONDAATJE, W. C. Observations on the Vegetable Products of Ceylon. Appendix to Ceylon Almanac and Annual Register for 1853.

List of Poisons known to the Kandyans includes " Ouss hatoo ; a kind of mushroom," " Kanamædiri hatoo ; mushroom."

313. PARKER, G. H. On the Morphology of *Ravenelia glandulæformis.* Proc. American Acad. Arts & Sc., XIV, n. s. (Vol. XXII), pp. 205–219.

Gives figures of *Ravenelia sessilis, R. indica, & R. stictica.*

314. PARKIN, J. Fungi found in Ceylon growing upon Scale Insects (Coccidæ and Aleurodidæ). 8vo., London, 1900, 2 pp. Abstract of paper read before Section K, British Association, Bradford, 1900.

315. PARKIN, J. Fungi parasitic upon Scale Insects (Coccidæ and Aleurodidæ) : a general account with special reference to Ceylon forms. Annals R. B. G., Peradeniya, III (March, 1906), pp. 11–82 ; 4 plates.

316. PATOUILLARD, N. Le Genre *Lopharia* Kalch. Bull. Soc. Myc. France, XI, pp. 13–15 ; 1 plate.

Includes *Lopharia mirabilis* = *Radulum mirabile* B. & Br.

317. PATOUILLARD, N. Le Genre *Cyclomyces*. Bull. Soc. Myc. France, XII, pp. 45–51.

Includes a reference to *Polyporus setiporus* Berk.

318. PATOUILLARD, N. Note sur le genre *Paurocotylis* Berk. Bull. Soc. Myc. France, XIX, pp. 339–341.

Contains description of *Paurocotylis fulva* B. & Br.

319. PATOUILLARD, N. Champignons nouveaux ou peu connus. Bull. Soc. Myc. France, XXIV, pp. 1–12.

Includes note that *Thelephora Thwaitesii* B. &. Br., *Thelephora dictyodes* B. & Br., *Thelephora suffulta* B. & Br., and *Corticium reticulatum* B. & Br., belong to the genus *Septobasidium*.

320. PATOUILLARD, N. Essai Taxonomique sur les Familles et les Genres des Hymenomycetes. 8vo., Lons-Le-Saunier, 1900.

Contains numerous references to Ceylon species.

321. PETCH, T. Mycological notes for the month. Tropical Agriculturist, XXIV, pp. 103–104 (May, 1905).

Branch canker in Tea ; *Septogloeum arachidis* : Orchid disease ; Cotton diseases.

322. PETCH, T. Mycological notes. Tropical Agriculturist, XXIV, pp. 137–138 (June, 1905).

Parodiella on *Crotalaria* ; *Helminthosporium* on *Hevea*.

323. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, pp. 183, 184.

Mildews on Orange and *Bixa orellana* ; *Uromyces fabæ*.

324. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, pp. 298, 299.

Phytophthora on Cacao and Hevea pods : *Diplodia* on *Arachis* ; *Uredo gossypii* ; *Læstadia theæ*.

325. PETCH, T. Plant Disease Prevention. Tropical Agriculturist, XXV., pp. 377–380 ; 1 plate.

326. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, pp. 411–413.

Leaf diseases of *Hevea* ; knots and tapping injuries.

327. PETCH, T. Prevention of Plant Diseases by spraying. Tropical Agriculturist, XXV, pp. 468–470.

328. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, pp. 523, 524.

Root diseases of *Hevea*.

329. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, pp. 630, 631.

Hemileia ; Actinonema rosæ ; Pestalozzia on rose, tea, and *Hevea ; Glœosporium* on *Hevea.*

330. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, p. 777.

Horse hair Blight on tea, *Hevea*, &c.

331. PETCH, T. Prevention of Plant Diseases by spraying. Leaflet No. 10, Ceylon Agricultural Society (Sinhalese).

332. PETCH, T. Mycological notes. Tropical Agriculturist, XXV, pp, 839, 840.

Club root.

333. PETCH, T. Mycological notes. Tropical Agriculturist, XXVI, pp. 68, 89.

Brown blight ; tapping injuries ; branch canker.

334. PETCH, T. Thread blight. Tropical Agriculturist, XXVI, pp. 224–225 ; 2 plates.

335. PETCH, T. Mycological notes. Tropical Agriculturist, XXVII, pp. 86, 87.

Fungi on *Castilloa elastica.*

336. PETCH, T. Diseases of the Coconut Palm. Tropical Agriculturist, XXVII, pp. 489–491.

Stem disease of the coconut ; *Pestalozzia.*

337. PETCH, T. Report of the Government Mycologist for 1905. Reprinted in Circulars, &c., III, No. 21.

Diseases of Tea, *Hevea*, Cacao, *Castilloa*, Cotton, Groundnuts, *Crotalaria*, Betel, Dadap ; miscellaneous fungi.

338. PETCH, T. Bud Rot of the Coconut Palm. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, III, No. 15 (April, 1906).

339. PETCH, T. Root Disease of *Hevea brasiliensis* (*Fomes semitostus* Berk.). Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, III, No. 17 (July, 1906) ; 2 plates.

340. PETCH, T. Descriptions of New Ceylon Fungi. Annals of the Royal Botanic Gardens, Peradeniya, III (1906), pp. 1–10.

341. PETCH, T. *Penicillium glaucum* in Copper Sulphate. Annals R. B. G., Peradeniya, III (1906), p. 94.

342. PETCH, T. The Fungi of certain Termite Nests. Annals R. B. G., Peradeniya, III (1906), pp. 185–270 ; 17 plates.

343. PETCH, T. "Speschnew : Pilzeparasiten des Teestrauches. Zeitschrift für Pflanzenkrankheiten, XVIII, pp. 310–312.

Review, with notes on Ceylon diseases.

344. PETCH, T. Bud Rot of the Coconut Palm. Leaflet No. 26, Ceylon Agricultural Society (Sinhalese).

345. PETCH, T. Diseases of *Hevea*, in "Rubber in the East," pp. 36–41, Colombo, 1906.

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DEPARTMENT OF AGRICULTURE, CEYLON.

ANNALS
OF THE
ROYAL BOTANIC GARDENS,
PERADENIYA.

VOLUME V., PART VI., NOVEMBER, 1913.

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An Orchid new to Ceylon.

(*Arundina bambusifolia* Lindl.)

BY

T. PETCH, B.A., B.Sc.

IN November, 1912, Mr. E. E. Green brought in from the Hewaheta district a ground orchid which had been found growing on patana land there. On examination this proved to be *Arundina bambusifolia* Lindl., a species which did not come under the observation of either Thwaites or Trimen as a Ceylon plant. It has been introduced into the Botanic Gardens, Peradeniya, from India or Malaya, on several occasions, but has not flourished. There does not appear to be any reason to doubt that in the locality stated it is truly native to Ceylon.

Subsequent investigation of the literature relating to this species revealed a somewhat interesting state of affairs. The plant was included by Wight in his " Icones Plantarum Indiæ Orientalis " (1840–56), and was there stated to be a native of Ceylon and Malabar. Wight gave a figure which he said was taken from a Ceylon specimen, but, according to Hooker (Flora of British India, Vol. V., p. 857), that identical specimen is now in the Kew Herbarium and is marked as from Assam, collected by Griffith. Consequently, it has been deduced that Wight made a mistake in citing Ceylon as a locality for this species. Moreover, according to Hooker, there is no evidence of its being even a Malabar plant. The present discovery re-instates it as a Ceylon species, and raises the question whether Wight's error lies in his citation of Ceylon or in the labelling of the herbarium sheet.

The Ceylon specimens are up to 130 cm. in height, with stems up to 1 cm. in diameter. The blade of the leaf attains a length of 28 cm., and a breadth of 2·3 cm. The rachis of

Annals of the Royal Botanic Gardens, Peradeniya, Vol., V., Part VI., November, 1913.

the inflorescence is green or yellowish green, not purple or brown. Hooker, in Curtis's Botanical Magazine (t. 7284), states that the raceme is sometimes branched, and Wight's figure shows that condition; that has not occurred on the Ceylon specimens available at present, but the non-flowering stems have produced a number of shoots from the uppermost node after the top of the stem has been cut off.

The flowers are up to three inches across. They differ in colour, to some extent, from the figure in Curtis's Botanical Magazine (t. 7284), being rose-purple, a much warmer colour than there depicted, while the ridges on the lip are usually not green, or if green are not so prominently green as in the figure.

Comparison with the closely allied Ceylon species, *Arundina minor* Lindl., has not yet been possible, as the herbarium material of the latter species is very poor, and no exact locality for it is now known, though Trimen stated that it was rather common. From the paintings available, it differs from *A. bambusifolia* in its rigid leaves, coloured rachis, and the strongly yellow lip with poorly developed rose-coloured margins. The flower of *A. densa* Lindl., which is cultivated in the Botanic Gardens, closely resembles *A. bambusifolia*, but the lip is marked with yellow; the plant, however, has a coloured rachis, and its rather rigid darker green leaves contrast strongly with the drooping leaves of *A. bambusifolia*.

A number of Ceylon specimens of *A. bambusifolia* have now been planted in the Botanic Gardens, and, with the exception of one introduced from Assam in 1911, all the plants of *A. bambusifolia* in the Peradeniya Gardens are of Ceylon origin.

White Ants and Fungi.

BY

T. PETCH, B.A., B.Sc.

MR. T. Bainbrigge Fletcher, Government Entomologist, Coimbatore, has called my attention to the following note on a supposed association of white ants with a fungus, which was published by General C. F. Sharpe in the Journal of the Bombay Natural History Society, IX., pp. 228, 229 :—

Deposits made by White Ants.—Two years ago I wrote to the *Asian* on the subject of a vegetable substance which the white ants appear to deposit on the surface of the ground here. I asked for information, but no one responded nor does anyone here seem to know what it is. Natives told me that it was a deposit made by white ants, and on turning over a piece or two of the deposit I found white ants underneath. The natives then astonished me by saying that if I let the deposit alone it would next morning be turned into fungi, and, sure enough, all the little egg-like particles became small fungi an inch high with heads up to the size of a four-anna bit. I ate some, and they had all the flavour of mushrooms, but are of a waxy white colour all through. I have sent you in a small box a specimen of the deposit. I have put a wet sponge in with it so that it may keep moist on the journey, and perhaps some of the eggs will have turned into small fungi by the time it reaches you. The deposit is flat and generally circular, some patches the size of a rupee, others about four inches diameter. Those I saw this morning are on a well-frequented road, on the road itself, and a few patches on the bank at the side. I have only native authority for it that the deposit is the work of white ants, corroborated by my finding white ants under the patches and in one case by the deposits occurring where I knew white ants to be. Here the white ants do not seem to betray their presence by throwing up earth as in Northern India.—C. F. SHARPE, *General.*

The omission of a description of the sporophore of the fungus makes any attempt at identification somewhat uncertain, but the details given apply exactly, so far as they go, to the mycelium, sporophore, and habit of *Entoloma microcarpum* B. and Br. The latter is a common species in Ceylon, and probably one of the best known, as it is usually the "mushroom" which the native cook serves up on toast.

Entoloma microcarpum grows sometimes on lawns, but more usually on bare patches of soil, in flower beds, along roadsides, or actually on roads and footpaths. It generally occurs in large numbers, frequently covering an area three or four feet in diameter. The pileus is at first conico-campanulate with an acute apex, but expands until it is almost plane with an acute umbo. In colour it is livid gray when moist, becoming darker towards the umbo ; when dry it is dirty white. Young examples are slightly silky and striate, while fully developed specimens may be radially streaked owing to the splitting of the surface layer. The margin is irregular and at first incurved ; in old specimens it is sometimes reflexed. The flesh is thin, and the pileus frequently splits to the centre. When fully expanded it measures 1·75 to 5 cm. in diameter. The stalk is white, longitudinally striate, slightly bulbous and tomentose at the base, solid, 3–5 mm. thick and 2·5–3·5 cm. high. The gills are rather thick, white, ventricose, forked, with an irregularly lobed edge ; they may be adnexed and separating, or free. The spores are $5–7 \times 3–4\ \mu$, elliptic, with a sublateral apiculus, pink, with a yellowish tinge. A figure of this species has been published in the Annals of Peradeniya, Vol. III., plate 17A.

The peculiar mycelium of this agaric has been previously described in this Journal (Vol. III., pp. 252–254). It consists of masses of spheres, bound together by fine hyphæ which run from each sphere to all others in contact with it. These masses are in many cases roughly spherical, or elongated and cylindrical, only a few millimètres in diameter, and occur scattered through the surface layers of the soil ; but they frequently take the form of thin flat cakes, which lie parallel to the surface at a depth of one or two centimètres. In extreme cases these cakes may attain a length of 15 cm. with a breadth of 6 cm., and, as a rule, several of them are produced in close proximity. The total amount of mycelium underlying a troop of *Entoloma microcarpum* is much greater than would be expected from the size of the agaric.

The individual spheres are 0·4 to 0·7 mm. in diameter. They lie in compact masses, without any particles of wood or dead leaves, &c., among them. The interior of a sphere is a tangle of interlacing hyphæ without any definite arrangement. These hyphæ are swollen here and there into irregularly oval cells, produced singly or in a chain. Some of the hyphæ towards the exterior are directed radially, and all these terminate at first in spherical or oval swellings. Some of them produce single spherical cells, 25 to 40 μ in diameter, which form to some extent an outer covering to the sphere; these cells are at first terminal, but become lateral by subsequent growth of the hypha. Others produce a chain of three to six oval cells of varying size, and then revert to normal hyphæ. In rare cases, branching occurs in these chains of spore-like cells in the same manner as in the spheres of the termite comb.

When the agaric develops the spheres turn yellow and collapse. The large spherical cells are then indistinguishable when the sphere is viewed as a solid object under a low magnification, and it appears as simply a clump of ordinary hyphæ. The agaric is not formed in the interior of a sphere, but develops on the top of a cluster of them.

At first sight these spheres appear identical with the white spherical bodies which grow on the combs of certain termites, and which Berkeley described under the name of *Ægerita Duthiei*. But closer examination shows that although it is possible to trace some resemblance between the constituent parts of each, they differ widely in the degree of differentiation to which those parts have attained, and completely in the arrangement of them. The *Entoloma* sphere is a tangle with some approach to a definite arrangement at the exterior, while *Ægerita Duthiei*, on the other hand, resembles a true conidial fructification in being composed of distinct branches radiating from a common stalk, the outer of which form branching chains of spherical cells, while the inner form similarly branching chains of regular narrow-oval cells. The definite structure and arrangement of *Ægerita Duthiei* are entirely lacking in the *Entoloma* sphere.

I found this species in April, 1905, growing in profusion on the side of a mound of earth at the base of a clump of palms. Part of the mound was occupied by a termite nest, and the remainder most probably consisted of the débris of previous nests, but at the time the soil was quite loose (not cemented together) and dark coloured, and was covered with grass and other vegetation. Heavy rains had washed away the surface of the mound and exposed the masses of spheres, which completely filled small cavities in the soil. These cavities were quite irregular, not more than a centimètre in diameter, and had no evident connection with the termite nest.

During 1906, when the writer was engaged on the study of the fungi of termite nests in Ceylon, the possibility that the *Entoloma* mycelium consisted of modified " spheres " from the termite comb was constantly borne in mind, and all the observed occurrences of the *Entoloma* were carefully examined with that idea in view. It was found, however, that in the majority of cases nothing could be discovered which would suggest an association with termites, and, as attempts to develop the *Entoloma* from artificially-made clusters of *Ægerita Duthiei* proved failures, the idea was ultimately abandoned. Since then the agaric has been repeatedly observed, and though the results of these further observations on the whole tend to confirm the previous conclusions, there have been several which rather incline one to regard the question as still open. These cases are described below.

On one occasion cakes of the mycelium were seen embedded in the soil on a bank by the roadside. The road ran through a tea estate, and the bank was therefore weeded clean. Some cakes were covered with soil, while others were bare, a condition which was attributed to the denudation of the surface soil by recent heavy rains, as pieces of mycelium were found lying free in the drain. On lifting up the cakes termites were found beneath them in some cases, in well-trodden " runs " or galleries. This however did not occur in all cases, and, knowing how readily termites will discover fungus-infested wood or fungi, the association was regarded as accidental.

On another occasion a large jak stump, beneath which was a termite nest, was dug up. The combs of the nest were broken up and mixed with the earth which was used to fill up the hole. This patch subsequently produced an abundance of *Entoloma microcarpum*.

A similar occurrence was noted in the Botanic Gardens, Peradeniya. A termite nest on one of the lawns, which had not reached the mound stage, was dug up, and the fragments of the combs were shovelled into the hole with the soil. Four months later, in the wet season, the site of the nest was indicated by an abundant crop of *Entoloma*. It might be surmised from these occurrences that the mycelium had developed from the fragments of the combs, but previous experiments in which combs were buried in holes in the ground did not give any such result, nor is it a general occurrence after termite nests have been dug out.

Specimens of *Entoloma microcarpum* were sent to me on one occasion, with the information that they were found growing in large numbers on the sides of a termite mound.

The theory that the *Entoloma* spheres are identical with the spheres of the termite comb is a fascinating one, but up to the present it has not been found possible to substantiate it. The underlying idea is, of course, that after a period of cultivation in the termite nest the fungus loses its vigour and requires rejuvenescence ; and to bring that about the termites carry the spheres up to the surface and plant them out in situations where they will develop the sporophore and so provide spores, which the termites convey back to the nest as " seed " for a new crop of spheres.

One of the chief difficulties in the way of this theory lies in the difference in structure between the *Entoloma* sphere and *Ægerita Duthiei*. It might, however, happen that this re-planting was only necessary when the mycelium in the comb began to produce abnormal spheres (though nothing of that kind has yet been found on termite combs) ; or it might be that the termite sphere serves only as the " seed," and that, in its subsequent growth in the soil to form the *Entoloma* mycelium, it produces spheres which differ from those which were formed under the very different conditions which prevailed within the nest.

Up to the present, all experimental work undertaken with the object of establishing a connection between *Ægerita Duthiei* and the *Entoloma* spheres has proved fruitless, but the question is one which appears to demand further investigation, conducted at different seasons and with combs in different stages.

On the available facts, the only explanation which can be given of the occurrence of *Entoloma microcarpum* on termite hills, or on the sites of demolished termite nests, is that the fungus grows normally in bare soil, and therefore finds a suitable habitat in such situations.

The Black Termite of Ceylon.

(*Eutermes monoceros*, Koen.).

BY

T. PETCH, B.A., B.Sc.

AN account of the fungi which grow in the nests of *Termes redemanni* and *T. obscuriceps*, in Ceylon, was published in the Annals of Peradeniya, Vol. III., 1906, pp. 185–270.

These termites inhabit subterranean nests, which are ultimately extended above ground into more or less conical mounds. The examination of these nests showed, what had been previously recorded for other species, that the combs produce a conidial fungus, *Ægerita Duthiei,* which presumably serves as food for the insects ; and in addition it was found that two other fungi grow from these combs when they are old, viz., an agaric, *Collybia albuminosa* (Berk.), and a xylaria, *Xylaria nigripes* Klotzsch (= *X. Gardneri* Berk.). The former is produced while the nests are still inhabited, but the latter only grows after they have been deserted. Since then it has been proved that *Sclerotium stipitatum* Berk. & Curr., which occurs only in termite nests, is the sclerotium of *Xylaria nigripes* (Ann. Myc., V., 1907, pp. 401–403), and that deserted nests usually produce in addition a yellow Peziza, *P. epispartia* B. & Br. (Ann. Perad., IV., p. 12). According to von Höhnel (Fragmente zur Mykologie, V., p. 12) the xylaria must be regarded as two species, one with perithecia wholly embedded in a uniformly cylindrical clava, usually simple (*X. nigripes*), and the other with projecting perithecia, or with almost distinct perithecia seated upon a filiform clava, the clava in either case being usually dichotomously forked (*X. furcata*) ; but there appears to be some probability of proving that these are really identical. All the fungi mentioned above are confined to termite nests, or rather they have not been found in any other situation up to the present.

During the course of the investigations referred to, several nests of other species, which do not live underground, were examined, and it was found that the combs in such nests were usually destitute of fungi. For example, in one nest situated in the hollowed timbers of a bridge, and in another in a hollow felled tree trunk, the combs were hard and dry, and had evidently never borne any fungus cultivation similar to that which occurs in subterranean nests. In order to obtain further evidence on that point, it was decided to examine the nest of the Ceylon black termite, *Eutermes monoceros*, and to determine if possible in what respect its food differed from that of the Ceylon mound-building species. *Eutermes monoceros* builds its nest usually (? always) in a hollow tree.

From the mycological standpoint this investigation was quite fruitless. The black termite does not cultivate a fungus within its nest, though it might be said to feed on fungi to some extent. However, a few notes on the habits of this species were accumulated, and as they may possibly be of interest they have been recorded below.

Eutermes monoceros is common in Ceylon. Its black "nests," hanging in stalactitic masses from hollow tree trunks, or from the ends of decaying branches, are familiar objects, and its organized processions in search of food never fail to attract the attention of scientific visitors. Yet little appears to have been recorded about its habits. Ridley, writing on the "Symbiosis of Ants and Plants" (Ann. Bot., XXIV., p. 469), refers to a closely allied species, *Eutermes umbrinus*, "a termite which is often to be seen going in long procession to or from a tree or woodwork, where it collects bark to cultivate a species of *Agaricus* on which to feed the young." But if that is correct, the food of *T. umbrinus* differs completely from that of *T. monoceros*, though the habits of the two species are identical. Since these notes were compiled, Dr. Ed. Bugnion has studied *Eutermes monoceros* in Ceylon, and has published two papers, one in the Annales de la Société Entomologique de France, LXXVIII., pp. 272–280, and the other in Bull. Soc. Vaud. Sc. Nat., XLVII., 417–437; and further information, also based on Ceylon studies, has been furnished by Escherich in his book "Termitenleben auf Ceylon."

The Nest.

The black hanging labyrinthine mass, which is usually regarded as the nest of the black termite, has really no claim to that title, since it is not made use of by the insects either as a habitation or a repository for food, eggs, or larvæ. The real nest occupies a cavity in the branch or stem from which the black mass hangs. In all the nests examined this cavity has been continuous, and has contained a single comb; in that respect the nest differs from those of the mound-building species of Ceylon, since the latter contain numerous cavities each of which holds one, or sometimes two, combs.

The comb (Plates VIII. and XIV.) is blackish-brown when fresh, but becomes darker when dry. It is composed of thin foliated plates, bent and distorted in all directions, but with some approach to a concentric arrangement. These plates are united to one another irregularly, so that the whole forms a coarse sponge-like mass with comparatively wide passages, separated by smooth, thin walls about 0·25–0·3 mm. thick. The substance of the comb when first exposed is moist and somewhat flexible, but it becomes brittle when dry. The comb differs from that of the mound-building termites in its colour, more open structure, and thinner walls. In the case of the latter the comb is brown, and the passages are smaller and more regular. Further, in the case of the mound dwellers the individual pellets of excrement, of which the comb is built, can be clearly distinguished, since they make the surface rough with minute close-set swellings; but though the comb of the black termite is also built of excrement, its surface is smooth. This difference is due to the fact that the black termites, when building the comb, make use of their excrement in a more liquid form than the mound-building species.

Examination under the microscope shows that the substance of the comb consists of brown amorphous masses, with fragments of the epidermis of various plants, a few pieces of black fungus hyphæ and a few fungus spores, and numerous acicular and cubical crystals. The same mixture is found also in the stomachs of the workers and soldiers. On treatment with iodine, no part of the mixture is coloured blue, but the amorphous masses are coloured violet with iodine after treatment with caustic potash.

When a comb is broken up, the king and queen may be found in any part of it. There is no special royal cell, and consequently the queen is not confined to any particular region. Moreover, she is not so abnormally distended as the queens of the mound-building species, and hence she is able to make use of her legs and move about fairly rapidly. The following instance affords an illustration of her powers of locomotion. A cylindrical comb, about 25 cms. high and 20 cms. diameter, was removed from a cavity in a cinnamon tree, and gradually broken up by the removal of slices on one side from the top downwards. The queen was ultimately found at the base in almost the last fragment, having evidently moved down to that position while the comb was being cut up.

As a rule the queen is about an inch, or rather less, in length ; her abdomen is swollen, cylindric, and white, with a black horny plate, above and below, in the middle of each segment ; in some cases the abdomen is sharply constricted between the segments, and in one instance, where that was the case, its colour was blackish.

But though the queen may have moved to some other position during the examination of the comb, it is evident from the arrangement of the other inhabitants that her normal situation is in the centre of it. This is shown by the disposition of the eggs and larvæ, which are arranged concentrically round the centre. The eggs are deposited in the galleries nearest the centre ; next to these, proceeding outwards, the passages contain the larvæ, the youngest nearest to the centre and the older further away. Consequently, in a complete cross section of the comb one sees a circular zone of passages which contain eggs, surrounded by other zones which contain larvæ in different stages of development. It is to be deduced, therefore, that the proper position of the queen is in the centre of the comb. It would not be possible to detect this by an examination of the empty comb, since the galleries themselves are not arranged concentrically. The arrangement of the eggs and larvæ is concentric with regard to the centre of the comb, but the plates which form the comb, where any arrangement can be detected, are more or less parallel to the walls of the cavity in which the comb is built. This is evident from Pl. VIII.

As is usual with termites, the larvæ are white. The immature winged insects are black and white. The flight of the latter from the nest has not been observed ; they were found in a nest which was opened on January 24, 1910.

The External Structure.

The black external mass is adherent to the surface of the branch or stem round the opening of the cavity which contains the comb. When pendent from a small base it is usually about a foot in length (Pl. VI.A), but where it adheres to a tree trunk it may be prolonged to a length of three or four feet (Pl. VII.). As a rule, the insects make use of a natural orifice in the stem, but one case has been observed in which they might possibly have made openings for themselves. This was a nest in a hollow stem of *Cassia multijuga*, which furnished the piece of comb figured on Pl. VIII. The stem was upright, and hollow from the broken top for a length of about thirty feet, the comb occupying the uppermost twenty feet of the cavity. In addition to an external black mass hanging from the opening at the broken end of the stem, numerous other smaller masses adhered to the stem at various distances from the top, and it was found that these were built round short horizontal tunnels which penetrated through the sound wood into the cavity. However, it is possible that these holes may have been bored by other insects, and subsequently made use of by the termites.

The external mass is more or less similar to the comb in general structure, though its galleries are smaller and its walls proportionately thicker. It usually terminates below in several projections, at the end of each of which is an opening which provides access to the interior. But though it also is built of excrement, the material is in quite a different form from that used in the construction of the internal comb. It takes the form of small cylindrical pellets about 1 mm. long and 0·5 mm. diameter when fresh, which contract to $0{\cdot}75 \times 0{\cdot}4$ mm. when dry. The termite emerges from the nest, takes up a position on the edge of an orifice or of a plate which is in course of construction, and extrudes a single pellet, the final stages of extrusion being attended by a rapid backward and forward movement of the abodmen. The pellets are simply heaped on one another and adhere only because they are moist ; they are not glued together by any special secretion. Consequently the walls of the hanging mass are coarsely granular with numerous minute interspaces, and they separate readily into their componet pellets if rubbed lightly when dry, while a shower of rain washes to the ground the whole structure unless it is in a sheltered position.

The object of this external structure is not known, and it is scarcely possible to make any suggestion as to its use which has any semblance of probability. If it is a store of material for the future construction of combs, it is an extremely inefficient one, for it is periodically carried away by the rains, and in the dry weather it cracks and falls to the ground. Moreover, there does not appear to be any necessity for a reserve of such material, and no observations have been recorded which would tend to show that it ever diminishes in bulk except by the accidents noted. It would seem reasonable to suppose that it is merely a method of getting rid of surplus excrement, but, on the other hand, the care and method exercised in its construction negative that suggestion. For the pellets are not simply heaped together indiscriminately, at least when the foundations of this structure are laid, but are arranged in a definite manner which appears to be the same for all nests. These foundations take the shape of thin plates, semi-elliptical as a rule, perpendicular to the surface of the branch or stem, and arranged in vertical rows ; some of these plates are shown in the photograph on Pl. VI. B, which was taken during the re-construction of the external mass a few days after it had been washed away by the rain.

In one instance, where the nest occupied a hollow tree trunk inclined at an angle of about 45°, these plates were from a quarter to two inches in length and were arranged in eight vertical rows about one inch apart, the length of each row being about nine inches. It was intended to take a photograph of that example, but unfortunately operations had to be deferred until the afternoon to secure a favourable light, and in the meantime it was completely washed away by a heavy shower. That was in September, 1910. On my return to Ceylon in November, 1911, the nest was found to be in a similar condition to that of the previous year. The heavy rains of the north-east monsoon had washed away almost the whole of the external structure, and the insects were busy re-building it. In that they made very little progress, because the rains every day destroyed what they had just added. The photograph on Pl. X. was taken on November 27. The opening of the nest is near the top, where the work is most advanced. Below that the plates are arranged in more or less vertical rows. These plates appear broader than they really are, because the termites have already begun to roof over the spaces between them by building out laterally from the outer edge of each plate. In that way the spaces between the rows become the main galleries of the external structure, while the openings between the plates in each row serve as communications between these galleries.

By December 1 the roofing of the galleries had been completed over half the total area, but on the following day the whole structure was again washed away. That sequence of events—reconstruction and immediate destruction—continued throughout December, until December 29, when the rains practically ceased. On December 29 the structure was in the same stage as on November 27. By January 2, 1912, the galleries had been completed over two-thirds of the total area. The work then progressed much more slowly, and reached the stage illustrated on Pl. XI. on January 10. In that stage the external mass consists of one layer of galleries, *i.e.*, of one story only, though the " story " is vertical, not horizontal. But the termites have already begun to add another layer. Here and there may be seen holes in the otherwise continuous surface. Through these the termites emerge and build an elongated enclosure, open at the lower end, which is immediately roofed over. These subsequent additions are made without any such regularity as governed the construction of the first layer.

It may be noted that building was carried on throughout the day, even in full sunshine. The photographs were taken in full sunlight, but in spite of that the insects are to be seen at work, though not very distinctly owing to the long exposure necessary.

Pl. XII. shows the stage reached on January 26. There is very little increase in the thickness of the structure, the additions being chiefly vertically downwards in the form of three stalactitic projections. At this stage the openings round the base of the mass, *i.e.*, on the surface of the tree, were closed, so that the only exits were situated on the projections, except for a few openings on the general surface where some desultory building was continued. It will be noted that the surface is cracked, chiefly horizontally, through drying. During February these projections were still further extended, and at the same time the insects began another black structure round an opening four feet lower down the stem. The photograph on Pl. XIII. was taken on February 21; the third projection, on the extreme left, had fallen off shortly after midday on that date. The rainfall during January and February had been exceptionally small, but on February 29 a shower of several hours' duration, totalling altogether 0·37 inch, occurred, which washed away the external structure almost completely, leaving the termites in a much worse position than on November 27—that is, presuming that this structure is of some use to them.

Escherich has suggested that the excrement of *Eutermes monoceros* differs from that of other termites in some respect which makes it unsuitable for use in the construction of the nest, or that it probably contains some substance which renders its presence in the nest injurious to the insects; on these suppositions the external structure is merely a mode of disposing of excrement rejected for hygienic reasons. But these suggestions ignore the fact that the true nest, *i.e.*, the comb within the hollow stem, is also built of excrement which differs only in consistency from that which is, on this theory, rejected.

Another fact which prevents the adoption of the theory that the external mass is merely a method of getting rid of surplus material was furnished by the nest just referred to. During the re-construction of the external mass in December, 1911, the insects employed not only pellets of excrement, but minute fragments of wood, which were glued to the structure by a secretion from the mouth (see later for another similar instance). Under normal conditions this does not occur, and it would therefore appear that the wood was used in this case because the supply of normal material had fallen short. That the termites continued to build under such conditions is surely evidence against the surplus material theory, unless it can be assumed that they are impelled by some instinct to be always engaged in building.

This external structure is in many respects similar to the chimneys of the nests of the mound-building species. It forms a tubular entrance, or a series of entrances, to the nest, but it is not made use of by the workers and soldiers, which enter the nest by an opening near the base of the mass or in some other part of the tree. In the case of the nest shown on Pl. XIII. the insects usually emerge through an opening four feet further down the stem, and during the three years which this nest has been under observation, this opening has not exhibited any trace of an external black structure except during February, 1912. Similarly the soldiers and workers of the mound-building species leave the nest, when in search of food, by means of underground passages, not as would be expected *viâ* the main entrance, the chimney. The chimney of the mound-building species is built with the earth which is excavated by the insects when extending the subterranean nest. This earth is brought up to the top and deliberately glued on the top of the chimney ; in this way the chimney serves to get rid of material which is at the time not required. It might be suggested that the black mass is a means of getting rid of decayed wood which must presumably be removed by the black termites when they wish to enlarge their nest ; the walls of the cavity in which the comb is situated are often smoothed down and usually blackened, and they do not bear loose fragments of decayed wood as they would in their natural state. But an examination of the black pellets shows that the material which the termites have eaten has been derived from external sources, not from the wood of the tree. It is indeed probable that they do eat the decayed wood which must be present in the cavity when they first take possession of it, but that can only be available for a short time. I have not been able to detect the remains of wood in the excrement, either in the comb or the external structure.

Apparently, the chief use of the chimney of the mound-building species is to afford the winged insects a means of exit which can be easily controlled. When the time of "swarming" approaches, the workers build up the mouths of the chimneys until they become mere slits, just broad enough to allow the winged insects to creep out. These slits are guarded by the soldiers, who only permit a few of the males and females to re-enter after their nuptial flight is over. The workers then seal up the entrances completely with earth, and so prevent the return of the others. It is possible that the external structure of the black termite nest may serve a similar purpose, but until the flight has been observed this must be regarded as a suggestion only.

The Procession.

Perhaps the most striking feature in the economy of the black termite is the organized procession which regularly sets out in search of food. Such foraging expeditions are, no doubt, also undertaken by the subterranean species; but while the latter proceed underground and are not noticed, the procession of the black termite is entirely above ground. A black ribbon, about three quarters of an inch in width, numbering thousands of insects, extends from the nest to the feeding ground, often for a distance of about fifty yards. The individuals in the procession are all workers, usually about six abreast, but sometimes ten, while the soldiers stand at intervals, at right angles to the moving mass, ready to ward off the attacks of enemies.

At Peradeniya the procession sets out between 4 and 5 in the evening, and under normal conditions all the insects have returned to the nest by 9 o'clock the following morning. These times are no doubt subject to variation in different localities, and Dr. Bugnion in his first paper has recorded that at Ambalangoda, in the low-country of Ceylon, he has observed them set out in one case at 7 in the evening and in another between 2 and 3 in the morning, while the return was concluded between 10 and 11 in the morning. In his second paper, Dr. Bugnion has recorded an extensive series of observations on the time and duration of the processions made by the inhabitants of a nest kept in his laboratory at Ambalangoda. In general, the procession set out about 6 P.M., or between 4 and 5 on dull days, while the return was completed by about 9 A.M. the following morning. The later time of setting out, as compared with that at Peradeniya, is perhaps what would be expected to occur in the low-country, where the sun's heat is more intense.

The insects follow the same track for weeks, or even months, together. To enable them to do that, they mark their course with minute streaks of excrement, applied in the more liquid form as used in the construction of the comb, so that after a few journeys the track becomes a broad black streak down the stem of the tree and along the ground. This is evident on Pl. VII. running obliquely downwards towards the right hand lower corner, while on Pl. VI.A two tracks appear running down to the left. Plate IX.A is a photograph of a track, one-sixth natural size, along a whitewashed wall, and Pl. IX.B shows the same track, magnified one and a-half times, the individual streaks being visible. Where the track traverses a sandy path, the surface particles of sand are cemented together after a few weeks' travel, and can be lifted up in sheets two or three inches in length; while the way over rough patches of fine gravel is smoothed by the deposit of pellets of excrement similar to those of which the external hanging mass is built. Escherich is inclined to regard the black streak as in some respect different from excrement, as it differs in consistency and form from the pellets of the external hanging mass. But it has the same microscopic characters as the latter, and is identical with the excrement of which the inner comb is built; and, as stated above, the insects make use of either form to mark their path according to the character of the ground traversed.

There is generally a well-defined track down the tree trunk; and the insects leave the nest and travel along it in full column without any hesitation. If the track on the ground has been in use for some time, their progress along it is equally steady and uninterrupted. Bugnion observed that under such circumstances the workers travelled at the rate of about one mètre per minute. But when no old path exists to guide them, their progress is necessarily slower and less regular. The following instance will serve to illustrate this. The nest in question was situated in a tree at the edge of a road over which the termites intended to cross. They travelled down the stem by a well-defined track and reached the edge of the road in regular column, but began to wander aimlessly when they found that there was no track beyond. The soldiers then took the lead, spreading out over a gradually extending front, and carefully examining every dead leaf and twig in the way. The workers followed, but apparently as they pleased, and by the time the middle of the road was reached (seven feet) there were three main streams extending over a front of about three feet, with scattered workers, between and beyond them, wandering in all directions. These three streams reached the other side almost simultaneously, the remaining seven feet being traversed in fourteen and a half minutes. During this time side columns had wandered off up and down the road, and the whole host appeared to be in the most hopeless confusion ; but as soon as the other side had been reached, one of the outer of the three main streams was selected (for no apparent reason) as the permanent track, and the soldiers immediately proceeded to call in all the workers from the other two streams, and the stragglers from a distance of six feet or more on either side. This they did by running in front of the wandering workers, and tapping their heads vigorously on the ground until the worker turned round and ran towards the main column. Twenty minutes elapsed before all had been collected and order restored.

On another occasion an attempt was made to ascertain the behaviour of the workers when the track was interrupted. The track, which ran over a sandy footpath, was swept away for a length of about two feet. But the soldiers immediately ran back from the outer half of the procession, and re-established it practically on the same line as before. In another instance, while a procession across a road was being watched, a carriage passed over it and crushed several of the workers ; the soldiers briefly examined the dead bodies of their charges, but the workers took no notice of the accident.

Although the majority of the workers are, at any given moment, proceeding in the same direction—outward in the evening, and homeward, laden with food, in the morning—yet it is always possible to find several individuals going the opposite way. Even before the column has reached the foot of the tree in which the nest is situated, some of the workers will be found returning homewards. On several occasions I have seen these contrary individuals turned back by the soldiers, and one gains the impression that the worker recognizes that it must keep to the track, but cannot recognize differences in direction ; if it happens, by some accident, to turn round, it proceeds along the track in the reverse direction until stopped by a soldier, even though it is continually running up against its fellow-workers who are proceeding in the right direction.

The chief enemy of the black termite is the large red ant, *Oecophylla smaragdina.* I have never seen birds attack the procession ; and hence, as birds eagerly devour the winged individuals at least of other species, it seems probable that the black termite is in some way unpalatable. The red ant may always be found hovering on the flanks of the column, ready to pick off an unprotected worker at the first opportunity. But they are mortally afraid of the soldier, and it is quite ludicrous to see the big red ant make a dash at the column, only to retreat as fast as possible when encountered by the much smaller black soldier. I have never witnessed an actual engagement between the two, and it does not seem probable that the soldier could inflict any serious injury by its bite. When the nest is broken open, and the comb handled, the soldiers do not bite, but the workers do ; and the bite of the latter is so weak that it is only felt when they attack the tenderest places, *e.g.*, between the fingers. Bugnion has shown that the horn of the soldier is hollow and communicates with a gland in the head, and he suggests that the secretion of this gland affords the means of defence. It is, however, not possible to detect any ejection of liquid from the head, though that is a common phenomenon in the case of the soldiers of many other species. Whatever the means of defence may be, it is extremely efficient ; and, as far as observations go, very few of the workers fall victims to *Oecophylla.*

In order to avoid the attacks of the red ant, the black termite, on its foraging expeditions, keeps in the open as far as possible, or travels along branches at some height from the ground. Though the procession would be out of sight if among grass, it does not travel over grassy places by preference, and if compelled to traverse them, it selects the most sparsely covered patches and takes advantage of every bare spot, since every blade of grass affords a point of vantage for the red ant. Hence the procession usually follows the roads and footpaths, generally keeping close to one side, a few inches from the grassy margin. The route may be changed from time to time even though the objective is the same ; and it seems impossible to doubt that such changes are made for the sake of greater security, as the following example would appear to indicate. This particular nest was situated at the top of a palm (*Livistona*) about thirty feet high, in the dense shrubbery which borders the Central Drive in the Peradeniya Gardens. The termites travelled down the stem, along the bare ground to the edge of the shrubbery, and then along the side of the road for a distance of about twenty yards ; there they turned at right angles into the shrubbery and ascended a tree, about three yards from the road, which for the time constituted their collecting ground. Five days after it was found that though they were still collecting from the same tree, they had abandoned their former track, and were proceeding from the palm stem along a *Hibiscus* branch which happened to be in contact with it at a height of about twelve feet, and thence along the interlacing branches of the shrubbery to the tree without ever coming down to the ground.

Another track, which encircled the library at Peradeniya, is worthy of mention. The library is a two-storied building, facing a hill at its eastern end, and access to the upper story is gained by a bridge from the hill. On the hillside, near the bridge, is a tree which contains a black termite nest. On one series of foraging expeditions the termites travelled across the bridge, and then round the library *viâ* its northern and western sides on a ledge at the level of the upper floor. When they came to the south-west corner they ascended to the roof, and so arrived at a tree, situated near the south-west corner, whose branches happened to touch the roof. In that way they reached their feeding ground without coming down to the ground.

It is of course possible to cite instances in which, contrary to that described above, the selection of the path shows a lack of aim. In one case the procession, on leaving the tree on which they had been gathering food, passed for a short distance along the ground in the direction directly opposite to that in which the nest was situated, then climbed an *Acalypha* to a height of nine feet, then along an arching branch and down a *Codiaeum* to within two feet of the ground, and thence down a *Maranta* leaf; by this round they had advanced three feet in the direction of the nest. Yet even this will not appear so aimless if it is remembered that the track was originally made in the reverse direction, and that the climb over the *Acalypha* represented an attempt to reach the feeding ground which overshot the mark.

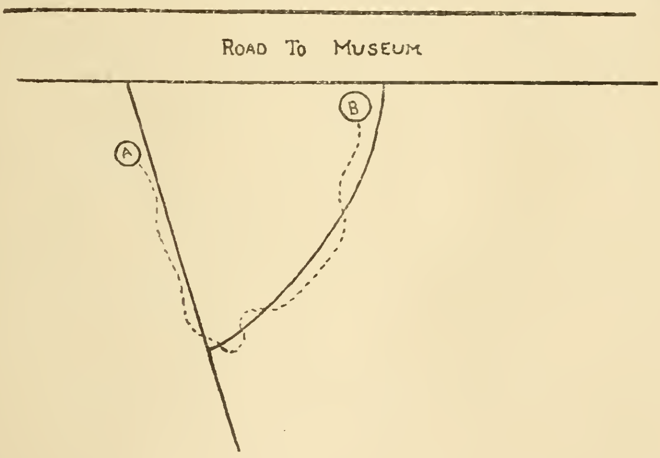


Fig. 1.

Another example of unnecessary travel is given in the accompanying diagram. The nest was situated in the tree A, the collecting ground being tree B. Both trees stand in short grass near the edge of a road, the distance between them being 17 yards. The termites left A in a straight line for B, but meeting a shallow (dry) drainage channel, they travelled along it for a distance of 18 yards, until they met another similar channel which led, in 24 yards, to the neighbourhood of B. Thus they travelled 42 yards, when 17 would have sufficed. probably influenced in their choice by the fact that the sides of the channel were almost destitute of grass. They crossed the channels five times, making use of twigs as bridges on each occasion ; as the channels were quite dry, this mode of crossing them is no doubt explicable by their habit of travelling off the ground wherever possible.

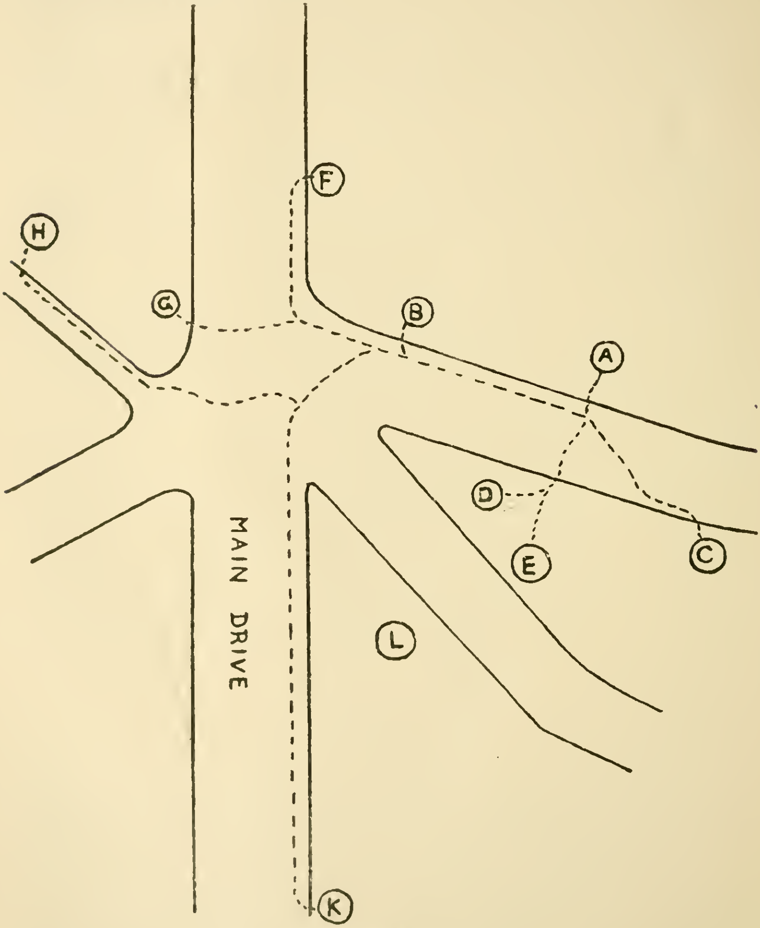


Fig. 2.

The above diagram shows the directions and extent of the excursions made by the inhabitants of a single nest during a period of about two years. It represents an area near the centre of the Royal Botanic Gardens, Peradeniya, where several roads meet. The main drive is bordered on either side by a shrubbery, and the part containing G and H, the fernery, is closely planted with large trees, while trees A to E are situated on open lawns, A being a large *Ficus* in which the nest was situated. The dotted lines indicate the paths taken by the termites. The shrubberies contain many large trees, in fact they are dense belts of trees with an undergrowth of shrubs, and other large trees are scattered over the lawns, but only those marked B to K were visited. The longest excursion was to K, a distance of about fifty yards.

For weeks together the termites gathered food from the higher branches of A, and probably only went further afield when that source of supply was temporarily exhausted. B was first visited, and then F and G, these latter being probably found by extending the foraging party from B. It seems to be a general rule that new feeding grounds are found by extending the old track rather than by striking out in a new direction. F and G were rather poor sources of food, but they were visited before C, on which food was abundant. But the discovery of sources of food appears to be purely a matter of chance ; there is no reason to believe that all the trees down to K were tried and found wanting, and indeed many of them were equally as good as K. Moreover, tree L, a large tree covered with suitable food, was never found by the termites, though nearer than H, G, or K.

The following record will give some idea of the frequency of these excursions, though it is incomplete, since it takes no account, for the first six months, of excursions into the higher branches of tree A in which the nest was situated. From June 6 to June 9, 1909, excursions were made daily to B. On June 16, two columns were out, one to B and the other to C ; but on June 18 and 20 they were collecting food from B only. After that they did not leave their tree until July, visiting F on the 2nd, G on the 5th, and C on the 13th and 14th. A long interval now ensued, and they were not seen away from the nest again until November 1, when they were collecting food from both F and C. On November 4 and 6 they visited G and H, and again on the 12th. They were not seen again until December 18, when they began to re-visit D, E, and C daily until January 3, 1910. From that date the record is complete. On January 4 and 5 they remained in the nest, but they were out again on the 6th and 9th visiting C and G. They were not out on the 10th, but from January 11 to February 3 they gathered food from the upper branches of their own tree daily. From February 4 to 7 they visited K, but that route was soon abandoned. On February 8 to 10 they visited B, and again on the 12th, the 11th being blank. From February 13 to 24 there was no procession, either on their own tree or abroad, but on February 25 to 28 C was visited daily. March 1 was a day of rest, but they were collecting from D on the 2nd. After that they were out only on March 15 and March 20 to 27, on the upper branches of their own tree, and then rested until April 12 to 15, when they resumed their visits to C and D.

From the records of the last three months it would appear that the procession is not a regular daily event. There were intervals of a fortnight, during which the termites were not seen to leave their nest. It might however be supposed that during those periods excursions of shorter duration were made at later hours, though that would appear to be contrary to their usual custom. The earlier records are incomplete, because they only take into account excursions to other trees; for more than three months no such excursion took place, but no doubt the termites found plenty of food on their own tree during that period. To some extent these excursions depend upon external conditions. Apparently the termites do not like wind, and they cannot travel during rain. If rain falls while the procession is in progress, the insects immediately take refuge on any vertical surface, *e.g.*, tree trunks, the tiled edging of the path, the sides of silt pits, &c., and they remain there, crowded together, until it has ceased. In that way the return to the nest may be delayed several hours. Those which are caught in the open by the rain are quite helpless, their legs being so weak that they are unable to move when wetted. In general, the processions appear to be most frequent after periods of wet weather. But that the insects do not merely respond to favourable external conditions is evident from the fact that, of nine nests under observation at Peradeniya, one never found processions from more than five at any given time.

Food.

Lichens form the staple food of *Termes monoceros.* Apparently they prefer algæ, but the supply of the latter is small in comparison with the extensive growths of lichen in the Tropics. Their procession usually terminates at a tree, or a group of shrubs, covered with lichens. Obviously it would appear that, in the Tropics, where every tree is more or less clothed with lichens, it would not much matter which tree the termites selected as their feeding ground ; but in reality the problem is not quite so simple as it seems. True the termites do not confine themselves to any particular species of lichen ; but on the other hand they only consume lichens of a particular type, or in a particular stage of development. Lichens which are furnished with a tough smooth cortex are avoided, only those of a looser texture, in which the surface appears powdery. being attacked ; this excludes the foliaceous lichens. and confines them to a few crustaceous species.

Only on one occasion have these termites been observed feeding on fungi alone. In September, 1912, the inhabitants of one nest were found congregated upon the window frames of the museum at Peradeniya, and an examination of their balls of food proved that they were collecting the fungi which blacken exposed wood in the tropics. These are apparently forms of *Cladosporium*, but as a rule they consist only of creeping hyphæ, either superficial or in the surface layer of the wood. In the present instance no erect conidiophores were observable, the only sign of the presence of the fungus being the superficial blackening. The termites scraped off the outer layers, leaving the window sashes covered with light-coloured patches owing to the exposure of the fungus-free wood below ; and the examination of the food which was being carried home showed that they had removed the thin layer of wood which contained the mycelium of the fungus. The balls of food consisted of small fragments of wood permeated by the hyphæ of the fungus. The fragments were only one cell thick, so thin that the balls appeared almost white. In this case it was impossible to obtain the fungus without taking the wood which contained it. Obviously the excrement of this nest would contain traces of wood cells, but in the light of numerous contrary observations this must be regarded as exceptional.

As an exception to the general rule, I have seen gelatinous lichens eaten by the inhabitants of one particular nest ; but in the majority of cases the insects have attacked crustaceous species of the type referred to. The green algæ which clothe damp flower pots are consumed by them, and they appear to be especially fond of the orange filamentous algæ (*Chroolepis* spp.), which are fairly common on tree trunks in the Tropics. But they do not relish fungi alone : *Meliola*, for example, they will scarcely touch, even when no other food is available (see later) ; and this leads one to suppose that it is the algal rather than the fungal element of the lichen which attracts them.

When they have reached their feeding ground, the insects congregate upon the suitable lichens, and make no attempt to gather the other species. With their mandibles, small fragments of the lichen are scraped off and gathered into balls about 1·5 mm. diameter. The largest I have seen measured 2·25 × 1·5 mm. The worker then marches off to the nest, holding the ball in its mandibles. As far as I have been able to ascertain, the workers load up the one which acts as carrier, adding particles until the ball is the proper size. When thousands of them are scraping away the lichen at the same time, a rasping sound can be heard distinctly. Fragments of bark, or epidermis, are sometimes scraped off with the lichen, and may be detected in the material of the comb ; but as a rule the insects succeed in removing the lichen without any trace of the host plant.

The termites have not yet been watched all night, and therefore there is some doubt as to the actual conduct of the procession. From what I have seen it would appear that there is a continuous movement to and from the nest during the whole time. Dr. Bugnion's account conveys the impression that in the instances observed by him there was an interval of several hours between the outward and homeward processions, and during that time no termites were seen on the track, *i.e.*, that the outward and homeward processions are independent movements undertaken by all the insects at the same time. But in the early morning a stream of workers may be seen travelling out to the feeding ground and a parallel stream on the same track conveying food to the nest. In one case a procession was observed setting out between 4 and 5 in the evening. By 5.30 the leaders had reached their objective, and their followers formed a continuous stream, six abreast, from the nest to the feeding ground, a distance of about thirty yards; at 8.45 P.M. there was still a continuous procession over the whole distance; but while five files were proceeding outwards to the feeding ground, the remaining line consisted of individuals, laden with food, returning to the nest.

It must be pointed out that in the case of a captive nest the movements of the insects are probably not identical with those which occur under normal conditions: this was certainly the case with a nest in captivity at Peradeniya, the inhabitants of which wandered out over the laboratory wall at all hours of the day.

Apparently the workers when collecting food eat what they require, and then carry a further supply home. At first, almost all the returning workers are laden with grayish, green, or red balls, but the last comers usually bear no burden; this lends support to the view that the loads are placed in position by other workers. In some instances, thousands of them return without any food, though it is abundant on the tree they have visited. What becomes of the food conveyed into the nest is not quite clear, but from observations on these termites in captivity it would seem that the worker carries the ball of food about, and the other inhabitants of the nest—those engaged in building the comb or tending the larvæ—which have probably not taken part in the procession, nibble pieces off it. The balls of lichen or alga are not used as material for the construction of "fungus gardens." The "fungus garden" of the mound-building termites is the comb itself, but in the present case the comb does not bear any traces of fungi. Nor has there been found any store of food in the nests examined, though in one case it was known that the termites had been collecting food for several weeks, up to within forty-eight hours of the time the nest was opened.

One apparent exception to the foregoing occurred in the case of a nest (already referred to) which occupied the upper twenty feet of a hollow, thirty feet long, in an almost vertical stem. The bottom of the cavity, about ten feet below the comb, was filled by a compact cylinder, 50 cm. long and 7 cm. diameter, composed entirely of balls of lichen bound together by white mycelium. Some of the strands of mycelium were up to 2 mm. in diameter and bore white tomentose sclerotia up to 12 mm. long and 8 mm. diameter. All these strands were encrusted with irregular crystals of calcium oxalate. When kept under suitable conditions, these developed a white *Poria*, which may be a *poria* form of the common *Polystictus Persoonii*. But it is most probable that this mass represented an accumulation of lichen balls which had been accidentally dropped from the nest above, rather than an intentional store of food.

A few black fungus spores and fragments of black hyphae may sometimes be found in the material of the comb, but these under certain conditions may be collected and eaten unintentionally. In one instance the termites were observed collecting lichen from the stems of bushes which were covered with "sooty mould," and under such circumstances they could scarcely fail to collect some of the latter. I have never found traces of wood in the excrement; but fragments of epidermis of various plants, doubtless scraped off with the lichen, sometimes occur in it. Frequently the excrement contains large numbers of cubic and acicular crystals.

A Captive Nest.

On January 24, 1910, a hollow stem, which contained a black termites' nest, was cut down and conveyed to the neighbourhood of the laboratory at Peradeniya. There it was cut open longitudinally, and the nest examined, the comb being broken up and the queen removed. This procedure necessarily evicted all the workers and soldiers, and, as the nest was a large one, myriads of them were left homeless. For several days these wandered round the laboratory, taking shelter under the eaves, under tables on the verandah, the door-steps, logs of wood, &c.; they had split up into separate bands, each consisting of thousands of workers and soldiers, a few of which were carrying larvae. The worker carries the larva in its mandibles, but the soldier carries it at the back of its head, fixed transversely, between the head and the abdomen. If the soldier is picked up with forceps and held in such a position that its head is bent forward and the larva consequently does not touch the abdomen, the larva does not fall off, but remains attached to the back of the soldier's head and requires considerable shaking to dislodge it. It is clear from that that the larva adheres to the head of the soldier. Escherich regards that as accidental; he considers that the soldier when alarmed exudes a defensive fluid which makes its head sticky, and in running about the nest it comes in contact with the larva accidentally. If that were the case one would expect the soldier to make some effort to dislodge its burden, instead of carrying it about for several days.

On January 30 one of these wandering bands took possession of a flower pot on the verandah, in which was planted the stump of a teabush, covered with a bell-glass. Some of the larvæ with them were almost as big as the workers. They remained there for two days, and gathered the green algæ which were growing on the sides of that and other similar pots, but made no attempt to build a nest. On February 14 they returned to this plant pot, and began to build a comb round the stump, but they abandoned it again in the afternoon and resumed their wanderings round the laboratory. On February 19 they again returned, and remained two days, but on the 21st they had disappeared. On March 15 they finally settled down under the bell-glass and began to build vigorously, obtaining food chiefly from the colonies of algæ on the plant pots and on the walls of the laboratory. The comb was gradually built up round the stump until it reached the top of the bell-glass, and extended laterally until, in places, it was united to the sides. But the available space was apparently greater than they required, and they did not carry the comb to the sides of the bell-glass everywhere. This comb is figured on Pl. XIV., about one half natural size. It will be seen that it differs from the comb figured on Pl. VIII., the walls being much rougher than in the latter. That is due to the fact that in this case the wall is built of particles of sand and earth, as well as the excrement of the insects, doubtless because the supply of food was scanty.

The construction of this comb brings out an extremely interesting point. Under normal conditions neither the comb nor the external hanging mass of *Eutermes monoceros* ever contain any particles of earth or sand; they are built entirely of excrement which is deposited *in situ*. On the other hand, the mound-building species construct their combs of excrement, but the mound is built of particles of earth which are brought up by the termites, placed in position on the old earthwork, and cemented there by a sticky secretion from the mouth; in that case, therefore, the comb and the mound are built of different materials and in different ways.

But Froggatt, and Dudley and Beaumont, have described how certain species repair their mounds with material extruded *ab ano*: in such cases the method adopted for the construction of the mound is identical with that which *Termes redemanni*, *T. obscuriceps*, &c., employ in the construction of the comb. The present case throws fresh light on these diverse habits. In this instance, both kinds of material were employed for the same work. The particles of sand were brought up by the workers and placed on the edge of a plate, where they were cemented by a secretion from the mouth exactly as the particles of earth are cemented to the apex of a chimney by the mound-building species; and, side by side with that, excrement was extruded in a semi-fluid form by other workers, after the usual manner of *Eutermes monoceros*. Thus it is possible to have both kinds of material and both methods of construction in the same work. The case is the more remarkable, in that *Eutermes monoceros* does not, normally, make use of earth and sand, though it may, in case of necessity, similarly employ particles of wood (see p. 402).

These termites made nightly excursions round the laboratory in search of food. To pass from the plant pot to the wall they constructed a short bridge of pellets of excrement. In order to prevent if possible the abandonment of this "captive" nest attempts were made to provide food for them, but this proved by no means an easy task. They would not eat the foliaceous lichens, which could be collected in abundance, and it was not possible to supply them with suitable species in any quantity without injuring the trees on which they grew.

Sooty moulds—*Meliola*, *Capnodium*, &c.—were tried, but though these were eaten to a slight extent, the termites preferred to wander away in search of other food rather than consume the " sooty mould " placed on the table near the nest. Ultimately it was found that they were especially fond of a yellow-brown alga (*Chroolepis* sp.) which clothes the trunks of trees ; and as that occurred on several trees whose bark was broken into readily detachable scales it was possible to collect a sufficient supply. Scales of bark bearing the alga were laid on the table near the nest, and sometimes in the daytime, but generally during the night, the insects removed every particle of alga from the bark. It was observed that the workers carried balls of alga into the nest up to those who were employed in the construction of the comb, and the latter, as also the soldiers, nibbled pieces off.

Next to the pot on which the nest was built there stood another similar pot, also covered with a bell-glass. When the termites wandered from the nest in search of food, it usually happened that many of them made a mistake when returning and ascended the wrong pot. As the flange of the bell-glass in the second fitted close over the rim of the pot, they were unable to get inside, and for hours together they ran round and round the bell-glass on the horizontal flange. In course of time the flange became covered with black streaks, like the usual track, and it was always possible to observe the formation of the track by wiping off the streaks with a damp cloth for a length of about an inch. When a worker came to the clear space, it halted for an instant, and then began to mark the track again, by ejecting semi-liquid excrement and moving about at the same time so that it lay in short streaks.

On one occasion a number of termites were observed engaged in this endless round at 10 A.M. ; from time to time individuals wandered off down the pot, and so home, but some of them were still running round at 5 P.M. In order to facilitate their return a bridge of bark, about four inches long, was placed across from one pot to the other, but though some of the soldiers examined it and one of them went halfway across it, none of them made use of it as a way home. This was in striking contrast to the readiness with which they would find food ; if the food was placed on another table two to three feet away, it was certain to be found during the night, the termites travelling down the legs of the one table and up those of the other.

During my absence from Peradeniya from April 25 for a month, the insects abandoned the nest, perhaps because they were not supplied with sufficient food or because the nest was allowed to become too dry.

Explanation of Plates.

*Plate VI.*A.—External structure hanging from a tuft of ferns on a *Ficus* stem: two tracks running down to the left. About one-twelfth natural size.

*Plate VI.*B.—External structure in course of reconstruction. The nest is situated between the two stems. About one-twelfth natural size.

Plate VII.—External structure in a hollow in a tree trunk, with track running down to the right. About one-twelfth natural size.

Plate VIII.—Comb of *Eutermes monoceros* in a hollow stem ; natural position vertical. About one-fourth natural size.

*Plate IX.*A.—Track of *Eutermes monoceros* on a whitewashed wall. One-sixth natural size.

*Plate IX.*B.—The same track. One and a half times natural size.

Plate X.—Foundations of the external structure. About one-eighth natural size.

Plate XI.—A further stage of the same structure.

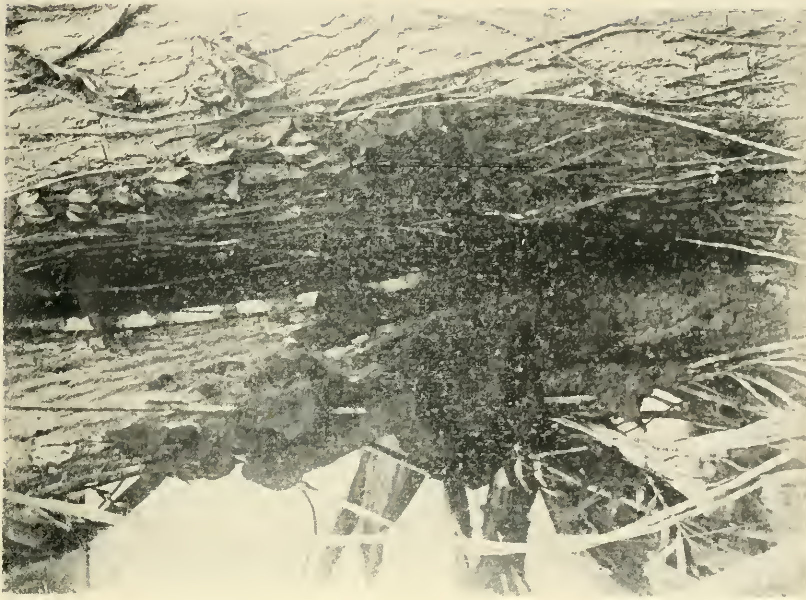
Plate XII.—The same structure almost completed.

Plate XIII.—The same; two projections lengthened. The third fallen off.

Plate XIV.—Comb built under a bell-glass round the stump of a tea bush. About one-half natural size.

A

B



EXTERNAL STRUCTURE OF EUTERMES MONOCEROS.

EXTERNAL STRUCTURE OF EUTERMES MONOCEROS.

COMB OF EUTERMES MONOCEROS × $\frac{1}{4}$.

EXTERNAL STRUCTURE: FIRST STAGE.

EXTERNAL STRUCTURE: SECOND STAGE.

EXTERNAL STRUCTURE: THIRD STAGE.

EXTERNAL STRUCTURE: FOURTH STAGE.

COMB OF EUTERMES MONOCEROS.

Notes on the Brazil Nut Tree in Ceylon.

BY

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IN November, 1880, three plants of the Brazil nut tree were received at Peradeniya from the Royal Botanic Gardens, Kew, under the name *Bertholletia excelsa*. One of these was planted out in the Botanic Gardens, Peradeniya (elevation about 1,500 ft.), and the other two in the Botanic Garden at Henaratgoda, in the low-country, where it was expected they would be more likely to flourish.

In 1887 Dr. Trimen recorded that they had not grown very fast, the largest tree at Henaratgoda being then 20 ft. 6 in. in height, with a girth of 11 in. at 3 ft. from the ground. The solitary tree at Peradeniya was much smaller, but had twice been eaten down by cattle. In 1895 there was apparently only one tree surviving at Henaratgoda. The growth of this Henaratgoda tree was carefully recorded during Dr. Trimen's directorship, and the following figures are available :—

December.	Height.		Girth at 1 ft.		December.	Height.		Girth at 1 ft.	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
1884	6	10	—		1890	35	0	2	0
1885	9	6	0	6	1891	46	0	2	4¼
1886	15	3	0	8	1892	—		—	
1887	20	6	0	11	1893	60	0	3	0½
1888	24	6	1	2½	1894	63	0	3	2
1889	33	6	1	7	1895	64	0	3	4

The Henaratgoda tree flowered in March, 1894, and in June, 1895, but did not produce any fruit. There are unfortunately no subsequent records for Henaratgoda, but the tree is known to have blossomed on several occasions since then. It is said to have fruited several times, but the number of fruits has been very small, and none have been produced during the last three years. No fruits are now available. The tree flowered in September, 1913.

The Peradeniya tree bore fruit for the first time in 1900. In 1902 a single fruit was recorded, which had not ripened by the end of the year. In 1906 it produced four fruits. In 1908 it bore "a good crop," but all the seeds sown failed to germinate. In 1909 it was said to have borne a larger number of fruits than in any previous year, and plants were raised from the seeds. In 1912 about forty fruits were produced. This tree flowers in May–July, and the fruits remain on the tree at least through the next flowering season. A fruit of the season May–July, 1912, fell in September, 1913. As a rule, however, the fruits are gathered when they are about a year old.

The Henaratgoda tree is now (August, 1913) about 65 ft. high, and measures 6 ft. 11 in. in girth at a height of 3 ft. from the ground. It is only sparingly branched, and practically all the branches are on the upper half of the stem, *i.e.*, above 30 ft. from the ground. Below that there are only three branches. These three lower branches are drooping, but the remainder are directed upwards. This arrangement of the branches gives the tree quite a different appearance from that of the Peradeniya specimen, but it is probably accounted for by the fact that the former is surrounded by tall trees, and the lower branches may have been suppressed in consequence.

The Peradeniya tree stands in practically an open situation. It is about 45 ft. in height, and measures 6 ft. 6 in. in circumference at 3 ft. from the ground. It bears a large number of branches, the lowest of which spring from the stem at a height of about 3 ft. 6 in. from the ground. All the branches on the lower half of the stem droop, and the lowest of them almost touch the ground at their extremities. In consequence the tree is so clothed with foliage that the trunk is hidden.

The Brazil nut of commerce is usually said to be the produce of *Bertholletia excelsa.* The genus *Bertholletia* was established in 1808 by Humboldt and Bonpland for the single species *B. excelsa*, and it was stated by the latter author that the Brazil nut was the seed of that species. Miers, however, in his paper on the *Lecythidaceæ*, published in 1874, held that there were two species of *Bertholletia*, and that the Brazil nut was obtained, not from *B. excelsa*, but from the other species, which he named *B. nobilis.* The question has recently been discussed by Young, who, from an examination of the fruits (pyxidia) imported into the United States in the ordinary course of trade, and of the opercula which are commonly found in samples of Brazil nuts, concludes that Miers' view is the correct one.

As the seeds of the supposed two species are, so far as is known, indistinguishable, there is the possibility that the Brazil nuts of commerce contain the seeds of both, though that is to some extent negatived by the evidence of the imported pyxidia, all of which, examined by Young, were of the *B. nobilis* type. But the question is not completely decided thereby; and, under the circumstances, it has been thought that the following notes on the trees in Ceylon, which were sent as *Bertholletia excelsa*, and produce what are apparently undoubted "Brazil nuts," might be of interest.

The principal points of difference between *B. excelsa* and *B. nobilis* have been summarized by Young from Miers' descriptions as follows:—

B. excelsa Humb. and Bonp.	*B. nobilis* Miers.
Tree 100 ft. or more high, with trunk 2·5 to 3 ft. in diameter.	Tree somewhat taller than *B. excelsa*, with trunk 14 ft. in diameter.
Leaves green, petioles 9–18 lines long.	Leaves rufescent, petioles 3–6 lines long.
Floral panicle 8 in. long, with single branch nearly equal in length and nodes $\frac{1}{6}$ in. apart.	Floral panicle 10 in. long, with about five short branches and nodes 0·25 to 0·5 in. apart.
Fruit slightly elongated, 6 in. in length.	Fruit approximately spherical, usually under 5 in. in diameter.
Cortex of fruit smooth, palish, entire, persistent.	Cortex of fruit comparatively thick and rough, darker, cracking as the fruit dries, and tending to loosen and drop off as the fruit is handled.
Opercular opening with straight or concave walls, narrowing slightly at its inner edge.	Opercular opening with sharp edge and concave walls, and widening considerably inward.
Operculum cylindrical, with roundish indented apex.	Operculum oval or radially compressed, conical and pointed at the apex.
Operculum breaks away and falls from the fruit as the columella shrivels.	Operculum remains attached to remnant of columella, and as the latter shrivels, falls into the cavity of the fruit.

As regards the first of these points, our trees do not yet afford any evidence. The ratio of height to diameter in *excelsa*, according to Miers, is from 40 : 1 to 33·3 : 1, and in *nobilis* about 8·6 : 1. The Ceylon trees exhibit ratios of 35·5 : 1

and 21·6 : 1, and therefore approach *B. excelsa* in stature, but they are perhaps too young to admit of any comparison. Miers states that *nobilis* differs from *excelsa* in its immense trunk, bare to a great height; on this point, it may be said that though our trees do not yet show an enormously thick trunk, one of them is almost bare to a height of 30 ft., while the other is clothed down to the ground, and it seems probable that this is due to a difference in situation rather than to the difference in size between the trees.

The leaves of the Ceylon trees attain a length of 20 in. and a breadth of $5\frac{1}{2}$ in. When young they are chestnut, but soon become dark green. The margin varies, being sometimes regular, sometimes obscurely toothed; the latter feature is scarcely noticeable on the fresh leaves, but becomes more prominent on dried specimens. The outer portion of the leaf is strongly undulating. The larger leaves have up to thirty pairs of main nerves, from 8–13 mm. apart, with shorter intermediate ones. The petioles are from 14–28 mm. long, but this measurement, on the fresh specimens, is not an exact one, as the leaf tissue extends as a wing on either side of the petiole. This last feature is especially marked on the smaller leaves, the petioles of some bearing wings 2–3 mm. broad, almost down to the base. On the character of the leaves, it will be seen that the Ceylon trees are referable to *B. excelsa*, as they are green and have relatively long petioles.

Miers states that the panicle of *excelsa* is 8 in. long, with a single branch nearly equal in length, with a rachis 2 lines thick when dried, its zigzag turns (with prominent nodes) 2 lines apart, the oval bracts very small; while *nobilis* has a broader panicle about 10 in. long, with about five horizontal branches 3–5 in. long, and nodes $\frac{1}{4}$ in. to $\frac{1}{2}$ in. apart. On the Ceylon trees the panicle is about a foot in length, with up to six branches. These branches, however, are not horizontal, but curve upwards until they become almost parallel to the main axis, and the whole inflorescence takes the shape of a candelabrum. Moreover, the degree of branching varies with the position of the inflorescence, and while those at the top of the tree may have six lateral branches, and the lowest three of those may bear two or three secondary branches, the inflorescences lower down may have only a single branch nearly equal to the main axis. On this character, therefore, panicles from the lower branches would be assigned to *excelsa*, and those from the upper branches to *nobilis*. It must, however, be stated that the majority of the inflorescences are at the top of the tree, and are therefore of the *nobilis* type, though their branches are not horizontal.

There is a difference between the panicles of the Peradeniya tree and those from Henaratgoda. In the former the branches arise from the main axis at distances of about an inch apart, while in the latter they are crowded together, less than half an inch apart, at the base of the inflorescence. The branches are also longer in the latter, quite independently of their lower points of attachment. The flowers are also closer together on the Henaratgoda specimens; for example, the main axis of a typical inflorescence from Henaratgoda bore eighty-seven flowers on a length of 27 cm., while a corresponding main axis from a well-developed inflorescence from the Peradeniya tree bore only thirty-six flowers on a length of 18 cm.

Miers' reference to a zigzag rachis is somewhat misleading, but it evidently refers to the profile of the dried rachis, not to its general direction. The rachis of a fresh specimen is straight where it is floriferous, and only very slightly zigzag between the branches, and it retains the same shape when dried. It is angular in section, with ridges which gradually increase in elevation up to the point of attachment of the flower. These ridges are more prominent on the Peradeniya than on the Henaratgoda specimens.

On the inflorescences of the Peradeniya tree the successive flowers may be up to 1 cm. apart, but are often opposite. On the Henaratgoda tree the arrangement is the same, but the distance between successive flowers does not exceed 5 mm. On some branches of the Henaratgoda inflorescences, however, the flowers are arranged in pseudo-whorls of three, the points of attachment of the three flowers being almost, but not exactly, at the same level.

The flower of the Peradeniya tree is white to cream coloured. That of the Henaratgoda is more deeply coloured, being orange yellow at the apex of the androphorum, and having the inner face of the latter streaked with, or almost uniformly coloured, purplish-red.

There are three bracts to each flower. The largest one, beneath the flower, is triangular, and measures about 14 mm. in length and 6 mm. in breadth ; it falls off before the flower opens. The other two are strap-shaped, tapering towards the tip, about 9 mm. long and 4 mm. broad, and are situated laterally, closely overlapping the bud and overlying the line of separation of the two sepals ; they fall off when the flower opens.

On page 161 Miers states that the sepals of *Bertholletia* are notched at their apex by three small teeth. In his descriptions he writes that *excelsa* has the sepals tridentate, while in *nobilis* they are obsolutely crenulate, and he further states that *nobilis* differs from *excelsa* in its rounder and more entire calycine lobes ; but in his figures of *B. nobilis* (plate 33, fig. 3) he shows the calyx with three fairly strongly developed teeth, and describes it, in his explanation of plates, as the calyx which splits into two semiglobular segments, each tridentate at the apex. Examination of the fresh specimens shows that this feature is a variable and accidental one. The globular calyx splits into two hemispherical sepals, whose margin is usually quite entire, but sometimes obscurely three-toothed. The teeth, however, are formed by the splitting of the sepal as the flower opens, and this splitting is accentuated as the sepal dries. Even sepals which are entire when fresh may become obscurely tridentate on drying. I have not, however, found sepals so markedly dentate as in Miers' figure, though I have seen them split with a single fissure halfway down to the base. The degree of fission at the apex of the sepal would probably depend on the degree of expansion of the flower. The flowers of the Ceylon trees do not expand so widely as shown in Miers' figure; indeed, the petals, though recurved at the apex, are so closely applied to the androphorum that it would appear that only self-fertilization can occur. It would seem probable, however, from Miers' description, that his figure of the calyx is that of *B. excelsa*. There is no difference between the calyces from the two Ceylon trees.

Young bases his decision on the characters of the pyxidium, which might be expected to be more constant than those already referred to. According to Miers' descriptions, the pyxidium of *B. excelsa* is 6 in. long and 5 in. in diameter, with a smooth, palish, lenticellated bark, which does not crack and fall off; the calycary zone, $\frac{3}{4}$ in. below the apex, is 3 in. in diameter; the opercular zone, 8 lines (16 mm.) in diameter, is contracted within into a depressed concave mouth, 6 lines (12 mm.) in diameter; the operculum is cylindrical, 5 lines (10 mm.) broad, 5 lines (10 mm.) high, round and umbilicated at the summit, and *falls out when the columella withers.* The pyxidium of *B. nobilis* is globular, 4–4$\frac{1}{2}$ in. in diameter, with a much thicker, rougher, darker, and more cracking resilient bark, 3 lines (6 mm.) thick; the endocarp is 4 lines (8 mm.) thick, subosseous; the inconspicuous calycary zone is 9–12 lines (18–25 mm.) below the summit; the upper zone, 6 lines (12 mm.) in diameter, has a sharp edge, concave and widening inwards; the operculum, of the same diameter, rises little above the mouth, is pulvinately depressed, radially sulcated, shortly umbonate at the apex, and *remains within the pyxidium when the columella withers.*

Miers' figures show the pyxidium of *B. excelsa* more or less lemon-shaped, *i.e.*, elongated oval, with a prominent swelling, bounded by the well-defined calycary zone, at the apex. Its bark is 4 mm. thick, and the endocarp 18 mm. thick, but the specimen was evidently immature, and it is probable that the endocarp would have contracted on ripening. The pyxidium of *B. nobilis* is shown as globose, somewhat flattened at the poles, without any swelling at the apex. The operculum of *B. excelsa* projects as a subcylindrical column above the apex of the pyxidium, and the opercular orifice has almost vertical sides, or is slightly contracted inwards. On the other hand, the operculum of *B. nobilis* is situated within the opercular orifice, and is conical, with a small acute umbo which scarcely projects beyond the opening, while the walls of the opercular orifice are strongly oblique, so that it widens inwards to double its external diameter.

The photographs of *B. nobilis* given by Young exhibit the same type of pyxidium as that figured by Miers, both with regard to general shape and the shape of the opercular opening. His figures of the operculum show that this is variable, from ovoid to conical, but in all cases is provided with a distinct apical point.

The pyxidia of the tree at Peradeniya are broadly lemon-shaped, with a strongly developed apical swelling, which is bounded by a well-defined calycary zone. They measure about 5·5 in. in length (5·2–5·6) and 4·5 in. in diameter (4·4–4·9). Compared with Miers' figures, they resemble the pyxidia of *B. excelsa* in general outline, in the well-defined calycary zone, and in the prominent apical swelling. The calycary zone is defined by a broad well-marked groove, about 1 in. from the apex and 2¼ in. to 2¾ in. in diameter.

When a year old the pyxidia are brown, pale rather than dark, and retain a slight greenish tinge. The bark of the pyxidium is strongly lenticellate, but otherwise smooth, and it cracks and separates from the endocarp as the pyxidia dry. It does not fall off, but no doubt would do so if the pyxidia were roughly handled. The bark is 4–6 mm. thick, and the endocarp 9–15 mm. From the characters of the bark the pyxidia of the Ceylon tree must again be referred to *B. excelsa*, but it has the *nobilis* character of cracking and separating from the endocarp. It is to be noted, however, that Miers' specimen of the fruit of *B. excelsa* was obtained from an introduced tree in Trinidad, and was apparently immature; it may be suggested that in the case of ripe pyxidia the bark would be cracked in that species also.

We now come to the characters which appear to be mainly relied on by Young, viz., those of the operculum and the opercular opening. The summit of the prominent apical swelling on the Ceylon pyxidia is depressed slightly, and the opercular opening is situated at the base of the depression. The opercular opening is from 7–12 mm. in diameter, with a sharp edge, and widens inwards, but it does not widen with a uniform slope, as shown in Miers' and Young's figures of *B. nobilis*. As will be evident from the accompanying illustration, the wall curves suddenly, immediately below the opening, and then continues almost vertically. The operculum is ovoid, with a sharp apical point of varying length, and the upper surface is sometimes feebly sulcate. Only its apical point projects through the opercular opening, and owing to the inward expansion of the latter the operculum remains within

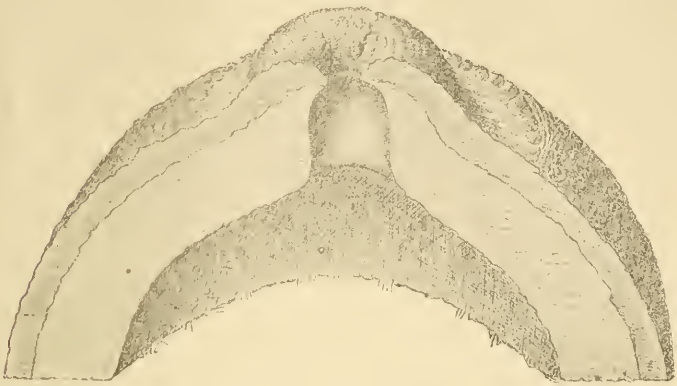

Fig 1.

the pyxidium when the columella shrivels. The accompanying figure shows the operculum with part of the columella attached.

Fig. 2.

From the fact that the operculum remains within the pyxidium, the Peradeniya tree should be referred to *B. nobilis*;

and the apical point of operculum indicates the same species. The operculum agrees with specimens found in commercial samples of Brazil nuts in Ceylon, and also with some of those photographed by Young, though none have yet been observed so markedly conical as that figured by Miers and the similar forms given by Young. Our specimens rather resemble the operculum of *excelsa* figured by Miers, but they possess the apical point of *nobilis*. The opercular opening, again, is of an intermediate character; it is contracted externally, and therefore does not permit the operculum to fall out, but otherwise it resembles Miers' figure of *excelsa* rather than Miers' or Young's figures of *nobilis*. But the pyxidium is that of *nobilis*, in having the operculum within the opercular opening, and not projecting as a cylindrical column. On the whole, the characters of the pyxidium are a combination of those of *B. excelsa* and *B. nobilis*, but if the fact that the operculum remains within the pyxidium is to be regarded as decisive, as it apparently is by Young, then the Peradeniya specimens must be referred to *B. nobilis*.

The characters of the Peradeniya tree may be conveniently summarized as follows :—

Pyxidium oval, with a strong apical swelling = *excelsa*.
Bark of pyxidium smooth, palish, lenticellate = *excelsa*.
Bark thick, cracking = *nobilis*.
Operculum does not project = *nobilis*.
Operculum with an acute apex *nobilis*.
Operculum remains within the pyxidium = *nobilis*.
Opercular opening narrowest at the exterior = *nobilis*.
Sides of opercular opening almost straight in the middle = *excelsa*.
Calyx lobes entire or obscurely tridentate = *nobilis*.
Panicle with one to six branches = either, chiefly *nobilis*.
Flowers, 0–1 cm. apart = either.
Petioles, 14–28 mm. = *excelsa*.
Leaves dark green = *excelsa*.

It will be evident that the Peradeniya tree in many respects combines the characters of the two species. The foliage is that of *excelsa*, and the shape of the pyxidium is that of *excelsa*, though the operculum and the opercular opening are those of *nobilis*.

On the whole, though conclusions based on a single tree can scarcely be regarded as valid, it would appear that this Peradeniya tree affords strong ground for the suggestion that there is, after all, only one species of *Bertholletia*. It will be seen from the figure that a very slight modification would convert its opercular opening into one which would allow the operculum to fall out, and it would seem probable that this feature is variable.

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DEPARTMENT OF AGRICULTURE, CEYLON.

ANNALS

OF THE

ROYAL BOTANIC GARDENS, PERADENIYA.

VOLUME V., PART VII., SEPTEMBER, 1914.

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Notes on the History of the Plantation Rubber Industry of the East.

BY

T. PETCH, B.Sc., B.A.

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THE history of the rubber industry of the East has so often furnished a theme that it might be thought that nothing remained to be told. In extenuation of the present compilation, the writer would urge that, in general, the existing accounts have dealt only with special incidents, and none of them can be said to have attempted a survey of the whole subject.

This account, naturally, deals chiefly with Ceylon, since except for what has already been published in the literature of other countries, only the records in the Ceylon archives are available. But practically no use has been made of the Ceylon records since Trimen incorporated some of them in the account which was subsequently included in the article on Para Rubber in the Kew Bulletin for 1898. Many of the facts will no doubt be new to the reader, but if they happen to conflict with accepted tradition, it is expected that he will judge their validity by consideration of the authorities quoted. The object of the present paper is rather to link into a connected record all the available evidence, up to the end of 1904, for the benefit of future writers.

It will be noted that frequent reference is made to the pages of the "Tropical Agriculturist." The writer wishes to acknowledge his indebtedness to the former editors of that Journal, who, for more than twenty years, vigorously advocated the planting of rubber in Ceylon, and endeavoured to arouse the interest of the Ceylon planter by publishing information about rubber from every possible source.

I.—The Introduction of American Rubber Trees.

After the successful introduction of Cinchona into India and the East, it occurred to Sir Clements R. Markham[1] that the same might be accomplished with rubber-producing plants. The consumption of rubber was steadily increasing, and owing to the destruction of the trees by native methods of tapping it was anticipated that the demand would soon exceed the supply. The chief rubber tree of India, *Ficus elastica*, was being destroyed wholesale by the collectors, and consequently the establishment of plantations under proper control was being strongly urged by the Forest Department of that country.[2] Under these circumstances, the Indian Government were persuaded of the advisability of taking steps to ensure the permanence of the industry, either by adopting the proposals of the Forest Department, or by introducing other rubber-yielding plants.

To Markham fell the preliminary steps of the enterprise. Before advising the initiation of any expensive operations, he

[1] Markham, "Peruvian Bark," p. 441 : "In 1870 I came to the conclusion that it was necessary to do for the indiarubber or caoutchouc producing trees what had already been done with such happy results for the cinchona trees."

[2] Mann, G., Progress Report of Forest Administration in Bengal, 1868–69.

commissioned[1] Mr. J. Collins to collect all the available information concerning rubber trees, in order the better to determine in what direction efforts should be made. Collins was not a plant collector, as has been stated, but was (or had been) Curator of the Museum of the Pharmaceutical Society. His selection was probably influenced by the fact that he had, a short time previously, published a Paper[2] on "India Rubber, its History, Commerce, and Supply." Collins compiled an exhaustive report[3] which was issued in 1872. There is no evidence that he visited South America. His report was based on information previously published, and on the specimens in the Kew herbarium, &c. A large volume of data was already in existence, more especially with regard to the rubber trees of the Amazon, which had been investigated by Spruce twenty years before. Spruce had collected specimens of most of the Heveas and of the rubber produced by them, and had recorded that *Hevea brasiliensis* yielded the rubber most abundantly exported; and details of Spruce's notes and specimens had been published by Bentham.[4] Collins's information with regard to Hevea was derived from Spruce.

Collins's Report includes a memorandum by Dr. Brandis, recommending the establishment of plantations of *Ficus elastica*, and approving of the suggestion to import Hevea. With regard to the latter, Brandis wrote: "The nearest approach to this (*i.e.*, the rainfall of Para) would be found in some parts of Ceylon, which, as regards temperature also, would appear to offer to the Brazilian Heveas a most congenial climate." He also recommended Malabar and Burma.

As a result of Collins's Report it was concluded[5] "that the establishment of plantations of *Ficus elastica* should be immediately undertaken in Assam; but that the caoutchouc from the Heveas and Castilloas of South America was superior to

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[1] Collins, Report, &c., p. vii.: "To C. R. Markham, Esq. Sir,—I have the honour to submit, as directed by you, for the information of Her Majesty's Secretary of State for India"; also p. iii.; and Markham, "Peruvian Bark," p. 445: "I intrusted the duty of making the necessary researches and investigations to Mr. J. Collins."

[2] Journal of the Society of Arts, December 17, 1869.

[3] Report on the Caoutchouc of Commerce, &c., 1872.

[4] Hooker's "London Journal of Botany," 1854

[5] Markham, "Peruvian Bark," p. 445.

that of the *Ficus*, and that consequently those trees should be introduced into British India."

The proposal to establish plantations of *Ficus elastica* appears to have met with some disapproval. Gustav Mann, who had advocated the systematic cultivation of this tree some years previously,[1] established plantations in Assam, notably at Charduar, with considerable success.[2] But elsewhere difficulties, real or apparent, were encountered, and the attempts resulted in failure.

It is not easy at the present day to understand why such difficulties were experienced with this species. Three general reasons were advanced, but none of them seem valid. It was stated that although *Ficus elastica* would grow with undiminished rapidity and luxuriance in stations remote from the hills, it failed to yield caoutchouc.[3] In the light of subsequent experience this statement must be regarded as inaccurate; it may possibly have been based on an examination of some other species of *Ficus*.

A second objection was that the tree could not be grown from seed, as the seeds were never fertile. This view was widely held in India, until King demonstrated that it was quite incorrect. He wrote[4]: "It may be as well here to allude to the fallacy that this tree cannot be grown from seed—an entire mistake; for if the seed be carefully collected and properly sown it germinates freely on soil." Plants have been raised in Ceylon from Assam seed,[5] and in Tonkin from seed from Java.[6] Details of the reproduction from seed will be found in the "Tropical Agriculturist," XVII., pp. 451–452.[7]

A more incomprehensible objection is that the tree cannot be grown from cuttings. Against this is the testimony of Mann[8] and of Brandis,[9] both of whom declared that cuttings rooted readily; and their statements are supported by Sir

[1] Progress Report of Forest Administration in Bengal, 1868–69.
[2] Ditto, 1884: reprinted (in part) in "Tropical Agriculturist," IV., pp. 94–96.
[3] Report of the Royal Gardens, Kew, 1875, p. 7.
[4] Report of the Royal Botanic Gardens, Calcutta, 1875–76.
[5] Thwaites, Report of the Royal Botanic Gardens, Ceylon, 1876.
[6] Vernet, G., Etude Generale sur le Ficus elastica.
[7] *Ex* "Indian Forester."
[8] Collins's Report, p. 53.
[9] Collins's Report, p. 54.

George King,[1] the chief authority on *Ficus*. In more recent times, Vernet, of Annam, has recorded [2] that reproduction by cuttings is easy, with proper precautions, and that he has obtained excellent results by that method, while other methods of vegetative reproduction have been equally successful in India, Java, Annam, and Tonkin. In temperate countries the propagation of *Ficus elastica* is an operation which is successfully performed by the humblest nurseryman, as is evidenced by the price at which it is possible to supply the innumerable plants which adorn the front windows of suburban residences.

Additional evidence of the possibility of establishing plantations of *Ficus elastica* is afforded by the experience of Java and Sumatra, where several thousands of acres have been placed under this product. Indeed, the oldest rubber plantation in the East is one of *Ficus elastica* in Java, which dates from 1864.[3] Particulars of this plantation have been published in several journals.[4] The plants were obtained from the neighbouring forests, by cuttings or by marcottage.

If further evidence be required, the experience of the Federated Malay States may be quoted. At the beginning of rubber planting in that country, many favoured *Ficus elastica* in preference to *Hevea brasiliensis*, and several estates undertook its cultivation. In the Annual Report of the Selangor Planters' Association for 1899,[5] it was stated that "up to last year it was difficult to get plants or cuttings, which found a ready sale at from fifteen to twenty-five cents each, but each plant put out for the last three years has been yielding thirty-fold, and there are now thousands of rooted plants available at from four to five cents each .... There should be about 500,000 plants available for next year." In the report for 1900,[6] 52,147 *Ficus* were said to have been planted, while in 1901 the area under *Ficus* was given as 700 acres.[7]

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1 Report of the Royal Botanic Gardens, Calcutta, 1873–74.
2 Vernet, Etude Generale sur le Ficus elastica.
3 Collet, O., Bull. No. 7 de la Societe d'Etudes Coloniales.
4 "Tropical Agriculturist," XX., p. 761; "Indian Forester," XXIV., p. 160.
5 "Tropical Agriculturist," XIX., p. 672.
6 *Op. cit.*, XX., p. 819.
7 *Op. cit.*, XXI., p. 739.

In Ceylon, experiments with *Ficus elastica* were unsuccessful. At the request of the Home Government Thwaites attempted its cultivation in 1874, but in 1875 he reported that the experiment had met with very little success : in 1876 seeds were obtained from Assam, and a few plants raised, but with the advent of other species of rubber trees the experiment appears to have been abandoned.[1] It is, however, to be noted that flourishing specimens of *Ficus elastica* were already in existence at Peradeniya, the famous row which till recently stood along the Gardens' front dating from 1833.[2]

On the whole, although one may feel thankful that *Ficus elastica* was considered a failure, the inference would seem to be justified that the lack of success in the seventies was not altogether due to difficulties of cultivation.

The First Introduction of Hevea.

After the publication of Collins's report, attempts were made by the India Office to import seeds of Hevea, and the Foreign Office was requested to take steps, through Her Majesty's Consul at Para, for obtaining a supply of seed.[3] But before the first consignment of seeds arrived, the India Office invoked the aid of the Royal Botanic Gardens, Kew, and it is to the enthusiastic support of the then Director, Sir Joseph Hooker, that the ultimate success of the enterprise is to be attributed.

The first seeds were obtained in June, 1873. On June 4 of that year [4] Markham forwarded to Kew 2,000 seeds, for which the India Office had paid £5.[3] They had been obtained through Collins from a Mr. Farris, who brought them from Cameta.[3] From these seeds about a dozen plants were raised, and in the same year Dr. King, then Superintendent of the Royal Botanic Gardens, Calcutta, took out six of these plants with him on his return to India.[5] From these plants others were raised by cuttings, and distributed to Sikkim.[6] But the climate of

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[1] Annual Reports, Royal Botanic Gardens, Ceylon, 1874, 1875, 1876.
[2] Willis, "Annals, Peradeniya," I., p. 6.
[3] Trimen, MSS.
[4] Thiselton-Dyer, Bull., F. M. S., II., p. 2.
[5] Report, Royal Botanic Gardens, Kew, 1873 ; Calcutta Report, 1873–74.
[6] Report, Royal Botanic Gardens, Calcutta, 1874–75.

Calcutta proved unsuitable for Hevea, and in the following year King expressed doubt that the plant would ever thrive there.[1] In 1876 he reported that it had failed in Calcutta and Sikkim.[2] There is no record that Calcutta distributed plants of this consignment to other countries.

A second consignment of seed, which was sent to India in 1875, was even more unsuccessful, not a plant being obtained. King refers to it as follows.[2] "It was with much regret therefore that I had to report to Government the utterly hopeless condition of a large consignment of Hevea seed sent out by the India Office during September last. This consignment was packed in large barrels, a singularly unfortunate arrangement for such oily and perishable seeds as Hevea."

Second Introduction of Hevea.

After the transmission of seed in the ordinary way had been found impracticable, Markham engaged Mr. Robert Cross, who had previously assisted him in importing Cinchona, to proceed to South America to obtain plants.[3] Cross, however, was sent first to Central America for seeds and plants of *Castilloa.*

Meanwhile Sir Joseph Hooker persisted in the attempt to secure Hevea, and commissioned Mr. H. A. Wickham, who was then resident at Santarem, on the Amazon, to collect seeds at the rate of £10 per thousand.[4] Wickham had been engaged in rubber tapping on the Orinoco in 1869–70, and, having travelled *viâ* the Orinoco to the Amazon, had published an account of his journey in 1872.[5] His book contained illustrations of the leaf and seed of *Hevea brasiliensis,* and thus demonstrated to Sir Joseph Hooker that here was a man available who was well acquainted with the tree he was desirous of obtaining. Wickham had previously (1873) contributed specimens of seeds and fruits from the Amazon to the Kew herbarium.[6]

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[1] Report, Royal Botanic Gardens, Calcutta, 1874–75.
[2] *Idem,* 1875–76.
[3] "Peruvian Bark," p. 458.
[4] Trimen, Sessional Papers (Ceylon), No. 13, 1881.
[5] "Rough Notes of a Journey through the Wilderness from Trinidad to Para," 1872.
[6] Kew Report, 1873.

Wickham collected his seeds, from trees which were being tapped, " in the forests covering the broad plateaux dividing the Tapajos from the Madeira rivers." [1] They were shipped immediately on board the ss. Amazonas,[2] which happened to be about to return to England at the time the seeds were ripe.[3] Wickham reached England in June, 1876, arriving at Kew on June 14.[4] The following day the seeds were sown, and 2,700 [5] subsequently germinated, some as early as the fourth day after sowing.[4]

As it had already been demonstrated that Hevea would not thrive in Calcutta or in any of the more readily accessible Botanic Gardens of India, Ceylon was chosen, in accordance with Dr. Brandis's suggestion four years previously, as the centre where the plants should be established and whence they might be transmitted to different parts of India. In the following August, 1919 plants were forwarded to Ceylon in 38 Wardian cases per the ss. Duke of Devonshire, in charge of a gardener, and about 90 per cent. arrived in good condition.[4]

In addition to the main consignment to Ceylon, two cases were sent to Singapore, and small parcels of plants were sent to Africa (West Coast), Burma, Dominica, Jamaica, Java, Queensland, and Trinidad.[4] " In the case of Singapore the result was unfortunate. Owing to the delay of the India Office in paying the freight, the cases did not come into the hands of the Superintendent of the Botanic Gardens to whom they should have been consigned until the plants were nearly all dead." [4] Ridley states that none of these plants survived [6] ; but that is evidently a mistake, since in the Kew Report for 1877, an extract from a letter from Murton (September 6, 1877) is quoted, to the effect that the Hevea sent last year (*i.e.*, 1876) were making good growth.

All the plants consigned direct to Burma died ; but later in the year Duthie took out another case to Calcutta, of which

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[1] Wickham, "Para Rubber" (1908), p. 49.

[2] Wickham, "Para Rubber" (1908), p. 47.

[3] There is no mention of rubber seeds on the ship's manifest : 141 cases of rubber were shipped at Manaos.

[4] Kew Report, 1876.

[5] Trimen, MSS.

[6] Straits Bulletin, IV., p. 308.

one-third was sent to Assam, and sixteen to Burma (1877).[1] The survivors of the latter, eight in all, were planted in the Forest Office compound at Mergui.[2]

In a recent official publication on rubber in Brazil[3] it is stated that Wickham obtained his seeds, " grace á la bienveillance du Gouvernement du Bresil qui fit rècolter ces graines par des Indiens sur les seringals de terre ferme, situès dans le Bas-Tapajoz." It would seem probable that these authors are confusing the events of 1876 with the previous attempts (1873) to obtain seeds through British Consuls in Brazil.

The Third Introduction of Hevea.

(See Addendum, p. 520.)

As has already been stated, Cross was sent to Panama in 1875 to obtain seeds or plants of Castilloa. In the following year he proceeded to Brazil to procure *Hevea brasiliensis*, sailing from Liverpool on June 19, 1876. It is curious to note that he left England within a week after Wickham's arrival. On July 15 he arrived at the port of Para, which he made his headquarters during his stay in Brazil. After exploring the surrounding districts by short excursions from Para, he began, on August 2, to collect seedlings, and by August 10 had accumulated about 2,000. Some of these were rejected, and the remainder, over 1,000, were planted in decayed leaves mixed with wood ashes in special cases. He returned to England in November, 1876.[4]

When Cross arrived at Kew the work of distribution of Hevea had been completed. Of the 1,080 seedlings which he brought, 680 were handed over to Bull, of Chelsea, and the remainder were kept at Kew. In each case, about 3 per cent. were saved.[5] From these, plants were propagated by cuttings,[6] about 100 being subsequently sent to Ceylon

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[1] Kew Report, 1877.

[2] Kew Bulletin, 1898, p. 264.

[3] O. Labroy and V. Cayla, " Culture et Exploitation du Caoutchouc au Bresil."

[4] Cross, Report.

[5] Trimen, MSS.

[6] The Kew Report does not say so. Trimen made the statement, and it was adopted by Thiselton Dyer in Kew Bulletin, 1898. It is now thought by Kew that these plants were Wickham's, not Cross's.

(September 15, 1877), and small parcels to Singapore, Java, Queensland, and Mauritius.[1]

The number of plants sent to Singapore was 22. They were despatched on June 11, 1877. It was probably 9 of these which Murton planted in Perak in October, 1877.

The total cost of the introduction of Hevea has been stated to be £1,505. 4*s*. 2*d*., but this sum includes not only the payment to Wickham, but also Cross's expenses. It would appear therefore to cover the whole expense of introducing Hevea, Castilloa, and Ceara. The details of the expenditure are[2]:—

	£
Wardian cases	120
Carriage to docks	7
Kew expenses	10
Carriage and passage to Ceylon, &c. ..	163
Wickham	700
Cross	505

Other Introductions of Hevea Brasiliensis.

The three instances already described are believed to constitute the only successful introductions of *Hevea brasiliensis* into British Colonies or Dependencies in the East. There are, however, several records which might appear to indicate that the Eastern stock has been replenished from time to time, and it may be as well to discuss these briefly.

In 1881, Mr. A. Scott Blacklaw attempted to open up a trade in seeds of Hevea and Ceara from Brazil, and advertised both kinds of seeds in the Ceylon Press. He had made arrangements for getting seeds in quantity, but feared " that the Para rubber cannot be raised in Ceylon from seeds brought from Brazil."[3] In a previous communication to the *Ceylon Observer*, October 21, 1881, he stated that he had brought two tins of Hevea seed from Brazil, and had sent them to Ceylon on trial.[4] Nothing further is known of this enterprise, and it is improbable that it was attended with any success, at least as regards Hevea.

[1] Kew Report, 1877.
[2] Trimen, MSS., from details furnished by the India Office.
[3] "Tropical Agriculturist," Nov. 1, 1881.
[4] Ferguson, " Indiarubber and Gutta-percha," 1st ed., p. 82.

In the report of the Forest Department, Singapore, for 1891, it is stated that seeds were obtained from Kew in that year. There is no record of any such consignment in the Kew publications, and Ceylon was then supplying seed to Kew for transmission to the West Indies. It seems highly improbable that Kew ever supplied Hevea seed to any Botanic Garden in the East, but in the Agricultural Bulletin of the Malay Peninsula (1898), p. 230, Ridley, in a discussion of earlier records, stated "seed has been successfully sent from South America *viâ* England, though usually with much loss." However, in the Straits Bulletin, IV. (1905), p. 308, the same author remarks that "This plant seems never to have been successfully introduced again from South America."

In the "Tropical Agriculturist" for October, 1898, there appears an interview with Mr. T. Christy, who was then engaged in supplying, from England, seeds and plants to tropical countries. According to this article, Mr. Christy stated, as evidence of the success of Para rubber, that he had recently exported thousands of young plants for plantations.[1] There would, however, appear to be some doubt as to the accuracy of this report, as, in an account of Mr. Christy's gardens in the "Gardeners' Chronicle," about the same date, reference is made to "young rubber plants (*Castilloa elastica*) for exportation."[2]

The Species introduced.

During recent years, it has on several occasions been suggested that the Hevea introduced into the East is not the species which yields the fine hard Para of commerce, the idea being in nearly all cases based upon the alleged inferiority of some grades of plantation rubber. And a somewhat similar question has compelled the attention of the rubber planter, namely, whether all the introduced Hevea trees belong to the same species. The inferiority, real or supposed, of plantation rubber is in most cases capable of explanation in other ways, more especially by the age of the tree; but the planter certainly has good grounds for questioning the identity of all the Hevea trees on his estate. He sees enormous variation in the size

[1] "Tropical Agriculturist," XVII ., p. 277.
[2] "Tropical Agriculturist," XVIII., p. 284.

of the leaf, well-marked differences in the character of the bark which appear to be related to latex-yielding capacity, and variations also in the type of seed. It is usual to attribute these variations to the effect of a new environment; and they are perhaps not more numerous than might be expected to occur when so many thousands of plants are brought under new conditions of growth. Whether these variations breed true has not yet been determined, nor has it been decided whether any particular types of leaf, seed, and bark are constantly associated with one another.

It has been customary to meet all such doubts by the statement that Wickham collected the seeds of one species on the Tapajos, and from those seeds all the cultivated Heveas are descended. But it will be seen from the details already set forth that this answer may not meet the case. Wickham's was certainly the main consignment, and was distributed to Ceylon, Singapore, and Burma; but Cross's plants,[1] which were obtained within easy walking distance of Para, may have been sent to Ceylon and Singapore, while both Burma and Singapore received plants or seeds from Ceylon subsequently, nearly all the old trees in the Singapore Gardens being from Ceylon seed. There does not appear to have been any distinction made between the consignments, though the old trees in the Forest Office compound at Mergui, if they still exist, are part of Wickham's collection, while those at Singapore and Kuala Kangsar are probably part of Cross's.

In addition to these consignments there was the earlier batch of seed obtained in 1873 from Cameta, near Para. Six of the seedlings raised were sent to Calcutta and need not trouble us further; but from the remainder, plants were propagated by cuttings at Kew (Kew Report, 1875), and it would seem quite probable that these would be distributed. In that case, though the bulk of the plants were derived from the Tapajos, there are at least two other sources to be considered, and under the circumstances it is apparent that a systematic examination of the plantation Hevea of the East is more desirable than has hitherto been supposed.

[1] But see Addendum, p. 520.

II.—The First Flowering of Hevea in the East.

By the end of the year 1877, *Hevea brasiliensis* had been established at Henaratgoda and Peradeniya in Ceylon, at Singapore, at Kuala Kangsar in Perak, and at Mergui in Burma. In Ceylon some propagation was said to have been effected by cuttings, and plants were distributed ; but it was recognized that no extensive distributions could be made until seed was produced. The flowering of the tree was therefore awaited with great interest, for the possibility of successful cultivation on a large scale depended entirely on whether viable seed would be produced or not. The first flowering must have occasioned some disappointment, for in neither of the recorded cases did any fruit result.

In Perak, one tree flowered in 1880, but did not set any seed. In the following year, two (or more) trees flowered and several fruits were produced. A letter from Mr. J. A. Swettenham,[1] under date September 2, 1881, to Dr. Trimen, runs as follows :—

"Mr. Hugh Low, C.M.G., has sent me from Perak a small quantity of seed of the *Hevea brasiliensis* which has this year just yielded fourteen ripe pods, the trees having flowered in March. Mr. Low says: "The first and largest tree flowered three times before it produced any fruit, but another which now only flowered once produced as many pods as the first. The flowers were very numerous, although the product is so small."

On September 3 he wrote :—

"I send you the Hevea seed by postal packet." [1]

In the "Tropical Agriculturist," October 1, 1881, Low states : "I have just gathered sixteen pods of ripe seeds of the *Hevea brasiliensis*, two of which I have sent to Mr. J. A. Swettenham in Colombo. The plants were put out in November, 1878 (should be 1877), and were then 3 inches high."

Trimen, in his Annual Report for 1880, states that "in the latter place (*i.e.*, Perak) a tree has flowered sparingly (at two and a half years, and 35 feet high) ; Mr. Low kindly promises seed if any ripen." None, however, were sent until 1881, as recorded above. A note in Trimen's diary states that three entire capsules were received, but the seeds were dead : apparently they had been gathered before they were ripe.

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[1] Letter in Peradeniya file.

In 1882 several trees fruited at Kuala Kangsar, and eighteen seeds were sent to Ceylon ; these, however, were unfortunately dead on arrival. The official report on the Perak Plantations for 1882 records[1] that seeds were distributed to Java, Singapore, Ceylon, and India ; and Ridley[2] states that Singapore received fifty seeds from Perak in that year.

H. Cottam has recorded that he packed a box of Hevea plants at Kuala Kangsar, for Madras, Christmas, 1882.[3]

In Ceylon, one tree flowered in 1880, but, as in Perak, no seeds were produced. The conductor of the Henaratgoda Gardens, when forwarding to Trimen fresh flowers in 1881, wrote that they were "from the tree which flowered last year."[4] This Henaratgoda tree bore nine seeds in May, 1881, and two seedlings were raised from them, but in 1882 only 36 seeds were obtained. In that year the plantation was thinned out in the hope of inducing a greater production of flowers. In 1883 nine trees flowered at Henaratgoda, and 266 seedlings were raised, part of these being distributed in Ceylon. In 1884 the Peradeniya trees began to yield seed, and over 1,000 seedlings were raised at Henaratgoda.[5]

The course of events in Ceylon was thus identical with that in Perak. In both countries the trees first flowered in 1880, but did not produce seed, ripe seed being obtained for the first time in 1881.

It may be noted that at the Government Plantation at Edangoda, trees planted (seed in baskets) in 1891 fruited in 1893, two years from the germination of the seed.[6]

In Singapore the trees were transplanted in 1878 into more swampy ground, according to the ideas of Cross's report, and their growth was thereby retarded. The Singapore report for 1881 records that propagation by cuttings was still being attempted, but that they were so unsuccessful that it was resolved not to retard the trees by further cutting, but to encourage them to grow quickly and " look forward to the

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[1] "Tropical Agriculturist," III., p. 407, *ex* " Straits Times."
[2] Bulletin, F. M. S., IV., p. 3.
[3] "Tropical Agriculturist," III., p. 157.
[4] Letter in Peradeniya file.
[5] Annual Reports, Royal Botanic Gardens, Ceylon.
[6] Report, Forest Department, Ceylon, 1894.

production of seed." In the report for 1882 it is stated that "an early crop of seed is looked forward to," but there is no record that the trees had flowered. The report for 1883 merely states that the plants of introduced rubbers mentioned in last year's report continue to grow well. There is no mention of Hevea in the report for 1884, but in 1885 it is recorded that seedling Heveas were growing in the nurseries of the Forest Department, planted in 1884 and 1885. Some of these would be the product of the 400 seeds which were sent from Ceylon in a Wardian case in the latter year.

The date of the first production of seed at Singapore is therefore doubtful. It has been stated that seed was first produced in 1882, and, on the same page, in 1881.[1] But these statements would appear to be negatived by the evidence already quoted. From the annual reports it may be deduced that the trees did not fruit before 1883, possibly not before 1884. Any seed distributed from Singapore in 1882 (there is no contemporary record of any such) could only have been obtained from Kuala Kangsar.[2]

III.—The Reports of Collins, Wickham, and Cross.

As has already been stated, Collins prepared a "Report on the Caoutchouc of Commerce, being information on the plants yielding it, their geographical distribution, climatic conditions, and the possibility of their cultivation and acclimatization in India," before the introduction of Hevea, &c., had been decided upon. Subsequently both Wickham and Cross published accounts of their operations, with information likely to be of service to planters. It may be of interest to quote these reports, wholly or in part, to show what information was at the disposal of the pioneer planters, and how many of the ideas once current arose.

Collins's Report.

Collins's report is a compilation, extending to 54 pages, of all the available information concerning rubber plants. As far as South America is concerned, he drew on the writings of

[1] Ridley, Bulletin, Straits and F. M. S., IX., p. 213.
[2] Ridley, Straits Bulletin, IV., p. 365 ; II., p. 3.

Spruce, Edwards, Bates, and Wallace; and although his book has been styled the first real report on the rubber industry, he never visited South America.

After an introduction which gives a list of all the rubber plants then known, the author describes the various species of Hevea, the quality of the latices yielded by them, the collection of the rubber, and the climatic conditions of the rubber districts. He describes a full herring-bone method of tapping, and states that the yield is sometimes increased by binding the trunk with cords or bands formed of the stems of twining plants! This statement may be due to an incorrect interpretation of Wickham's figure. He also states that a modern method of preparing rubber by adding alum to the latex, and subjecting the coagulum to pressure, had been purchased by the Government of Para. But some doubt is thrown on his accuracy by the information which he quotes, that ammonia will effect coagulation.

Other sections deal similarly with *Castilloa*, *Ficus*, *Landolphia*, &c. He notes that Cervantes' name was really *Castilla*, not *Castilloa*—a point which was afterwards strongly insisted upon by the late Dr. P. Ohlson Seffer.

Part II. deals with the cultivation of rubber trees. With regard to *Ficus elastica*, the reports of Gustav Mann are quoted at length. In *Castilloa elastica* the trees are said to be tapped in the form of a spiral, and the figures given might well have represented the later "full spiral" tapping which was temporarily practised on Hevea; and in describing the full herring-bone, he suggests that the diagonal cuts might be made on one side only (*i.e.*, half herring-bone).

Among the tapping knives described is one, a timber marking knife, which is practically identical with the Jebong knife, and another specially devised to prevent injury to the cambium. Iron collecting cups are advised, with one side concave to fit the tree. In dealing with coagulants, he states that "the treatment with an acid (acetic ?) can only be put down as a conjecture at present."

Collins's report afforded a valuable summary, but contained little information likely to be of practical use to the planter. Probably for that reason it does not appear to have been generally consulted, the cases where his advice seems to have been followed being generally the result of independent discovery.

Wickham's Report.

Wickham's report, entitled "A Note on the Introduction of the Indiarubber Tree into India," was issued by the Indian Government, and republished by the Ceylon Government in 1877. The following is a complete reprint of the report, as published in Ceylon :—

The introduction into India of the true Para indiarubber (*Hevea*) may be said to be now fairly inaugurated. If it is not a great success, I think, without doubt, the fault will be that it has not been planted out in suitable localities.

The indiarubber tree (*Hevea*) grows naturally throughout the Amazon valley, with the exception of certain localities. I found it very abundant high up on the Orinoco, above the junction of the Guaviare (the latter stream by right indeed should be styled the Orinoco). It is plentiful on the banks of the Cassiquiare, that curious bifurcation of the Orinoco by which it contributes water to the Rio Negro, and converts Guagana into an immense island. I do not know how far it may extend up the Maranon into Peru, never having been there. It is abundant and very fine about the cataracts of the Tapajos, and it was on this river that I obtained the seeds which produced the plants now to be despatched from Kew to India.

I also found it growing in the interior between the Tapajos and Xingu. The rivers from which the largest supply is now brought by the traders are the Purus and the Madeira.

In its native forests it grows dispersed among the other forest trees, two or three trees rarely being found in juxtaposition. In appearance the *Hevea* are handsome trees, with straight cylindrical trunks. They differ wholly from the Ulé trees—the Central American indiarubber tree (*Castilloa*), which I had seen in Moskito and Nicaragua. The wood is soft and perishable. As in the great majority of tropical American trees, the bark is not very thick. It is of a gray colour on the surface, but when scraped (as has frequently to be done before it is possible to tap them in some of the moister districts, owing to the thick growth of the moss ferns and orchids on the bark) approaches in appearance and colour the coat of a light bay horse. Under the native mode of tapping, however, they soon present a warty disfigured appearance. The seeds grow, three together, in a sort of hard pod. This pod bursts, when it is ripe and becomes heated by the sun. with a sharp popping sound, and scatters the seed for a considerable distance around the trees. I have been assured by an Englishman, long resident in the country as a trader, that an oil closely resembling linseed oil in its properties is to be extracted from the seed.

It is worthy of notice that the tree casts its seed *at the same time of year* both on the Orinoco and Amazon, although the wet and dry seasons are reversed in the two valleys. It would be interesting to note whether the seed continues to fall at the same time of year in their new home in India.

The rainfall varies considerably in different districts where the *Hevea* are found. In some districts the year is nicely divided into wet and dry seasons, each of about six months' duration. In others, it rains more or less the year round. In such districts it is more difficult to collect the *caoutchouc* profitably. If the stem of the tree be wet when it is tapped, the milk spreads over the surface of the bark and is lost. Again, if a shower should come on before the milk is collected from the cups, and it become mixed with water, it will not congeal, and so is also lost.

The range of temperature in the indiarubber country is from about 73° to 88° throughout the year ; on the lower Rio Negro it increases in the afternoon to 100°.

From what has been said, it may be seen that the main part of the rubber must be collected during the dry season, although the "ciringeros," who live near their "ciringals," or indiarubber walks, improve their opportunity by tapping their trees whenever fine days occur during the rainy season. The "ciringero" occasionally gives his trees a rest, but the trees are always tapped excessively. It is astonishing to what a degree they will stand tapping. I have seen large trees apparently none the worse, further than that they were somewhat disfigured by the knarled appearance of their bark, the owner of which assured me he had tapped for twenty years successively, but then he tapped them himself and had an interest in their preservation. The same trees scattered their fruit in abundance. An industry more in accordance with the character of the South American it were difficult to find, the labour so small and yet so remunerative. I have myself collected 10 lb. of rubber per day, tapping 70 or 80 trees of various size. An experienced Tapuyo Indian can collect much more. If such be the case in the woods, where the trees are scattered and much time is necessarily lost in getting from one tree to another, what will be the profit of a well-arranged plantation of these trees under good supervision ? In the "igapó," or low lands off the rivers, flooded during the rise of the waters, there is a spurious kind of *Hevea*. It is called by the natives "ciringa do igapó" or "barigordo," from its habit of growing with a bulged stem. The seeds of this species are much longer and larger than those of the true rubber. The milk appears to be worthless.

When the native has discovered for himself a district in which "ciringa" trees are sufficiently numerous and near together, he first connects them together by cutting a "picado," or path, with his bush knife. Having thus discovered their relative bearing, he next straightens and clears out his paths, endeavouring at the same time to take in as many trees as possible in each path, and to make all the paths converge to a certain spot where he has put up his "rancho" or "barraca." This done, and having collected a supply of the old nuts of the inaja (*Maximiliana regia*), or other palm trees, or of the outer shell of the Brazil nut, he is ready to commence operations on the first fine day. There is some diversity in the manner of taking the rubber milk on the Amazon. In some districts long strips are procured from the inner pith of the foot stalk of the leaf of the inaja or the Bacaba palm. These are tacked obliquely round the stem of the trees, with sharpened pieces made out of the hard covering of the same leaf stalks. This being smeared on the inside with wet clay serves to form a channel to collect and conduct the milk into the cup placed to receive it. In the other manner, which I consider the better, three of four cuts about an inch long are made in the bark with a minute axe. The cups are put on in a ring round the trunk, usually a span or more apart. In this way the number of cups is proportioned to the size of the tree.

Tin cups are used. They are made slightly concave on one side in order to fit the convexity of the tree trunk. These are fastened to the tree with a piece of kneaded clay, of which the "ciringero" carries a supply in his bag. The tapping always take place as soon as there is light enough in the forest to see by. One man is apportioned to each path, say, containing 100 trees. When he has tapped and cupped his trees he sits down at the end of the walk for half an hour or so. As soon as he perceives that the tree last tapped has ceased to drip the milk, he starts at a trot on the back track, detaching and emptying the cups into his calabash as quickly as possible. The cups he leaves up side down at the base of the trees. Speed throughout is a great object, as the milk speedily coagulates; then it can only be sold for an inferior price as "sernambi." When the men arrive at the central hut, from their different paths, they empty their milk into one of the large native earthenware pans. Care is taken to squeeze out with the hands all the already coagulated curd-like masses. These are thrown to one side to be made up into balls of "sernambi." Earthen pots resembling miniature kilns are placed over small fires and the "ciringero" sits down to the really tedious part of the business. He drops a handful or so of the palm nuts down the narrow neck of his little kiln and forthwith arises a dense smoke. He now takes his wooden mould—not unlike a fives bat in form—and holding it over the pan pours some of the milk over it, keeping it turned, so that it shall not run off before he succeeds in drying it in an even surface, as it soon does as it is passed backward and forward through the smoke; this is continued, one coating of milk after another, until he has finished the supply of milk for the day; he then sticks his mould up in the thatch for the repetition of the process next day, and until he is satisfied with the thickness of the "biscuit."

I believe very good rubber might be made by simply allowing the milk to congeal in moulds during the night of the day on which it has been tapped, if, on the following morning, it were placed under a very powerful press in order to expel the fluid contained in the cheese-like cells. When fresh, the milk has a very agreeable smell and taste, but it soon becomes putrid. The child of an

Indian woman employed on my "ciringal" used to drink considerable quantities of the fresh milk; I suppose it was rendered harmless by becoming mixed with saliva, as it will not congeal if mixed with water.

There are many trees in tropical America which produce milk from the bark yet more copiously than the *Hevea*. Who knows but that some day equally economic use may be made from some of them?

With regard to the success of the introduction of the *Hevea* into India, much will, of course, depend on the nature of the soil on which they are planted. In Venezuela and Brazil I found the *Hevea* growing on two classes of country; on the high clayey uplands embraced by the branching rivers, but still at considerable distances from them, and on the low alluvial lands immediately bordering on them.

From the far greater size and apparent age of the trees I cannot but imagine that the original locality of the tree was in these uplands. The fact of their being so generally found on low lands bordering on the waters may be accounted for. The seeds are scattered widely when they burst; many of them fall into ravines and gullies and are carried by the watercourses of the rainy season into the rivers, to be cast up by the tide and windy squalls, and readily take root on the rich soil of the alluvial islands and shores of the backwaters. In illustration of this I have frequently seen a string of *Hevea* growing even on a beach, backed by sandy lands, far from their proper localities.

Although I know nothing personally about the climate of the Eastern Indies, yet I imagine, from what I have read, that the Malay peninsula is most likely to combine the climatic conditions required by the indiarubber tree of the great valley of South America.

It is a mistake—naturally fallen into by the travellers who have passed up and down the great water-ways of South America, without having penetrated far into the interior high clay lands enclosed by them—to suppose that the *Hevea* are confined to the low, often-flooded islands and margins of rivers. Growing on these clayey uplands, I met with the largest of these trees, rivaling in height and girth all but the very largest trees which grow in these parts.

At the same time, perhaps, on rich alluvial lands would be found the best localities for establishing plantations of these trees. Nor do I think it would prove a serious drawback if they should be planted on lands which become annually flooded, to the depth of a foot or so, for a few weeks in the year. The land selected should, I think, be heavily timbered. The timber to be cut down some eight or nine weeks before the first rains are expected, in order to give time to get a good burn over the ground. The ground also should be cleaned up sufficiently, by piling and burning the logs; those remaining to be rolled on one side. The plants might be set out in walks, converging to a central point, in order to facilitate the collecting of the milk. I would strongly advise that the *Hevea* should be planted alternately with cacao; these low bushy trees would shade and keep the ground moist, without interfering in the least with the *Hevea*, which would soon tower above them. This plan also would much increase the value of the plantations.

Another thing I would recommend. The milk of these trees is yielded in much greater abundance near the ground, and when, by some chance cause, an elbow of root is protruded above the ground, the flow of milk from it, on its being tapped, is very much greater than from any other part of the tree. Now, would it not be possible to devise some method by which the roots might be induced to put up elbows above the surface of the ground? Great caution must be used, in tapping the trees, not to penetrate beyond the bark into the wood. Great numbers of trees are destroyed in this manner on the Amazon. As soon as the wood is injured, certain species of boring beetles attack the tree, and it soon dies.

From what I have seen of these trees in their native country, where I have occasionally known them planted, and have made some experiments on their growth myself, I have ventured on the foregoing remarks, feeling, at the same time, satisfied that this will be found to be quite the best manner of forming a plantation on a large scale. If this plan were followed in a suitable locality on rich alluvial soil, the tapping of the young trees might commence gradually in from seven to ten years after planting out, and would soon become the source of a great revenue.

Cross's Report.

Cross's report gives a full account of his travels, the part relating to Hevea covering eight closely-printed pages. He took up his abode in Para, and made daily excursions to the neighbouring rubber districts. His account, therefore, relates only to the immediate neighbourhood of Para, and the seedling plants which he collected were obtained within easy walking distance of the town. The following extracts may be of interest :—

The land around Para, including where the city stands, rises from the banks of the river southward in the form of gentle undulations, indented, however, in many places by deep gully-like natural ditches, called *gapós*, which often penetrate for many miles into the interior of this vast forest region, and are filled daily by diurnal tides. To those navigable by canoes or sailing craft the term *ajarape* is often applied. The intervening land between the *gapós* is frequently flat and moist, and owes its origin, first, to tidal deposits, and afterwards is raised higher by the decayed remains of successional rank growths of vegetation. On the elevated lands beds of white sand, 20 feet in depth, are met with, covered with a layer of decayed vegetation. At a similar level to this we find a deposit approaching to clay or very fine sand and mud, with here and there masses of sandstone or granite cropping out. In every direction where a view can be obtained, the country is seen to be covered by dense exuberant forest. Leaving Para, I travelled over the high ground for several miles, until the primitive forest was reached, and then went down towards the *gapós*. Following through the wood a path used by the caoutchouc collectors, we soon came to a large tree in a state of decay, which had been tapped many times. At first sight I felt extremely puzzled and perplexed at the appearance it presented. From the ground up to a height of 10 or 12 feet the trunk was one swollen mass of warty protuberances and knots, covered with thick scales and flakes of hard dry bark.

This singular state of growth, the result of the practised system of tapping, has not yet been recorded by any one, and so was to me unexpected. A few minutes of careful examination soon showed the real cause of these deformities. The collector makes use of a small axe-like implement an inch broad. At each stroke he cuts through the bark and into the wood for fully an inch. Hundreds of these are made in the wood of each tree in the course of a few years, and cannot heal under any circumstance; but a layer of wood is formed over the injured part, at the expense of the bark and general vitality of the tree. The newly-formed wood is again cut into and splintered, and so the process is repeated on each successive layer until the trunk becomes merely a mass of twisted wrinkled wood, with very thin insipid bark. In this condition hardly any milk flows from the cuts, and although for years a few green leaves may continue to sprout from the points of the twigs, yet the tree may be considered as dead, and, in fact, finally withers away. It is, therefore, the injury done to the wood, and not overtapping, which lessens the flow of milk, and ultimately causes the death of the tree. The cuts in the wood are of course unnecessary, since the milk is met with only in the bark. The healing-over process, which afterwards takes place, is similar to that seen where a branch has been lopped from a trunk. The wood is compact and rather hard, and for this reason the tree lives on for a number of years, although cut and hacked every season; but the flow of milk becomes so lessened that many are practically abandoned for years before they die. This and several large adjoining trees were growing in moist deep heavy soil of a fertile character, but quite out of the reach of any inundation.

On August 2 I went in search of plants, and descended to the region of the *gapós*. It had rained a good deal previously, and the collectors' footpaths were ankle deep with mud. After wading several little pools we came to a deep *gapó*, into which the tide flowed. It was connected with many lesser watercourses that formed a kind of network, extending over a wide district of forest-covered country, the more elevated parts of which were raised only from 3 to 4 feet above the highest tides. A considerable number of rubber trees grew along the margins of both the larger and smaller streams, intermixed with cacao and forest trees. Three were observed the bases of the trunks of which were flooded to a height of 1 foot, yet the roots seemed to run up to the brow of the bank, and no matted rootlets were observed, as is the case with the willow tree when growing on the margin of a rivulet. Most of the others occupied dry situations. Those *gapó* ditches were lined with soft rich mud, without doubt possessing great fertility. The exhalations from such places, shrouded by a forest growth of 80 or 100 feet high, were sensibly felt, and on nearly every occasion when I visited those localities I experienced slight attacks of fever afterwards. The collectors also, during the working seasons, are often indisposed from the same cause. Although the forest was excessively damp, yet tapping was being carried on, as a man was seen mixing up some clay at the side of a *gapó*. A number of good plants were met with beneath the oldest trees. The seedlings did not usually grow in any place where the ground was covered by more than 2 or 3 inches of water at flood tide. However, by far the greatest number were met with on sites above the reach of the highest tides. I measured a few of the largest trees, all of which had been tapped for periods varying from five to fifteen years. Those found growing in shallow *gapó* ditches are preceded by an asterisk. The circumference of each, one yard from the ground, was as follows :—

No.		Ft.	in.	No.		Ft.	in.
1	..	6	9	7	..	4	0
2	..	6	10	8	..	5	10
3	..	4	7	9	..	4	0
4	..	3	0	10	..	4	6
*5	..	5	10	11	..	4	8
6	..	5	3	*12	..	2	8

Most trees occurring within the limits of the worked districts are tapped if possessing a diameter of 6 or 8 inches. Regularly tapped trees, as a rule, do not exceed 60 feet in height.

His account of the method of tapping the tree is similar to that of other writers, but in greater detail. He notes that the latex is said to flow more freely in the early morning, but does not attach much importance to the statement. The actual tapping is described as follows :—

The cups, as already stated, are of burnt clay, and are sometimes round, but more frequently flat or slightly concave on one side, so as to stick easily when with a small portion of clay they are pressed against the trunk of the tree. The contents of 15 cups make one English imperial pint. Arriving at a tree, the collector takes the axe in his right hand, and, striking in an upward direction as high as he can reach, makes a deep upward sloping cut across the trunk, which always goes through the bark and penetrates an inch or more into the wood. The cut is an inch in breadth. Frequently a small portion of bark breaks off from the upper side, and occasionally a thin splinter of wood is also raised. Quickly stooping down he takes a cup, and pasting on a small quantity of clay on the flat side, presses it to the trunk close beneath the cut. By this time the milk, which is of dazzling whiteness, is beginning to exude, so that if requisite he so smooths the clay that it may trickle directly into the cup. At a distance of 4 or 5 inches, but at the same height, another cup is luted on, and so the process is continued until a row of cups encircle the tree at a height of about 6 feet from the ground. Tree after tree is treated in like manner, until the tapping required for the day is finished. This work should be concluded by 9 or 10 o'clock in the morning, because the milk continues to exude slowly from the cuts for three hours or perhaps longer .... On the following morning the operation is performed in the same way, only that the cuts or gashes beneath which the cups are placed are made from 6 to 8 inches lower down the trunks than those of the previous day. Thus each day brings the cups gradually lower until the ground is reached. The collector then begins as high as he can reach, and descends as before, taking care, however, to make his cuts in separate places from those previously made. If the yield of milk from a tree is great, two rows of cups are put on at once, the one as high as can be reached, and the other at the surface of the ground, and in the course of working, the upper row descending daily 6 or 8 inches, while the lower one ascends the same distance, both rows in a few days come together. When the produce of milk diminishes in long-wrought trees, two or three cups are put on various parts of the trunk where the bark is thickest. Although many of the trees of this class are large, the quantity of milk obtained is surprisingly little. This state of things is not the result of over-tapping, as some have stated. Indeed, I do not believe it is possible to overtap a tree if in the operation the wood is not left bare or injured. But at every stroke the collector's axe enters the wood, and the energies of the tree are required in forming new layers to cover those numerous wounds. The best milk-yielding tree I examined had the marks of twelve rows of cups which had already been put on this season. The rows were only 6 inches apart, and in each row there were six cups, so that the total number of wood-cuts within the space of three months amounted to seventy-two. It grew close to a *gapó* only 8 inches above high-tide mark, and being a vigorous tree the cups were usually well filled, but with two years or so of such treatment the tree would probably be permanently injured. It has been supposed that the quality of the milk is better in the dry season than during the rains. Such is the case with some vegetable products, but, as regards indiarubber, there ought not, I think, to be any appreciable difference. In the rainy season the milk probably contains a greater proportion of water, but, on the other hand, I am of opinion that then a larger quantity of milk flows from the tree. No doubt the dry season is the most suitable for caoutchouc collecting, although, wherever a plantation is formed with preparing house convenient, tapping may certainly be always carried on when the weather is fine. It is a common report that the trees yield the greatest quantity of milk at full moon. In order to ascertain this, a number of very careful experiments would require to be made, extending over one or two years.

Even if such an assertion was found to be true, it would probably make little difference, as tapping will have to be carried on when circumstances are most favourable.

The descriptions of the collection of the latex and the preparation of the rubber follow the usual lines. One observation made by him is of interest :—

But on one occasion, when the collector was commencing to smoke some milk, I saw him wait for a short time, during which he put his hand repeatedly to the mouth of the jar, and soon learned that he could do nothing until the smoke was hot. The dense white smoke rose abundantly, but the milk would not thicken on the mould. After a little while the jar became heated, and the operation went on quite satisfactorily. I put my hand above the mouth of the jar, but could not bear the heat scarcely a second, and although the temperature of the smoke was apparently less than boiling water, yet I judged it must have been at least 180° Fahrenheit. Therefore the rapid coagulation of the milk is simply produced by the high temperature of the smoke. I have no doubt that with a strong current of heated air, or a good pressure of steam from a pipe, a similar result would be obtained. The finely divided particles of soot, which forms a large proportion of the smoke, undoubtedly absorb a considerable amount of moisture, although at the same time it must be looked on as an impurity. I have no hesitation in giving my opinion that equally as good rubber could be prepared by putting the milk in shallow vessels, and evaporating the watery particles by the heat of boiling water.

The district visited by Cross consisted of marshy or low-lying ground intersected by numerous tidal ditches. Hence he was of opinion that " the flat, low-lying, moist tracts, lands subject to inundation, shallow lagoons, water holes, and all descriptions of mud accumulations, miry swamps, and banks of sluggish streams and rivers," would be found best adapted for Hevea. Yet in his notes he repeatedly gives evidence rather to the contrary. " By far the greatest number were met with on sites above the reach of the highest tides." " This and several large adjoining trees were growing in moist, deep, heavy soil of a fertile character, but quite out of the reach of any inundation." " Three were observed the bases of the trunks of which were flooded to a height of 1 foot, yet the roots seemed to run up to the brow of the bank," &c.

Of the three reports, that of Collins was admittedly a compilation ; Wickham's was somewhat brief ; while that by Cross contained a wealth of details which appealed strongly to the practical sense of the planter. It is scarcely surprising, therefore, that Cross's report formed the main source from which Superintendents of Botanic Gardens and planters derived information.

IV.—Distribution in and from Ceylon.

In 1875 the only Botanic Gardens in Ceylon were those at Peradeniya and Hakgala, the latter, at an elevation of 5,600 feet, being opened for the cultivation of cinchona in 1861. It was necessary, therefore, to open a new garden in the low-country for the reception of the Hevea plants. The choice of a site—Henaratgoda—was probably influenced by its proximity to the railway and its accessibility from Peradeniya or Colombo, but in several respects it has proved an unfortunate one. The available area is small and does not admit of expansion, and the soil is poor. Moreover, it is far removed from the districts which have since proved most suitable for Hevea.

The land was acquired in 1876, but the plants arrived too late to be planted out that year, and they had to be kept in bamboo pots at Peradeniya until the following June. On June 6, 1877, Dr. Thwaites wrote :—" We are now getting Hevea and Castilloa into our new garden, and we have fine healthy plants grown in bamboo pots to put in. Some of both kinds planted out here (*i.e.*, at Peradeniya) in the open ground are doing very well."[1] These latter plants were probably planted in the old vegetable ground, where the Palmyra Avenue now stands, a site which originally bore all the Hevea, Ceara, and Castilloa planted at Peradeniya. A group of eight Hevea still exists there, but the trees appear to be too small to be part of the original stock. There is no record, however, of any subsequent planting of Hevea in that locality. If these are the trees alluded to by Thwaites, they are part of Wickham's consignment.

Thwaites' letter, quoted above, refers to the plants obtained by Wickham. The second consignment of plants to Ceylon was not sent from Kew until September 15, 1877. How many of the latter survived the voyage, and what was done with them, has apparently not been recorded.

[1] Kew Report, 1877.

The total number of plants sent to Ceylon was 2,019, 1,919 being those raised from Wickham's seed and 100 in the second consignment. Of the former it was recorded that about 90 per cent. survived the journey, so that altogether it would appear that Ceylon received between 1,800 and 1,900 plants. But it is not possible to place much reliance on these figures, which, under the circumstances then existing, are scarcely likely to have been based on Thwaites's personal observations. Trimen, on his arrival in February, 1880, found about 300 of the original plants at Henaratgoda, and from the size of the area occupied by them it does not appear probable that there were ever very many more. Some would perhaps be kept in bamboo pots for the purpose of propagation, and others were distributed, but, making every allowance for that, there must have been an enormous mortality while the plants were in bamboos, if the figures cited above are even approximately correct. There is, however, another possible explanation (see later).

It is not now possible to give the early history of these plants with any degree of completeness, as scarcely any documents relating to the internal management of the Botanic Gardens during Thwaites's directorship have survived. The recorded events of the next three years (1877–1880) are as follows :—

In his report for 1877 Thwaites stated that propagation by cuttings was being carried on successfully. In 1878 he recorded that rather more than 500 rooted plants, raised from cuttings of the stems, had been sent to British Burma, and further supplies were being prepared for the same destination. In the same year a few Wardian cases of rooted plants were sent to India. The Kew report for 1878 gives the number sent to Burma as 516. Thwaites's report for 1879 states that small supplies had been sent to British India (33 plants), and a moderate distribution had been made to some planters in Ceylon. It is probable that the isolated old trees which are to be found on several estates in Ceylon, *e.g.*, Imbulpitiya, Dedugalla, Eadella, &c., and which are said to be of the same age as those at Henaratgoda, originated in that way, though popular rumour accounts for their existence by a less creditable explanation.

Thwaites retired in 1880 at the age of sixty-eight, and was succeeded by Dr. Trimen. Trimen's report for that year states that a new nursery for the propagation of Hevea had been formed at Henaratgoda, and 662 cuttings had been distributed. For the further history of Henaratgoda we are restricted almost entirely to the facts published in the annual reports, eked out a little by the quarterly reports (MSS.) of the Conductor, for although Trimen kept detailed records of all operations carried on in the Gardens, his diaries relating to Henaratgoda, to which he makes frequent reference, are not now available.

From the records prior to 1881 it would appear that Hevea had been successfully propagated by cuttings, and that plants had been raised in sufficient number to provide stocks for other countries. But from Trimen's diary for January, 1881, we learn that he was then endeavouring to get cuttings of both Hevea and Castilloa to strike by means of a hot-bed at Peradeniya, having apparently discovered that propagation by cuttings in the ordinary way of the East was not to be depended upon. In a letter dated October 24, 1881, Trimen wrote : " Propagation of the tree (*i.e.*, Hevea) from cuttings has proved extremely difficult, and out of many thousand attempts a very small number have succeeded. Thus, the number of plants in these Gardens has scarcely increased. My own experience in this matter *is the same as that of my predecessor* (italics mine—T. P.), and of Major Seaton in Burma, to which part of India a large number of plants was sent from Ceylon .... I have been over the trees here and at Henaratgoda ...., and I find about 50 stocks of the original trees which can be spared."

In Trimen's summary of the History of Hevea in Ceylon, published in the Kew Bulletin, 1898, pp. 254–257, he stated that on his arrival in February, 1880, he found at Henaratgoda about 300 of the original seedlings, tall, slender trees four years old, the tallest about 30 feet high, and at Peradeniya about 20 trees, smaller and less luxuriant in growth. That is to say, in about three and a half years 1,500 plants had disappeared, if the original numbers are correct. There is no reason to doubt Trimen's figures, though the loss is abnormally large. Making every allowance for deaths, destruction by hares, &c.,

and the customary thefts, it is difficult to understand how the stock could have dwindled to such an extent in so short a time. As a possible explanation I may offer the following suggestion, which to those who are acquainted with the history of the Gardens, *circa* 1880, may have some semblance of probability. The total number of plants distributed prior to 1881 was considerably more than 1,200 : the actual number recorded is 1,211, in addition to "a few Wardian cases" to India, and "a moderate distribution" to planters in Ceylon. All these were supposed to have been raised from cuttings, but as soon as Trimen inquired into the matter propagation by cuttings ceased ; and the old labourers at Henaratgoda insist on asserting that all the cuttings died—that no plants were ever raised there from cuttings. It would seem probable that the plants which were distributed as raised from cuttings were really the original stocks ; to any one who knows the East, the assumptions involved in such an interpretation are by no means out of the ordinary.

At Peradeniya, Hevea, Castilloa, and Ceara were in existence in the old vegetable garden (now the Palmyra Avenue) in 1883,[1] and Hevea in the old nursery (near the present nursery). These appear to have been of Thwaites's planting. In April, 1881, Trimen planted twelve Heveas near the herbaceous beds in the South Garden, and eighteen, of which six died soon after, on the opposite side of the road, half way down the river bank, in order to imitate the conditions recommended by Cross.[2] No further planting was done at Peradeniya until 1905, when ten acres were put out on the Experiment Station on the other side of the river.

At the present time there are old trees in the Peradeniya Gardens distributed as follows :—A clump of eight behind the Palmyra Avenue, a group of eleven near the herbaceous ground (Trimen, 1881), another group of twelve on the river bank (Trimen, 1881), one near the nursery (Thwaites), and one (formerly in the hedge) near the potting shed. The last named plant appears to have been an escape, and it differs in some respects from the other trees : it has not borne seed during the last two years.

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[1] Trimen's "Guide," 1883. [2] Trimen's diary.

Hevea was in existence near the nursery and behind the Palmyra Avenue prior to 1883, and as Trimen does not record planting them, it would appear that they date from Thwaites's time, and are probably part of the original stock. They are much smaller than the others, but they were planted in ground which had been under cultivation for a long period, while those in the South Garden were planted on newly-cleared land. Whether the trees in the South Garden were part of the original stock transplanted, or plants raised from cuttings, was not recorded. In the case of Castilloa and Ceara, Trimen recorded that some were transplanted, but he made no record of the origin of the Hevea. It would appear most probable, as he calls them " young trees," that they were part of the original stock.

The 300 trees which Trimen found at Henaratgoda in 1880 appear to have been in one group on the ground now occupied by the 45 survivors. These were thinned out in 1882, and again in 1885. The second thinning appears to have reduced their number to approximately what it is now. Willis has recorded that there were 48 in 1897.

In his report for 1881 Trimen stated that new plantations had been made, but it is not clear that that refers to Henaratgoda. In 1887 he recorded that there were 457 fine trees there.

The trees at Henaratgoda may be divided into three main groups. The first group, to the left of the main drive, is considered to be the remnant of the original plantation. The second group, which lies to the left and right of the main path, is generally believed to consist of trees of the second generation, and is supposed to date from 1886. The third group is situated at the extreme end of the Garden, bordering the river, on land which is occasionally flooded. In addition there is a small group of trees to the right of the path, between the first and second groups, and, until recently, scattered trees, probably self-sown, were to be found in the jungle bordering on the second group.

In 1897 Willis made notes of the numbers of trees, and plans of the second group, in which tapping experiments were then being conducted. He gives the number of trees in the "old plantation" (*i.e.*, group 1) as 48. His plan in the second plantation shows 226 trees and 54 vacancies to the right of the path, and 73 trees and 37 vacancies to the left. Of the third group he states: "Further on, a lot of about 20 fairly good and 50 poor trees." This gives a total of 417 trees, but ignores those between the first two groups and the scattered trees round the second.

That the first group represents the original plantation is no doubt correct. Of the third group we have no information. One is tempted to suppose that they are the second consignment, planted as far away as possible from the first; but, on the other hand, they may have been transferred to that situation from the old plantation by Trimen, when he similarly planted trees on the river bank at Peradeniya in 1881. These, however, are suggestions only.

The second group is generally said to date from 1886, and tradition states that they are the remains of a nursery established in that year. Dr. Trimen was on leave during that year, and the seed crop was not recorded. The number of seeds distributed was practically the same as in 1885, but, on the other hand, the crop increased enormously about this time.

But the facts which throw doubt on the supposition that this second plantation consists of plants of the second generation are the entries in the Conductor's reports from 1881 onwards. The original plantation was thinned out in 1882 and 1885. The plants taken out were not thrown away, but transplanted to other parts of the Garden.

On March 31, 1882, the Conductor reported that "two new clearings for about 70 *Urceola esculenta*, 30 Landolphia, and a few Hevea roots are being (got) ready"; "*Hevea brasiliensis*, several old roots were transplanted among the Liberian coffee." On September 30 of the same year he refers to "two new clearings, in which I have planted Hevea roots." On December 31, 1882, he reports that he is clearing another piece of jungle to plant out the remaining Hevea roots from the old plantation; in March, 1883, he states that the portion referred to in his last report is cleared and holed, and will be planted with Hevea and plantains, and in June he records that 116 roots have been planted out. The *Catholic Messenger* of July 3, 1883, states that "Para rubber trees have been planted out through the cacao"; from the surviving trees and the tradition of the Gardens, the cacao was situated where the first rows of the second plantation now stand.

On the other hand, there is no record that seedlings were planted out. In 1894 the Conductor wrote : "I have prepared in a spot just near the nursery in a bare ground 125 holes to plant out some of these (*i.e.*, Hevea seedlings). This I did with the intention of adding to the old plantations just near the *Tabernæmontana crassa*." This Tabernæmontana was in existence in 1897, the twelfth tree (counting vacancies) along the main path, in the second plantation. It was planted there at the end of 1883. As Willis gives all the trees there as eleven years old on his plan of 1897, it would appear that the Conductor's intention was not carried out.

From the details given it would seem probable that the second plantation was established by transferring, at different periods, the weaker trees from the original plantation. Vacancies may possibly have been supplied with seedlings. But there are no definite records (in the absence of Trimen's notebooks).

The plants distributed in 1881 were *part of the original stock*; 28 were sent to the Andamans at the request of the Indian Government, and others to Johore. In 1882 further supplies *from the original stock* were sent to Nilambur, Calcutta, Ootacamund, and plants from cuttings (*fide* Trimen) to North Borneo. In 1883 27 plants, *again from the original stock*, were forwarded to Nilambur, and 12 to a Mr. Davidson, Singapore.

In 1881 two seedlings were raised at Henaratgoda. In 1882, 36 seeds were obtained, but the number of seedlings raised was not recorded. A few were sold at 20 cents each to local purchasers. In 1883 300 seeds were obtained and 266 plants raised ; 66 of these were sold before the Director was aware of the fact, and the remaining 200 were advertised for sale. The purchasers in 1883 included Culloden estate.

Some of these seedlings were sent to Madras and Buitenzorg early in the following year. In 1884 a good crop was obtained at Henaratgoda and over 1,000 seedlings were raised, while the Peradeniya trees began to fruit in the same year ; 107 seeds were sent to Nilambur, and 3 plants to the Agricultural Society of Madras. An extensive distribution of seeds and seedlings was made locally to Government Agents and other officials, 500 plants being sent to Mirigama and 270 to Minuwangoda at the request of the Assistant Government Agent, Western Province, 6 to the Assistant Government Agent, Ratnapura, and 100 seeds to the Model Farm, Kalutara. Hevea had previously been tried at Kurunegala before the end of 1881. In 1885 the crop at Henaratgoda was about 1,400, of which 300 were sent to Nilambur, and 400 in a Wardian case to Singapore ; the remainder of the crop was disposed of in Ceylon.

In 1886 plants were sent to Queensland. Locally, 12 plants and 200 seeds were sent to the Assistant Government Agent, Kegalla. 1,175 seeds were sent to Peradeniya, where they were apparently disposed of locally. This distribution would seem to negative the idea that the second plantation at Henaratgoda was established from a nursery laid down in 1886.

In 1887 a good crop of seed was produced and distributions made to Nilambur, Penang, Fiji, Queensland, Rangoon, and Jamaica, in the latter instance 2,000 in a Wardian case *viâ* Kew. In December of that year a request was received from Singapore for seed in quantity, too late to be complied with, but in 1888, 11,500 seeds were sent ; the total crop for 1888 was over 20,000, 3,000 being sent to Nagpur and 1,100 to Fiji.

In 1889 seeds were advertised for sale in Ceylon, and for some years subsequently most of the seed was disposed of locally. A consignment was sent to Queensland in 1889, another to British East Africa in 1891, and plants to British North Borneo in the latter year. In 1892 seeds were sent to Deli, and 300 in a Wardian case to Singapore in 1893. In 1889 Hevea was planted in the newly-established Botanic Garden at Badulla, on the eastern side of the Island.

The following list summarizes the early distributions of Hevea from the Botanic Gardens stock to other countries :—

Burma : 516 plants, 1878 ; seeds, 1887.
Nilambur : plants, 1878 ; 33 plants, 1879 ; plants, 1882 ; 27 plants, 1883 ; 26 plants, 1884 ; 107 seeds, 1884 ; 300 seeds, 1885 ; seeds, 1887.
Madras Agricultural Society : 3 plants, 1884.
Nagpur : 3,000 seeds, 1888.
Calcutta : plants, 1882.
Ootacamund : plants, 1882 ; seeds, 1887.
Andamans : 28 plants, 1881.
Singapore : 12 plants (Mr. Davidson), 1883 ; 400 seeds, 1885 ; 11,500 seeds, 1888 ; 300 seeds, 1893.
Penang : seeds, 1887.
Johore : plants, 1881.
Perak : 40 plants (H. Walker), 1891.
Buitenzorg : 3 plants, 1884 ; seeds, 1887 and 1897.
Deli : seeds, 1892.
Sumatra : seeds, 1897.
North Borneo : plants, 1882 ; 40 plants, 1891 ; seeds, 1897.
Saigon : seeds, 1897.
Fiji : seeds, 1887 ; 1,100 seeds, 1888.
Queensland : plants, 1886 ; seeds, 1887 and 1889.
Mauritius : seeds, 1897.
British East Africa : seeds, 1891.
German East Africa : 500 seeds, 1891.
Jamaica : 2,000 seeds, 1887 ; 200 seeds, 1893.

In 1894 Trimen showed that the seed could be sent long distances by post, if properly packed. 200 were sent to Kew, every one of which germinated after being a month in the post.

Much has been made of the alleged failure of the Ceylon planter to take up the cultivation of Hevea in the eighties. The above records show that he had not much opportunity of doing so. Hevea, Castilloa, and Ceara were established in Ceylon in order that they might be transmitted to other countries in the East, and the records prove that the Botanic Gardens faithfully observed the conditions of their trust. Only when the demands of other countries had been satisfied were Ceylon planters able to obtain seed in quantity.

Meanwhile, the Ceara rubber produced seed in abundance, and from 1878 onwards Ceylon was able, not only to scatter Ceara seeds over the entire tropical belt, but to supply the Ceylon planter with all the seed he required. Unfortunately, Ceara proved a failure, as it still is, from a Ceylon planting standard, everywhere ; and the would-be rubber planter was compelled to wait for another ten years or so before the better known Para rubber tree was available. It has been stated that the failure of Ceara made the Ceylon planter averse to experiment with Hevea. But the records scarcely bear that out. Of course, after the failure of coffee, the Ceylon planter found tea a profitable investment, and Hevea did not for fifteen years afterwards promise a greater return, even in the opinion of its most enthusiastic supporters. But there was never any difficulty in disposing of Hevea seed, and the crop of the Botanic Gardens was generally in such demand that only a limited number was allowed each applicant. The statements that the Ceylon planter planted Hevea as a shade tree and was astonished to find later that it yielded rubber, and that he had to be persuaded to plant rubber in 1904, are, of course, merely the pleasantries of after-dinner oratory.

The first real opportunity of the Ceylon planter came in 1889, when about 8,000 seeds were advertised for sale locally. 6,000 were purchased by Mr. Farquharson and 2,100 by the Eastern Produce and Estates Co. In 1890–1892, however, the planter was again unable to obtain much seed, as the greater part of the crop was reserved for the Ceylon Forest Department. There was a great demand for seed in 1892, but only 16,000 could be supplied to private purchasers. In 1893 seed was again advertised for sale at Rs. 5 per thousand, and there were so many demands that though 91,000 seeds were available, only 2,000 could be allotted to each applicant. In 1894 86,000 were sold ; in 1895, 76,750 at Rs. 10 per thousand : and in 1897, 88,500 (1896 is not recorded). In 1898, though a large quantity of seed was then available from private estates, the Henaratgoda crop (70,000) was sold by auction at Rs. 27 per 1,000, under guarantee that the seed would be planted in Ceylon. In 1899 the price realized was Rs. 15 per thousand. Since 1899, the Botanic Gardens seed has formed only a small fraction of the available seed crop of Ceylon, the bulk of the enormous quantities which have been exported to all parts of the world being derived from those estates which planted Hevea from 1883 onwards.

From 1898 to within recent years the Hevea seed crop of the Botanic Gardens has averaged about 150,000 seeds, though 250,000 were said to have been distributed in 1902. This, of course, does not include the crop of the more recently planted Hevea (10 acres) on the Experiment Station at Peradeniya.

Among the early purchasers of seeds are the following :— In 1891, Arapolakande, Elpitiya, Gikiyanakande, Hanwella, Hylton, Vellaioya, Seenigoda, Vogan, Woodslie ; R. J. Farquharson (? Kepitigalla), J. Murton, C. Byrde, T. C. Huxley. In 1893, Arampola, Arapolakande, Beredewela, Coorundoowatte, Crurie, Deegala, Deviturai, East Gourekelle, Elpitiya, Elston, Glenrhos, Glendon, Greenwood, Ingiriya, Ingurugalla, Kaluganga, Kondesale, Kumarudola, Kotiyagala, Narthapane, Putupaula, Seenigoda, St. Leonards-on-Sea, Tudugalla, Udam mita, Wariagalla, Yataderia ; Aitken, Spence & Co., H. Creasy, J. Murton. Seeds were issued free to the Assistant Government Agent, Matara. In 1894, Alliawatte, Arapolakande, Cocoawatte, Birkin, Doranakande, Gikiyanakande, Gourekelle, Goonambil, Halwatura, Kelani, Kitulkelle, Kumaradola, Maddegedera, Mortlake, New Peradeniya, Pambagama, Passara, Polatagama, Ratnatenne, Palikerewa (?), Sunnycroft, Tudugalla, Watagoda, Wariapola, Yataderiya, Yellangowrie ; Eastern Produce and Estates Co., A. de Soyza, J. W. Orchard.

In 1896 it was reported that Halwatura had 50,000 plants, which had been planted out the previous year (*T. A.*, XV., p. 784). In 1898 Arapolakande was said to possess trees ten years old (*T. A.*, XVII., p. 854). The Kalutara Co. put out 10,000 plants in 1898 (*T. A.*, XVIII., p. 619), and Yataderia added 13,000 to their previous stock in the same year (*T. A.*, XVIII., p. 632). Culloden had 30,000 trees in 1898 (*T. A.* XVII., p. 832).

In 1899 Gikiyanakande and Igalkande reported Hevea six years old, and Wiharegama, trees five to six years : Rasagalla had 35,000 trees, the oldest two years ; and Daisy Valley, Kurunegala, had also Hevea planted (*T. A.*, XIX., p. 93). The largest tree on Culloden, sixteen years old, measured 8½ feet in circumference at 3 feet in that year, and others girthed over 7 feet (*T. A.*, XIX., p. 108). Hevea had then been planted in the Moneragala district (*T. A.*, XIX., p. 623).

In 1900 Putupaula estate reported 21 acres in coffee and Hevea, and 20,000 plants in nurseries (*T. A.*, XX., p. 271).

In 1901 Culloden and Heatherley had 40,000 Hevea, and "an estate in West Matale" 22,000 (*T. A.*, XXI., p. 15). The Kalutara Co. reported 11,883 Hevea, exclusive of the previous year's plants (*T. A.*, XXI., p. 610). Knavesmire had between three and four thousand trees (*T. A.*, XXI., p. 626) : Moneragalla, 103 acres Hevea and Ceara (*T. A.*, XXI., p. 628) : while Cocoawatte and Park estates each reported "a large number."

The Vogan report for 1902 states that 10 acres were under rubber. Yataderia had then 55,000 trees, 843 in tapping (*T. A.*, XXII., p. 698). Rayigam had 20 acres planted in that year, making, with that in tea, about 50 acres, up to ten years old (*T. A.*, XXII., p. 749).

The report of the Kalutara Planters' Association for 1902 states that 360 acres were planted in rubber in the district, in addition to 300,000 trees through tea. The output for that year was 7 tons as against 3½ tons in 1901. 1,300,000 seeds had been sold, of which 414,000 had been exported. The Kelani Valley took the bulk of the remainder, as well as 460,500 plants. (*T. A.*, XXII., p. 609.)

In 1885 the acreage under rubber, according to Ferguson's Ceylon Handbook, was 629 acres. His Review of the Planting and Agricultural Industries of Ceylon, 1888, gives the area as 386 acres, the diminution being due to the replacement of Ceara by other products. The Directory for 1890 shows an increase to 678 acres. In 1898 the area was estimated at 1,071 acres (*T. A.*, XVIII., p. 274), and in 1901 (May) 2,597 acres (*T. A.*, XXI., p. 15).

The subsequent development is shown by the following table :—

Year.	Acres.	Year.	Acres.
1902 ..	4,500	1908 ..	175,000
1903 ..	7,500	1909 ..	180,000
1904 ..	11,000	1910 ..	200,000
1905 ..	40,000	1911 ..	215,000
1906 ..	100,000	1912 ..	230,000
1907 ..	150,000	1913 ..	240,500

The exports of rubber from Ceylon are given in the following table. As there is no " wild " rubber in Ceylon the figures represent the plantation product, and practically all Hevea rubber :—

1889 ..	11 cwt.	1897 ..	80 cwt.
1890 ..	39 packages	1898 ..	25 cwt.
1891 ..	78 packages	1899 ..	70 cwt.
1892 ..	65 cwt.	1900 ..	73 cwt.
1893 ..	52 cwt.	1901 ..	66 cwt.
1894 ..	82 cwt.	1902 ..	189 cwt.
1895 ..	16 cwt.	1903 ..	389 cwt.
1896 ..	157 cwt.	1904 ..	676 cwt.

From 1897 to 1901 the older estates found that it paid them better to sell seed than to tap the trees ; hence the lack of increase in the exports during that period.

The rubber first exported was in more or less irregular lumps and cakes. After Parkin's experiments in 1898–99 the biscuit form was generally adopted, and this was readily taken by the market. Culloden, Kepitigala, Heatherley, Edangoda, Clyde, Nikakotua, Yatipawa, Igalkande, Kumaradola, Tudugalla, Aberdeen, Deviturai, Arapolakande appear in the sale lists about the end of 1902, the consignments being generally " fine thin biscuits." Figgis & Co.'s report for 1901 states : " Of Ceylon, small lots sold at high prices .... Ceylon is much liked and sells readily."

The exports of rubber seed increased to such an extent in 1898 that they were considered worthy of separate enumeration in the Customs' returns. The export of rubber plants has not been kept separate, but the total export of plants increased from less than 150 packages per annum prior to 1898 to the numbers quoted below, the increase being no doubt almost entirely Hevea plants :—

Year.	Total Hevea Seed.	Hevea Seed to Straits Settlements.	Total Plants of all kinds. Packages.	Plants to Straits Settlements. Packages.	Plants to India. Packages.
1898	95½ cwt.	92 packages	237	102	94
1899	439 packages	431 packages	357	2	297
1900	141¼ cwt.	88 cwt.	229	28	123
1901	81 cwt.	41 cwt.	331	—	226
1902	141 cwt. (80 to Burma)	1 cwt.	527	—	499
1903	196 cwt.	91 cwt.	1,212	6	989
1904	277 cwt.	74 cwt.	435	2	345
1905	697 cwt.	24 cwt.	748	4	345
1906	2,333 cwt. (India, 568) (Burma, 133)	264 cwt.	3,988	20	2,583
1907	2,016 cwt.	337 cwt.	9,536	767	5,139
1908	1,101 cwt.	151 cwt.	4,525	20	1,068
1909	925 cwt.	69 cwt.	3,840	11	869
1910 June, 1911	2,122 cwt.	74 cwt.	7,624	132	1,134

V.—HEVEA UNDER THE FOREST DEPARTMENT, CEYLON.

During the Ceara rubber boom, 1881–83, Trimen distributed large quantities of Ceara seed to all parts of the Island, *e.g.*, Vavuniya, Mannar, Anuradhapura, Jaffna, Hambantota, for experimental cultivation under the supervision of the Revenue Officers. The other two rubbers, Hevea and Castilloa, which were then thought not to be tappable before the age of ten or twelve years, were, he considered, eminently suitable for forest cultivation, and for nearly ten years he urged that view. In 1882, when Mr. F. d'A. Vincent was engaged in reporting upon the forests of Ceylon, Trimen wrote: "But there are other substances besides timber yielded by forest trees which are not suitable for private culture. Such are most of the indiarubbers, especially Hevea and Castilloa, and such even more markedly are the gutta-perchas, for which a large demand must arise before long. These products appear to me eminently suitable for cultivation by a Forest Department as a source of revenue." There was then no land in the possession of the Botanic Gardens available for extensive plantations of Hevea or Castilloa, and it was necessary, in order to ensure an adequate seed supply, if these were not immediately taken up by planters, that plantations should be established elsewhere. But at the time there was no Forest Department.

In 1883 the Castilloa began to produce seed, but as the Hevea trees were also fruiting no one wanted the former. Trimen accordingly made an attempt to get plantations of Castilloa established at Ratnapura and Kalutara, to ensure a stock of that species, but as no funds were available he was unsuccessful. 300 seedlings were, however, planted at the Model Farm, Kalutara, in the following year.

In 1884 770 Hevea seedlings, about three quarters of the total for that year, were sent to Minuwangoda and Mirigama for experimental cultivation; apparently the attempt was a failure, there being no subsequent record of any old trees in those districts.

In 1888 the organization of a Forest Department was in progress, and we find Trimen once again calling attention to the possibility of making a revenue by the cultivation of rubber. "As a valuable forest product, Para rubber may be confidently reckoned upon as a steady source of future revenue, and I strongly recommend that large plantations of it be formed in suitable places and under competent supervision in the low-country of the Western and Southern Provinces."

In 1889 the Forest Department was finally established. Towards the end of the year Trimen approached the new Department on the question of Hevea, but found it unwilling to undertake the cultivation. The opposition was however overcome, and in the Forest report for that year it was stated that "by desire of Government, this Department will undertake before the commencement of the south-west monsoon of 1890, a plantation of Para rubber from seed supplied by the Royal Botanic Garden, Henaratgoda. The place selected for the plantation is near Nambapana in Sabaragamuwa, where the climate is considered by Dr. Trimen to be suitable."

Though there had been some reluctance on the part of the Forest Department to plant Hevea, Mr. F. Lewis, the Officer in charge of the district in which the plantation was situated, supported the project so enthusiastically that its success was assured, at least from the chief point of view, that of a seed reserve. In 1890 15 acres were planted at Edangoda, on land which was, in part, flooded during the wet season; basket plants were employed and proved unsuitable for the low-lying parts of the plantation, all those subjected to submersion being killed. The remaining plants, 1,872 in number, made good growth.

In 1891 another acre was added to Edangoda, and a new plantation of 16 acres opened at Yatipawa in the same district. In 1892–3 5 acres were added to Edangoda, and a further 21 acres to Yatipawa. In 1894 no further additions were made, as there was no more land considered suitable in the vicinity; the vacancies at Yatipawa were supplied with plants grown from seed from the Edangoda plantation, some of the trees which were planted in 1891 having fruited in 1893.

In 1896 26 acres were opened at Midellana in the Pasdun korale. 3,000 seeds were obtained in that year at Edangoda and sold for Rs. 24 (Rs. 8 per 1,000, Forest Report, 1896). The total area under Hevea at Yatipawa and Edangoda was said to be 58 acres.

In 1897 the seed crop at Edangoda and Yatipawa was 11,500; these were planted in nurseries at Midellana, where 75 acres were cleared for extensions.

Meanwhile, in consequence of a communication from the Colonial Office on the subject of rubber growing in Ceylon, plans were drawn up for establishing Government rubber plantations on a much larger scale. It was proposed to open 300 acres per annum in the Pasdun korale for ten years, making a total of 3,000 acres. This proposal aroused considerable opposition, especially in the districts where planters had been building up a rubber industry for the past fourteen years, and the current opinion was voiced by the *Times of Ceylon* (October 14, 1897) as follows:—"We see that Mr. Lewis recommends further and extended cultivation in the Pasdun korale, and, if Government sanctions it, it is proposed to reserve all the Government seed available for this purpose. But we are inclined to ask, as most planters will, why should Government go into a speculation in rubber cultivation, which Mr. Broun points out will cripple the finances of the Forest Department at first, and which Mr. Lewis speaks of reaching as large an area as 3,000 acres in yearly plantings of 300 acres? This fine property is to be developed in one block, and is to have a special superintendent, as the charge of it would be too much for the Assistant Conservator of Forests. We can understand this, but we cannot understand why the Government should utilize the Forest Department and the Botanical Department to become estate proprietors and compete with private planters in the new industry. It is going beyond the functions of a Government altogether, and was never thought of in the case of tea, or coffee, or cinchona. The experiments of the Director of the Botanic Gardens in cinchona and tea, and the provision of seed for encouraging those cultivations when in their infancy, were most useful to planters, and will be gratefully remembered by them, but apparently Messrs. Broun and Lewis are going to do something much more ambitious than provide seed for planters, or discover the best localities for rubber cultivation, or the best method of extacting the rubber, such as we submit they should content themselves with."

His Excellency the Governor, Sir West Ridgeway, allayed the alarm by stating in his address to Council that the Government were only taking up the cultivation experimentally, and to supply seed to planters, and not as a commercial speculation; and in accordance with that declaration the scheme was not proceeded with.

In 1898 the Midellana plantation was abandoned, and 27 acres were opened at Korossa, near Rambukkana. The seed crop in that year was 30,000, and in 1899 it rose to 563,000. In 1900 Edangoda and Yatipawa were said to be together 64 acres in extent: 119,500 seeds were collected. No additions were made to the Government plantations until 1903, when 21 acres were added to Korossa. The total acreage in 1904 was 112 acres at Yatipawa, Edangoda, and Korossa, and $3\frac{1}{2}$ acres at the abandoned plantation at Midellana (Badureliya). Including the old trees in the Botanic Gardens, the Government then owned nearly 120 acres of Hevea.

Though the Government rubber plantations fulfilled their purpose in providing seed, the revenue otherwise obtained from them was very small. In 1902 the right of tapping, at Edangoda and Yatipawa, 64 acres of Hevea from eight to twelve years old, was leased for rather less than Rs. 1,000 per annum, and the lease was renewed on the same terms the following year. In 1906, when it was evident that there was no further need of a Government seed reserve, these plantations were sold by auction, the 112 acres, Edangoda, Yatipawa, and Korossa together, realizing Rs. 98,000.

For the information in the foregoing paragraphs I am indebted chiefly to the annual reports of the Forest Department.

VI.—Introduction of Hevea into Perak.

Hevea was introduced into Perak from Singapore by Murton, in October, 1877. Murton mentions his visit to Perak in his report for 1877, and states that "Liberian coffee, Para rubber, Brazil rubber, and the Ceara scrap rubber have been planted at Durian Sabatang and Kuala Kangsar." In the following year Mr. (afterwards Sir) Hugh Low, then Resident of Perak, referred to these plants as follows, in a letter to the Colonial Secretary, Singapore, under date July 26, 1878 :—

> The only plants of this description within my knowledge are one plant of what I suppose to be the Hevea and nine of the Manihots. These were brought here by Mr. Murton in October last, and planted at the back of the Residency, and are growing very well. They were quite small when they arrived here, but the first is about 5 feet high with branches of equal length, and the Manihots vary from 4 to 8 feet, and are growing vigorously. I believe Mr. Murton left plants of some kind at Durian Sabatang and at Thaiping or Matang, &c.

The original letter is quoted by Ridley,[1] who also states [2] that it appears that the Hevea at Durian Sabatang (Teluk Anson) were washed away by a flood shortly after they were planted. But what purports to be the same letter was quoted by Murton in his report for 1878, and on comparing the two it is seen that Murton took advantage of that opportunity to correct several of Low's statements. He writes :—" They (9 Heveas and 1 Castilloa) were brought here in October last by Mr. Murton, &c." He omits all reference to rubber plants at Durian Sabatang, and hence it would appear that none were planted there. He records that the coffee planted there was washed away.

It has been stated on several occasions that Low's plants were obtained from Ceylon. C. Baxendale (" India Rubber Journal," October 12, 1912) writes : " Two cases were sent from Ceylon to the late Sir Hugh Low, who planted them at Kuala Kangsar." But there is no record of any such consignment in the Peradeniya archives. Two cases of rubber plants were sent to Singapore in 1876, and a further consignment in 1877, both from Kew. Low, writing in 1896, referred to " the Hevea I received from Kew through Singapore," a statement which appears decisive on the point.[3]

It would seem probable that the plants which Murton took to Kuala Kangsar were part of the consignment forwarded by Kew on June 11, 1877. In that case they might be some of those collected by Cross. The 1877 consignment included 4 Ceara, 22 Hevea, and a few Castilloa. One of the Castilloa was retained at Singapore and another planted at Kuala Kangsar. One Ceara was also taken to Perak.[4] What was

[1] Bull., F. M. S., IX., p. 212.
[2] Bull., F. M. S., II., p. 3.
[3] Bull., F. M. S., II., p. 3.
[4] Singapore Report, 1878.

done with the remaining Hevea, or how many survived the journey from England, was not recorded, but it would seem probable that at least one half of the consignment was taken to Kuala Kangsar.

It may be noted that there is nothing in the records to show that more than nine Hevea survived the journey from England, or that Singapore retained any of the 1877 consignment, though it is probable that the Heveas were shared in the same way as the Cearas and Castilloas.

As already stated, 1 tree at Kuala Kangsar flowered in 1880. 16 (or 14) fruits were produced in 1881, 3 of which were sent to Ceylon. In 1882 several trees fruited, 18 seeds being sent to Ceylon, 50 to Singapore, and others to Java and India. Wray states that seed sent to Taiping in 1882 did not germinate, and the same is true of that sent to Ceylon. H. Cottam has recorded that he packed a box of Hevea plants at Kuala Kangsar for Madras, Christmas, 1882.[1] In 1884 (Sir) Frank Swettenham collected 400 seeds from the tree then in bearing, and planted them out (399 plants) on the banks of the Kangsar river.[2]

Further details of the old trees in Perak have been recorded by Wray in his "Notes on Rubber Growing in Perak," December, 1897.[3] He states that seed from Kuala Kangsar was planted in the Museum grounds, Taiping, in 1887, and had since been planted at Parit Buntar, Sitiawan, Tapah, Batu Gajah in Kinta, and other places. More were planted at Kuala Kangsar in 1891. The trees in the Museum grounds yielded 14,000 seeds in 1897, of which 3,000 were sent to Jebong and 11,000 to Yam Sing estate. From Arden's "Report on *Hevea brasiliensis* in the Malay Peninsula, 1902,"[4] it appears that seed from Kuala Kangsar was planted at Kamuning estate in 1887 and at Sitiawan about 1892.

Derry, in a report on Kuala Kangsar, 1897, stated that 25,000 seeds were supplied from the trees there in that year. Application had been made for 70,000 seed in 1897, and orders had been booked for 100,000 in 1898.

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1 "Tropical Agriculturist," III., p. 157.
2 Straits Bulletin, II., p. 61.
3 Kew Bulletin, 1898.
4 "Tropical Agriculturist," XVII., pp. 675, 808.

VII.—Singapore.

The Singapore Botanic Gardens were established by an Agri-Horticultural Society which was formed in the year 1860. In 1874, as the Society was no longer able to carry on the Gardens according to the original intention, they were handed over to the Government, and H. J. Murton was appointed Superintendent.[1]

Murton received some Hevea plants from Kew in 1876. Two cases were sent, probably 100 plants, but nearly all the plants died owing to excessive delay in clearing the consignment. In 1877 Kew sent 22 more plants, most of which (apparently) survived. From this stock Murton took 9 plants to Perak in 1877.

In 1878 Murton wrote : "Following the advice given by Mr. Cross, in his report to the India Office, I replanted the Heveas in the low ground of the Economic Garden, where they have not grown so freely as before."

In 1879 Murton stated that propagation of the Hevea and Castilloa was then rather difficult, whereas they were formerly propagated freely from the weak wood produced while in pots. The latter remark was evidently intended to refer to the propagation at Kew, for the Singapore plants were apparently planted out in 1877. Confirmation of this interpretation is afforded by the report for 1881, in which Cantley wrote that Hevea had "baffled all attempts to strike by cuttings. It is the more remarkable that precisely the same manner and treatment was observed as practised so successfully at Kew."

At the request of Kew, Murton forwarded plants of Hevea, Castilloa, and Ceara to Queensland in 1878. From the recorded experience with cuttings it would seem probable that the Hevea were part of the original stock.

The total number of plants (Hevea) retained at Singapore could scarcely have been more than a dozen. Ridley, writing in 1903, referred to nine old trees,[2] and Vernet in his account of Singapore in 1911 gives the number of survivors of the original stock as six.[3]

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[1] W. Fox : "Guide to the Botanic Gardens, Singapore," 1889.
[2] Straits Bulletin, II., p. 1.
[3] "Annales des Planteurs de Caoutchouc de l'Indochine," 1911, p. 660.

In 1882 Singapore received 50 seeds from Perak, but whether the number of trees at Singapore was increased thereby has not been recorded.[1]

In 1884 Cantley, who was then Director of the Botanic Garden, organized the Forest Department of the Straits Settlements, the two Departments, Botanic Gardens and Forests, being officially distinct, but under the same Director; and during the next few years the care of the foreign rubber plants passed entirely into the hands of the Forest Department. In the report of the Forest Department for 1885 it was recorded that American, African, and native rubbers had been planted in the Tanglin nursery, Singapore; "rubber trees of sorts" in the Bukit Bruang nursery, Malacca; and Ceara and Hevea in the Waterfall nursery, Penang. It is most probable that these were in part the outcome of the 400 seeds which were sent from Ceylon in a Wardian case in 1885, a consignment which must have doubled the number of Hevea in the Straits Settlements. The Economic Garden at Singapore was transferred to the Forest Department in 1886, and thereby all the Heveas in the Straits Settlements were placed under that management.

In 1886 the forest reserves of Singapore consisted of about 11,500 acres, only about one half of which was under timber: in addition there were 22,000 acres in Malacca and 8,800 acres in Penang, in approximately the same condition. There was therefore a large area available for planting Hevea. But although the Forest reports for 1885 and the following years give details which reveal vigorous efforts in raising young trees and replanting the waste lands of the forest reserves, Hevea is not mentioned among the trees selected. As a matter of fact Cantley had not formed a favourable opinion of the new rubbers. In his report for 1885 he stated: "The foreign rubber trees mentioned in previous reports continue to grow well, but in a country where the best rubbers grow wild it is somewhat superfluous to refer to foreign species, the ultimate success of which may be doubtful. What is more required is the careful conservation and cultivation of native

[1] Straits Bulletin, II., p. 3.

kinds, the growth and produce of which in our soil is not a matter of question." Again, in 1886, he wrote: "Other foreign rubbers, such as Para, Ceara, and Panama rubbers, grow well, but so far as experiments have gone the produce of latex is very watery, and it is doubtful whether they will hold their own against the better native kinds." And this was five years after the extremely favourable reports on Trimen's samples from Ceylon! These remarks of Cantley's would seem to afford a sufficient explanation why Hevea was not made use of in replanting the forest reserves.

In December, 1887, Cantley left Singapore on leave, and his place was taken temporarily by Derry, who was then Assistant Superintendent of Forests, Malacca. Ceylon received a request from Singapore for Hevea seed in quantity that year, too late to be complied with, but in the following year 11,500 seeds were sent, and from these 8,000 plants were raised.[1] Thus, for the second time, Ceylon must have more than doubled the number of plants in Singapore. Ridley, who assumed charge of the Botanic Gardens and Forest Department in November, 1888, has recorded that nearly all the old trees in the present Botanic Gardens were raised from that consignment,[2] but it would seem probable that some of them may have been those sent in 1885.

In the report for 1889 it is stated that there were 1,095 young Heveas in the Bukit Mandai and Sambawang reserve (Singapore), but no further extensions are recorded for Singapore, Penang, or Malacca. The Malacca report for 1890 records the planting of 397 Hevea. In 1891 eight acres were planted at Sambawang, and it was stated that more seed was urgently required. In 1892 2,050 Heveas were planted at Bukit Mandai, covering 13 acres. From that year extensions appear to have ceased until rubber had attracted the attention of planters. The management of the forest reserves was separated from that of the Botanic Gardens at the end of 1894, and though the latter retained the Economic Garden, it was allowed to grow up in scrub jungle to such an extent that in 1897 it had to be recorded that the greatest amount of labour

[1] Ridley, Annual Report, Forests of Singapore, 1888.
[2] Agricultural Bulletin, 1898, p. 230.

was expended in clearing the scrub, so that the Hevea seeds might be collected. In 1898 Hevea was sent to Lumut and Balik Pulau for planting in the forest reserves, and more trees were planted in the Economic Garden.

Rubber attracted practically no attention in Malaya in the early nineties. The annual reports of the Residents of the various States usually make some reference to the progress of the planting industry, but none of them mention rubber. The Selangor report for 1894, Perak for 1895, Kuala Kangsar for 1896, may be instanced. During those years planters were interested chiefly in coffee, so much so that one report (Kuala Langat, 1896) refers to the " universal coffee fever." Even the accounts of well-known estates, *e.g.*, Jebong, Selinsing, do not refer to it : Selinsing, in July, 1897, was stated to have coffee, nutmegs, and ramie.[1]

The earliest reference to rubber planting on an estate in Malaya which the writer has been able to discover is to be found in the " Tropical Agriculturist " for December, 1895 (XV., p. 397), where the editors record that they had received a visit from Mr. Baker, who had planted, or intended to plant, 500 acres in Lower Perak.

In 1897 a slump occurred in coffee. The heavy fall in the price of coffee caused widespread alarm in the Native States, and it was alleged that coffee growing would no longer pay except under exceptional conditions.[2] The report of the Selangor Planters' Association for 1897 states : " It is evident that coffee planters must turn their attention to the cultivation of other products as well, and your committee are glad to be able to report that a large number of the valuable Para rubber trees have been planted."

The choice of rubber, to replace or supplement coffee, was no doubt due in a great measure to the energetic propaganda which had been carried on by Ridley at Singapore for many years. To some extent also the decision would be influenced by the successful experience of Culloden, and the steady rise in the price of this product, which had been on the up grade

[1] "Tropical Agriculturist," XVII., p. 276.
[2] "Tropical Agriculturist," XVII., p. 565, *ex* Straits paper.

since about 1893.[1] In the "Home and Colonial Mail" of June 5, 1896, it was stated : "The boom in rubber goes on merrily. The price of best Para has gone up within the last few weeks from about 2*s.* 9*d.* to 3*s.* 9*d.* per lb., and it is thought by the trade that 4*s.* or so may be reached." [2] And the "Colonies and India" (March 20, 1897) referred to "the coming rubber boom" when the hard Para reached 3*s.* 7*d.*[3]

The Selangor Resident's report for 1897 stated that experiments were being made with Para rubber, and exceptionally favourable terms for the acquisition of land for that purpose were sanctioned during the year, and the monthly report of the Acting District Magistrate, Matang (? December, 1897), records that Mr. Stephens, of Jebong estate, had applied for some 3,000 acres of land for rubber planting in accordance with the terms of the Circular lately issued.[4] The report of the Selangor Planters' Association for 1898 states : "Probably no more important evidence that planters are at last realizing the futility of risking their all on any one product has been afforded during the past year by the energy with which large areas have been planted up with Para rubber. Had it not been for the shipments of seed from Ceylon, operations would have been considerably restricted, as the local supply was nothing like sufficient to supply the demand."

389,500 Hevea were planted in Selangor during 1898 (P. A. report). The reference to Hevea in the report of the Planters' Association, Selangor, for 1899, is as follows :—

Para Rubber.—The low prices for coffee during 1899 stimulated the cultivation of this product very considerably, and no less than 1,600,000 imported and locally grown seeds were put into nurseries in Selangor, which have produced, say, 1,000,000 healthy plants, all of which either have been or are being planted out. On all estates in Selangor where Para rubber has been planted it is doing extremely well, and at present it seems as if rubber was going to be one of the leading products of the State. . . . It is satisfactory to report that through the representations of the U. P. A., F. M. S., the Federated Malay States Government have voted a sum of $4,000 in the 1900 Estimates for the purpose of carrying out experiments with rubber and other products.

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[1] "Tropical Agriculturist," XIII., p. 11.
[2] "Tropical Agriculturist," XVI., p. 102.
[3] "Tropical Agriculturist," XVI., p. 782.
[4] "Tropical Agriculturist," XVII., p. 486.

In 1899 a difficulty arose with regard to the supply of seed from the Singapore Gardens, owing to the cancellation of orders from planters in the Native States until such time as Singapore demands had been satisfied. The seed crop of the Botanic Gardens for that year was expected to be 150,000, and one planter who had ordered 500,000 could be supplied with 15,000 only.[1]

The report of the Selangor Planters' Association for 1900 states that 1,146,870 seeds, imported and local, had been planted that year, and the same authority gives the total area under Hevea in 1901 as 7,487 acres. An account of rubber planting in Malaya in 1902, in the "Tropical Agriculturist," XXII., p. 178, puts the area as follows :—

Selangor	2,926	British North Borneo	100
Perak	540	Johore	200
Negri Sembilan	678	Province Wellesley	100

Objection was taken to this estimate by Mr. Francis Pears, who stated that the acreage in Johore was then 1,000.[2]

It is evident from the foregoing that the demand for Hevea in Malaya first made itself felt in 1897, when it was evident that coffee was on the down grade. It is also clear that in the earlier years of the rush planters were dependent on Ceylon for their seed, the local supply being quite inadequate. Another interesting factor in the development of the industry is recorded in the report of the United Planters' Association of Malaya for 1902, where it is stated that "from Ceylon comes the most pronounced inclination to invest in this product." It was already known that Hevea would pay in Ceylon, but it was recognized that the growth of the tree was better in Malaya, and Willis, in his pamphlet on Castilloa of 1899, advised those who wished to plant rubber to go further East. In accordance with that advice, many Ceylon planters embarked on rubber planting in the F. M. S. Indeed, as is well known to the older generation of rubber planters, the earlier estates of Malaya were planted in great part by Ceylon planters, with Ceylon seed and Ceylon capital.

[1] "Tropical Agriculturist," XIX., p. 301.
[2] "Tropical Agriculturist," XXII., p. 271.

The distribution of seed from the Singapore Botanic Gardens, as recorded in the annual reports, was as follows :—In 1896 2,810 seeds were distributed, " a very large amount " according to the report. In 1897 the demand was said to be in excess of the supply, but only 21,035 plants and 10,875 seeds were distributed, though the seed crop was said to be 83,000. In 1898 the crop was 98,650, and these were all distributed, together with 10,650 plants. From 1899 to 1906 the seed crop varied from 150,000 to 175,000 per annum, approximately the same as that at Henaratgoda, but since then it has risen to 372,500 (1911), probably as a result of the more recent extensions. The distribution of seed from the Singapore Gardens has, however, been much greater than these figures indicate, an extensive trade having been carried on in seed purchased from neighbouring estates. In 1911 465,000 seeds were purchased and distributed.

VIII.—India.

A list of the consignments of seeds and plants sent from Ceylon to India has already been given. The locality chosen for the establishment of plantations of all the three American rubbers was Nilambur.

Cross, who visited Nilambur in 1881, reported that the Hevea had seemingly not found its proper habitat there. The young plants had shot up like long whip-handles with a bunch of leaves on the top. He suggested that some should be planted in the Carcoor Ghat at an elevation of 1,000 feet, and others at about 2,000 feet.

The following further details of the Nilambur plantation have been taken from the Kew Bulletin for 1898 :—

> At Nilambur the rubber trees (Ceara and Hevea) were planted amongst teak trees. In the Administration Report for 1884–85 it was stated " the growth of the rubbers on the whole continued good, though Mr. Hadfield doubted whether they would yield much revenue, as there was little milk in the seven-year old trees." Again : " One pound of rubber was obtained from 80 of the largest trees in 1886–87, but no tapping was done subsequently."

No distinction appears to have been made in these reports between the Hevea and Ceara rubbers. It is possible that the failure noted applies more particularly to the latter trees.

The latest information available on the subject is contained in the report of the Nilambur Teak Plantations, 1895 (Appendix C, p. 69). The following remarks (quoted from Commercial Circular, No. 8 of 1897, issued by the Reporter on Economic Products to the Government of India) appear under Exotic Plantations—Rubber :—

3. *Working.*—The rubber is quite out of place in the middle of a teak plantation, even should it prove itself of any commercial value. The soil occupied is some of the most valuable in the plantations. Experiments are now being conducted in tapping the rubber, and, as far as they have gone, show little prospect of any material revenue being realized. The biggest trees are now nearly twenty years old, and each covers the space required for two teak trees of the same age. The yield appears to be from 4 to 6 oz. of rubber, which production may perhaps be continued for five or six years (even this is very doubtful), and the result expressed in current coin would compare very unfavourably with the value of two teak trees of the same age.

Probably the most paying thing to do would be to fell this area in 1895, clean, and to plant it up with teak. In order, however, that the success or failure of the rubber growing may be proved, it is proposed to clean and fell at the end of the first rotation in 1900, when very few saplings of small size will be available, and plant up the whole area with teak in 1901. This compartment will then work into the working circle."

In a note on the Working Plan for the Nilambur Valley Teak Plantation, the Inspector-General of Forests in India, Mr. B. Ribbentrop ("Indian Forester," 1898, p. 168), discusses the suggestions for cutting out the rubber trees as follows :—

It would appear that the experiments carried out with the introduction of rubber-yielding trees have so far been unsuccessful, but I feel nevertheless disinclined to agree in the proposal that the experiments of making the Nilambur basin an important centre of rubber supply should be discontinued........ To me it seems that the Nilambur basin is eminently adapted for the growth of rubber-yielding plants, and the facility of export renders the prospect of a trade in a product which can bear a land transport of hundreds of miles particularly attractive. The demand for rubber, and its price, are constantly increasing, and I would strongly advise that experiments should be continued till the most suitable rubber-yielding tree is found, which will grow in localities not required for the extension of the teak plantation."

IX.—Burma.

A Note on the Cultivation of *Hevea brasiliensis* in the Tenasserim Forest Circle was written by Colonel W. J. Seaton, Conservator of Forests, in 1888 (see Kew Bulletin, 1898, p. 264)

Hevea was first planted at Mergui in 1877, when eight seedlings, the survivors of a small batch received from Dr. King, the Superintendent of the Royal Botanic Gardens, Calcutta, were planted out in the Forest office compound.

In 1879 a large number of Hevea plants were sent from Ceylon, but although a man was sent in charge, only 178 survived the voyage. These were planted out about $1\frac{3}{4}$ mile inland from Mergui, on somewhat low ground drained by the sources of the Boke Chaung. Only 64 of the plants survived the planting operations, and this number was reduced, chiefly through the attacks of white ants, to 50 in 1886.

Propagation by cuttings was attempted in 1879 and later years, but without success, " the cuttings generally dying off during the second year." In 1884 a few of the older trees began to produce seed, and 51 seedlings were raised : these were transplanted to the main plantation, but only 28 survived. A large quantity of seed was produced by the fifty old trees in 1885, but it was kept too long, and only 121 seedlings were raised. In 1886 better results were obtained by sowing the seed early, " and by the part removal of the husk enclosing the seed." (This latter statement would appear to make it doubtful whether these records really refer to Hevea.) 7,030 seedlings were raised in 1886, and 8,430 in 1887. (In view of the records of the Ceylon crop from over 300 trees, these figures must be considered doubtful : do they refer to Ceara ?) 54 seeds were received from Ceylon in October, 1887, but all failed to germinate.

The stock in 1888 was as follows :—

Trees planted, 1879	50
Seedlings of 1884–86, planted out ..	2,752
Seedlings in nurseries	12,039

In the year 1900 the establishment of a rubber plantation of 10,000 acres in Burma was sanctioned. As it had by this time been demonstrated that the cultivation of Hevea was a profitable industry, and planters had for several years been opening up estates in rubber, the prospect of Government competition aroused considerable resentment. The question was raised in the House of Commons, where Lord George Hamilton, replying to Mr. Sharpe (Kensington N.), stated : " The Government of India have authorized an extensive experimental plantation of the Para rubber tree in the Tenasserim division of Burma .... I am aware that attempts are being made to develop the production of rubber in Ceylon and elsewhere by private enterprise, but I do not think that this is a reason why the Government of India should not do their best to develop their resources in that country, and encourage private enterprise by showing that this tree can be profitably cultivated in parts of India" (May 18, 1901).

Later in the year the Ceylon Planters Association presented a memorial to the Secretary of State for the Colonies protesting against the proposed plantation in Burma, and their example was followed by the United Planters' Association of the Federated Malay States. How far these memorials influenced future action is not known, but operations appear to have been confined to planting 663 acres and clearing another 772 acres in 1902 (*T. A.*, XXII., p. 606).

The foregoing particulars may be supplemented by several additional details from "Notes on the Cultivation of *Hevea brasiliensis* in Burma," by W. A. Hearsey.

Hearsey states that of the eight seedlings planted in the Forest office compound at Mergui (now the Mergui Municipal School), two were alive in 1906. Their girth was about 5 feet. They were tapped as an experiment in 1902, when 2½ lb. of dry rubber was taken from each.

In 1898 36 of the fifty odd trees which were in existence at Bokchaungale in 1888 were still alive.

The number of seedlings in the nurseries in 1888, which, as we have said, seems scarcely credible, becomes 42,039 in Hearsey's account. He states that planting seems to have been carried out over the 56 acres of the Mergui Experimental Garden up to the year 1892, about 8,000 to 10,000 plants being put out at 20 feet by 10 feet. In October, 1898, there were 5,000 trees of all sizes.

With regard to the proposal to establish a plantation of 10,000 acres, Hearsey states that, up to 1906, 2,500 acres had been planted up by Government, viz., 1,500 acres in Mergui and 1,000 acres on King's Island.

Seeds from Mergui were planted at Bhamo in 1889 by C. W. Palmer. The seedlings were planted out by Hearsey in the following year, along the road from the Forest House to the Bhamo Fort.

In 1899 a small area was opened at Kambe near Rangoon as a combined rubber estate and sewage farm. The seeds were apparently obtained from Mergui in 1900. In 1901 there were 2,159 Hevea and 502 Ceara on an area of 27 acres (*T. A.*, XXI., pp. 303–7). In 1902 this was said to have been taken over by the Forest Department from the Cantonment Committee, who had previously had charge of it (*T. A.*, XXII., p. 606) ; but according to an account of the plantation published by Lt.-Colonel Wylie in 1909, it was still in charge of the Committee. The number of Hevea in 1909 was 6,160.

X.—Penang.

Hevea was planted in the Waterfall nursery, Penang, in 1884, presumably from Singapore. Seeds were sent there from Ceylon in 1887. Very few trees appear to have survived, the whole seed crop in 1897 being 600. Penang is chiefly to be remembered as the scene of Curtis's tapping experiments.

XI.—Andamans.

The consignments to the Andamans have already been mentioned. The Deputy Conservator of Forests, Port Blair, has kindly furnished the following information, under date January 23, 1914, concerning the rubber trees now growing there :—

There are 30 Para rubber trees (*Hevea brasiliensis*) planted east of the Namunaghar main road opposite the approach road to the vegetable garden. Some of these were the first trees to be tapped by Mr. Kelly. They appear to be of different ages, and there is no clear record of what was done with them.

Apparently 28 stocks or stumps were received from Ceylon and planted about September, 1881 (Annual Report, Port Blair Settlement, for 1881–2) . . . . . . The report for 1883–4 shows that they had reached a height of over 20 feet, and mentions that some cuttings (? stumps) were put down in January (? 1884). It would appear that altogether some 40 plants were put out.

This small plantation was made over to the Forest Department in 1904–5, "together with 9,207 Ceara trees," according to the report of the Settlement, but no mention of this fact is made in the Forest Report, and the Ceara trees certainly have never been taken over.

These 30 Para trees at Namunaghar are planted on flat ground just above sea level, between the road and the mangrove swamp near the mouth of the freshwater stream. The soil is alluvial, and may be called a loam.

They were apparently planted in five rows of eight, at 15 feet apart, thus occupying an area of 120 feet by 75 (say one-fifth of an acre). The tallest trees are now 60 feet high, and the largest girth taken at 3 feet from the ground is 4 feet $8\frac{3}{4}$ inches.

The majority have done quite well, only they have suffered from being too closely planted, and there is nothing to show that they received any cultivation, except possibly in the first few years.

Seven are now above 4 feet girth, eleven from 3 feet to 4 feet girth, and ten are from 2 feet to 3 feet, and only two below 2 feet, on measurements taken at 3 feet above ground.

Over 10,000 seeds were obtained in 1913 from these trees, and sown in the nursery at Goplakabung.

XII.—Tapping Experiments, &c.

In 1881 Trimen carried out trial tappings on the Henaratgoda trees, and reported that the latex of the Hevea and Castilloa was " already " in a more concentrated form than that of the Ceara. In the following year rubber was obtained from five Heveas by smoothing one side of the tree and making short cuts with a knife ; in that way $2\frac{1}{2}$ ounces of dry rubber was obtained. This was forwarded to Messrs. Silver, who reported that the rubber did not differ chemically from the better descriptions of Para, but that the ash was only about one half that of the latter. " As far as can be determined on so small a sample, there is reason to believe that as regards strength and elasticity it would be fully equal to good Para indiarubber." It was valued at 4*s.* per pound. Samples of Castilloa and Ceara were also sent, and on the results of the examination of the three rubbers Sir Joseph Hooker wrote as follows in the Kew Report for 1882 : " The task initiated by the India Office has now been successfully accomplished. A stock of authentic plants of the species yielding the three most important South American rubbers has been introduced into the East, and it has been shown that they are capable of yielding, under the conditions of Indian climate, products in no way inferior to those produced by them in their native countries."

Hevea was again tapped at Henaratgoda in 1883, and there is still in the Peradeniya Museum a sample of twelve ounces obtained in that year. Samples of Hevea, Castilloa, and Ceara rubber from Henaratgoda were exhibited at the Colombo Show in 1883.

After that date the trees appear to have been left alone, the impression being that they could not be tapped safely until they were ten years old ; but no exact statement can be made, because Trimen's diaries for Henaratgoda, and his notes on rubber, are missing from the Peradeniya records.

In 1888 Trimen tapped one of the Henaratgoda trees, eleven years old—circumference 50 inches at 3 feet. It was tapped during three periods of dry weather, viz., 7 days between January 25 and February 15, 6 days between July 20 and August 29, and 4 days between December 6 and 20. The total yield was 1 lb. 12¾ oz., the rubber being in thick strings and small cakes, the former coagulated on the tree and the latter in the cups. Tapping consisted of single oblique incisions, as before. Part of this sample is still in the Peradeniya Museum in fair condition.

The same tree was tapped again in 1890, for 17 days, on about the same dates as before. Small V cuts were made with a chisel, instead of oblique cuts with a knife. Some of the latex was collected in coconut shells fastened with clay to the base of the stem, but most of it coagulated on the tree : 2 lb. 10 oz. of rubber was obtained. In 1892 it was again tapped in the same way, and 2 lb. 13 oz. obtained : 2 lb. of this was sent to England and valued at 2*s*. 3*d*. to 2*s*. 6*d*. per lb. ; the brokers reported that the quality was very good indeed, and the curing seemed to have been effected in the proper manner ! In 1894 the same tree yielded 3 lb. 3 oz., and Trimen stated that he had little doubt it would have borne tapping every year ; this year's sample was valued in England at 2*s*. to 2*s*. 4*d*. per lb. In 1896 3 lb. were taken from it.

The first record of any tapping at Singapore occurs in the report for 1890, where Ridley stated : " The Para rubber trees continue to thrive in the damper spots, and those that are old enough to cut produce a considerable quantity of rubber, which appears of good quality. Samples have been sent to England for analysis. If the quality is satisfactory this plant will be well worthy of cultivation in many spots of damp waste land, in which few other crops can be grown without great expense in draining." In the report for the following year (1891) it is stated that Messrs. Silver had pronounced the sample of very good quality. The old idea as to the tappable age of the tree, derived from the accounts of Cross and others, still handicapped the new product, Ridley adding that fast as the tree grew it would be nearly ten years before it was at the best stage for tapping. The methods adopted were not recorded.

The trees at Mergui were tapped in 1888. Five ounces were collected from five trees in July and 12 ounces from 42 trees in November. Large numbers of incisions were made, an average of 22 per tree in the five largest trees (average girth 37 inches), and an average of 12 per tree on the smaller (average girth 31 inches). The samples were reported upon by the Silvertown works.

About the year 1896 rubber began to attract more attention. The price of the product began to increase, and prospects of profitable cultivation appeared more favourable. Probably for the latter reason the Kew authorities began to inquire into the fate of the plants sent out by them in 1876–77, and so stimulated those responsible for the management of Colonial Botanic Gardens to renewed effort, while as has already been shown, the failure of coffee in the F. M. S. provided there a sufficient inducement to the planter to seek after new products.

The reception accorded to the Peradeniya report for 1896 illustrates the trend of opinions on the subject of rubber planting. The information it contained on this question did not amount to much, but it appears to have been the first notice to attract general attention. The American rubber journal, "The India Rubber World," wrote of it as follows (September 10, 1897) :—

The most important steps in rubber cultivation now under way are being taken in Ceylon, where the new Director of the Royal Botanic Gardens is addressing himself to the task enthusiastically, in the belief that results of great value are attainable. The new Director of the Royal Botanic Gardens in Ceylon is a believer in the cultivation of indiarubber as practicable at least for that part of the world .... It may be that Mr. Willis has found in Ceylon exceptionally favourable circumstances, and that the hundreds of planters who in that Island are now seeding Para rubber alongside their tea estates may derive a profit therefrom as promptly as the last generation did from their first plantings of tea. Though we Americans are little tempted to invest in rubber plantations under any conditions, we may watch with interest the development so confidently predicted in Ceylon, remembering that we, no less than the rest of the world, have profited from the enterprise shown by the English colonists there for more than a third of a century in the growing of cinchona.

"The Tropical Agriculturist," commenting on the same report, wrote : "Mr. Willis's sober statement of fact is by no means discouraging to the actual or intending rubber planters .... There is, therefore, clear encouragement to go into rubber with the Para kind" (*T. A.*, XVII., p. 41)........ "Following the Henaratgoda experience as tabulated by Mr. Willis, we consider Para rubber culture as safe an industry as any which can be recommended to capitalists and planters who are not in a hurry for immediate returns" (*T. A.*, XVII., p. 83).

In the same year, in response to an inquiry from the Colonial Office initiated by the Director of Kew, Sir William Thiselton Dyer, a Sessional Paper (XXIII. of 1897) was published by the Ceylon Government, recounting the progress made in Ceylon. It contained a history of Hevea in Ceylon by the Director of the Botanic Gardens, an account of the plantations under the Forest Department, by Mr. F. Lewis, and details (with estimates) of a proposal to establish a plantation of 3,000 acres. The reception accorded this proposal by the planting community has already been referred to.

In June, 1897, Ridley published an article on Rubber Cultivation (Agricultural Bulletin of the Malay Peninsula), which included several new points of the greatest importance. In the first place, he stated that the trees could be tapped at the age of three, if well grown, though it was better to wait until they were five. Previous writers had all been of the opinion that tapping should not be begun until the age of ten, and the earlier rubber planters had consequently planted Hevea on estates of other products as a secondary crop ; but Ridley's declaration brought the planting of rubber as a sole product within practical range.

Secondly, he adopted the herring-bone method described by Collins, in preference to the single V's or isolated oblique cuts described by other writers. It is probable that this was not adopted from Collins, but from local Malay practice. Wray ("Rubber Growing in Perak") stated that this was the way the Ipoh trees were tapped by the wild tribes of Perak, and that it was also used by Malays in tapping trees for bird-lime. It was employed at Taiping in July, 1897 (Wray), and by Derry at Kuala Kangsar, August, 1897. Wray also records that the Kuala Kangsar trees were tapped in this way by Malays in 1888–9.

But more important than either of these, Ridley described the method, now universally employed, of re-opening the original cut. This was an entirely new departure from the methods in vogue on the Amazon, and it is not too much to say that it, more than anything else, has made rubber planting a paying industry.

Ridley estimated that 2 lb. per year could be obtained from a five- or six-year old tree, and recorded that a nine-year old tree tapped every day for a week had yielded 30 ounces. Tapping was performed with a chisel and a hammer. The latex was collected in cigarette tins provided with a lid, allowed to coagulate naturally in the tin, and dried in the sun. He advised that it was best to tap in the evening as the latex is then thicker, and that the trees should be planted 12 feet apart, or even closer. The latter recommendation was in accordance with the idea that it was best to have as many stems as possible to the acre and to prevent branching low down, while the former agrees with the method of natural coagulation in the cup. The latex was left in the cup all night and the coagulated rubber collected the following morning.

In the same year (1897) Curtis tapped one of the Penang trees which had been planted in 1886. He recorded that only half an ounce of rubber was obtained on the first day, but by renewing the cuts on seven subsequent occasions 1 lb. of dry rubber was obtained. The rubber was allowed to coagulate naturally and was dried in the sun. Part of the sample was sent to England in the following year, and was valued at 3*s*. 3*d*.

per lb. In 1898 the same tree was again tapped. Seven full herring-bone cuts were made with a chisel, and the latex was collected in tins fastened to the tree with a nail and clay. The tree was tapped 15 times in 34 days, and 3 lb. of rubber was obtained. Its girth was then 41 inches. The latex was allowed to coagulate naturally except on two occasions, when water got into the cups, alum being used in those cases.

Curtis's reports for 1897 and 1898 contain the first recorded observations on the phenomenon which is now known as "wound response." In 1897 he pointed out the small yield at the first incision and the subsequent increase, in general terms; while in 1898 he recorded the separate yields for each day's tapping, showing an increase in yield up to the seventh tapping. No other experimenter in the East had recorded that previously—Ridley, for example, writing in 1897, does not mention anything of the kind; and therefore whatever credit is attached to the re-discovery of "wound response" must be assigned to Curtis.

In his 1899 report Curtis again referred to the necessity of re-opening the wound, and in 1900 he mentioned "smoke drying," after coagulation. The Penang tree tapped by Curtis was re-tapped annually until 1909, the total yield for 13 years being 52 lb. 6 oz. It is to be noted that this yield is not comparable with yields obtained by modern methods of treatment, because in the earlier years (up to 1904 ?) the latex was allowed to coagulate naturally, and the rubber consequently retained a high percentage of moisture; Ridley states that these earlier samples lost 35 to 40 per cent. on washing.

In January, 1898, Willis issued a circular on Rubber Cultivation in Ceylon, dealing solely with Hevea. It was chiefly a reprint of earlier records, but included the result of six tappings, at weekly intervals, on 27 trees, about 2 feet in girth, carried out in 1897: the average yield per tree was a little over 5 oz. The trees were tapped by separate V's, as in the method employed by Trimen, and, as elsewhere at this date, the latex was allowed to coagulate in the collecting cups. Willis estimated that, with 300 trees to the acre, a yield of 120 to 140 lb. per acre might be expected after the tenth year, with a prospect of a good return on the capital invested.

Among the recommendations of this Circular were (1) that the trees should be tapped when 24 inches in girth, which a few might reach in the sixth year; (2) that the best results "had been obtained" by planting 8 or 10 feet apart; (3) and that not more than 10,000 acres in Ceylon was suitable for profitable rubber cultivation. In accordance with the latter view, Willis advised in the following year that those who wished to plant rubber on a large scale would probably do better in countries further East.

Willis's statements concerning the yields of Hevea in Ceylon, based on the Henaratgoda trees, were vigorously combated by rubber planters in Kalutara, where Hevea had now been tapped for several years and yields of 4 to 5 lb. per tree obtained. It was on these results, not those of the Botanic Gardens, that Ceylon planters based their faith in rubber. Harrison (in letter, Peradeniya file) stated that 4 lb. of rubber were taken from one Culloden tree in 1895, and 3½ lb. in 1896.

A memorandum on Rubber Growing in Perak was drawn up by Mr. L. Wray in December, 1897, and issued in January of the year 1898 (*T. A.*, XVII., p. 621, *ex* "Malay Mail," January 19). Wray stated that 15 to 20 feet apart would appear to be the correct spacing, but at 20 feet it might be necessary to plant something in between them to keep them from early branching, a course which would not be necessary if the trees were planted at 15 feet. In Larut, on an estate at Kampong Dew, Hevea was being planted 10 feet by 10 feet, with the intention of thinning them out later to 20 by 20 feet. On July 5, 1897, tapping was begun on a tree at Taiping by a herring-bone, ¼ inch wide, extending to the wood. The cuts were re-opened several times, until they were half an inch wide. The knife employed was "like a boat-builder's draw knife," with two handles and a U-shaped cutting edge. Further particulars were not given.

A report by Derry on the trees at Kuala Kangsar, dealing chiefly with the year 1897, was published in 1898 (*T. A.*, XVII., 832). The trees there were tapped in August, 1897, and by the end of October 60 trees had been tapped, and 88 lb. of rubber obtained. Trees 6 years old averaged 10 oz., while trees 12 years old produced 3 lb. each. They were tapped daily, herring-bone fashion, with a pruning knife, and the cuts were re-opened with a chisel. The latex was collected in tin boxes, provided with a lid, nailed to the base of the tree, allowed to coagulate naturally, and then kept in smoke for about a week. Derry recommended that the trees should be tapped in the evening, and that they should be rested when leafless. He stated that tapping could begin in the fifth year, and advised planting at 14 feet by 14 feet. His samples were valued at 2*s*. 8*d*. and 3*s*.

An account of the further tapping of the Kuala Kangsar trees is given in the report of the Superintendent of Government Plantations, Perak, for 1900. Tapping was begun in March, 1899, and continued until July, 82 trees, average age 14 years, being tapped. Alum was employed in coagulation, and the rubber afterwards smoked. The yield was 327 lb. of best and 33 lb. of scrap, the former realizing 3*s*. 10*d*. and the latter 2*s*. 6*d*. per lb. The eleven best trees gave over 97 lb., one yielding 12 lb. 1½ oz.

Derry noted that there were two well-marked varieties of Hevea at Kuala Kangsar, (1) the typical tree, generally branching low down, with large leaves attaining 13 inches in length and 5 inches in breadth; and (2) a tree with smaller leaves, taller trunk, and smaller, rather pointed seeds, the latter being the inferior. The record is the more interesting because the Kuala Kangsar trees were derived from Low's original nine, and the latter were part of one consignment, *i.e.*, those brought by Cross.

In 1899 Parkin published the results of experiments which he had been carrying out in Ceylon for about a year.[1] His Circular, which runs to 64 pages, contains information concerning the latices of other species then grown in the Botanic Gardens, but deals chiefly with Hevea. It forms the most notable contribution to the knowledge of Hevea rubber up to that date, and indeed for many years subsequently; and is still worth consultation both for its facts and its suggestions.

[1] Parkin, J., Caoutchouc or Indiarubber, Circulars, Royal Botanic Gardens, Series I., Nos. 12, 13, 14, June, 1899.

On the question of tapping, Parkin investigated the yield from single incisions in varying directions, and from V cuts, and concluded that, unless the flow was poor, the V did not give double the yield of the single oblique cut. He tapped with chisels of various patterns, and collected the latex in tins provided with a spike to fix them to the tree, and a lid to prevent bark, &c., falling in. Throughout he employed the single cuts recommended by Cross and Wickham, and did not experiment with the herring-bone method or the timber scoring knife recommended by Collins. His notes on "wound re-action," now generally known as "wound response," constitute the first attempt at an investigation into that phenomenon, though in the actual observation of it he was ante-dated, so far as the East is concerned, by Curtis; Willis had recorded in the previous year that the second tapping yielded more than the first, without making any special comment on its importance. Parkin advised that the tree should not be tapped all round, though he only contemplated single incisions. His results on tapping are of fundamental importance, though he did not attempt the method of re-opening the cut now universally adopted. His remarks on that point appear to show that he was acquainted with that method, but rejected it as too dangerous: Curtis visited Ceylon in 1899, and described the method, but too late for it to be employed in Parkin's experiments.

It may be noted that the dates given in Parkin's Circular are conflicting: it is signed April 13, 1898, by Parkin, and May 25, 1899, by Willis, while the date of publication is given as June, 1899. The experiments described extend to June 6, 1899.

In dealing with the latex, Parkin departed altogether from the practice hitherto current. It had previously been the custom, in all the recorded experiments, to allow the latex to coagulate naturally in the collecting cups, and hence it was considered necessary to tap only in the dry weather and to prevent rain water entering the cups. Parkin, however, realized the necessity of bulking the latex, and preventing coagulation in the collecting cups: he therefore put water in the cups, and advised that dilute ammonia should be used when the flow was small. The latex was then strained through coarse cloth, and coagulation effected in fixed quantities. This was an important advance, though it is now so generally adopted that no one realizes that it only came into use in 1899. No mention was made of coagulating in other than collecting cups in other reports, until Curtis referred to pouring the latex into plates in his report for 1899, after his visit to Ceylon.

Parkin's chief work, however, was concerned with coagulation. He experimented with a dozen different coagulants and determined the limit of coagulation for each, finally selecting acetic acid because it effected complete coagulation over the widest range. Samples of the rubber prepared were analysed and tested by MM. Michelin & Cie., and formed the first set of specimens submitted to comparative tests of this kind. The results of these tests were published in the Annals of the Royal Botanic Gardens, Peradeniya, and have been generally overlooked by writers on the subject. The method he recommended was as follows :—The latex was filtered through coarse cloth and then diluted ; next it was heated nearly to boiling point, and the requisite amount of acetic acid with a little creasote added ; after the separation of the rubber, cold water was added. The white spongy mass of rubber was then pressed into thin sheets, in order to obtain rapid drying throughout the mass. Parkin stated that acetic acid effected coagulation equally well in the cold, and that that method might prove the better for use on a large scale, but it was difficult to use creosote in the cold. He noted that "tackiness" was produced by drying in the sun, and advised quicklime or calcium chloride for rapid drying.

The value of this part of Parkin's work may be gauged from the fact that the chief points of his method have been universally adopted. The "cold" method has proved most suitable, and consequently creosote has been omitted, but a few years ago heating the latex was re-introduced in order to obtain pale rubber. The methods previously in vogue by which small masses of rubber coagulated naturally in the collecting cups were allowed to putrefy or dry in the sun were obviously impracticable for use on a large scale, and Parkin's method solved the difficulty. Further East, it met with considerable opposition, and it does not seem to have been adopted at Singapore until tapping on a large scale was begun in 1903. Then, as in other cases, it was found to be the only method practicable.

Parkin's rubber was prepared in thin circular discs or sheets, which have since been styled biscuits. He advised that they should be about one-eighth of an inch thick, so that the rubber might dry quickly, the biscuit when dry being translucent. Analyses of his rubber proved that it contained about 1 per cent. of moisture, as against the 20 to 30 per cent. of the naturally-coagulated rubber. This manufacture of clean dry rubber was again a revolution in method which is to be attributed to Parkin. Attempts have recently been made to show that " biscuits " or cakes of rubber were made in the East before Parkin's, the insinuation being that his method had been ante-dated. But the cakes previously made had nothing in common with what is known as " biscuit " rubber, except that they might by accident be circular. When the rubber was allowed to coagulate in the collecting cup, it naturally formed a circular disc, which might be pressed out into a cake thick in the centre and thinning out towards the edges. Some of Trimen's sample collected in 1888 consists of such cakes. Their real nature was described by Ridley in 1897, when he stated that " a sample cake of rubber prepared in the Botanic Gardens in 1893, on being cut across in 1897 was found to be perfectly sound and elastic, and the interior even retained the white colour of the fresh rubber." Further evidence is afforded by the brokers' report on Curtis's rubber in 1902. " They say that the sheets should be thinner than yours. What comes from Ceylon is made in the shape of, and about the size of, a dinner plate." (Straits Bulletin, II., p. 24.) To allege that these were identical with Parkin's biscuits, which were of uniform thickness and quite translucent, is ludicrous.

Specimens of Parkin's biscuits were exhibited at the Colombo Show of 1898.

Parkin attempted the centrifugalization of Hevea latex, but failed to effect coagulation. In addition to the Circular already referred to, he contributed Papers to the Annals of Botany on "Observations on Latex and its Functions," and "The Extra-floral Nectaries of *Hevea brasiliensis*."

In 1899 the F. M. S. Government voted a sum of 4,000 dollars for the purpose of carrying out experiments in rubber and other products: and in 1900 Mr. Stanley Arden was appointed to the post of Superintendent of the Experimental Plantations at Kuala Lumpur. It would appear, however, that the experimental plantations were not established until 1902 (*T. A.*, XXIII., p. 32).

Arden carried out tapping experiments on the same lines as Parkin, *i.e.*, with the idea of ascertaining the principles of rubber tapping, but on a more extended scale. His report for 1901 deals chiefly with experiments in tapping and coagulation at S'tiawan, Perak, where, on trees grown on a native estate and somewhat stunted, he obtained an average yield of $\frac{3}{4}$ lb. from six- to seven-year old trees, and 2 lb. from nine-year old trees. On Pataling estate, trees three and a half years old, measuring 32 inches in girth at 3 feet, yielded 6 oz. Arden discarded the mallet and chisel in favour of a pruning knife, and subsequently made a knife with adjustable blades. He found that the latex flowed most freely from the lower part of the trunk, that V incisions yielded more than vertical or oblique cuts, and that the herring-bone yielded less than V's "extending over the whole area." In one experiment the incisions were renewed on both sides of the wound, upper and lower, for a month, daily and every second, fourth, and seventh day; he concluded that nothing was to be gained by the longer interval. In his coagulation experiments mercuric chloride, common salt, alum, acetic acid, and other reagents were tried.

Arden's chief contribution is his "Report on *Hevea brasiliensis* in the Malay Peninsula, 1902." His experiments deal with the yields obtained from oblique incisions, V cuts, and full herring-bones, both from single incisions and from renewed cuts. They are described in detail, but in most cases are not comparative. His V cuts, for instance, were made a year later than the oblique incisions. He recommended V's or small herring-bones scattered over the stem to a height of

6 feet, and re-opening of the cuts to eight times. Further re-opening was, he considered, not to be recommended. Arden emphasized the necessity of a well-developed crown to the tree, and noted that the trees at the edge of a plantation frequently gave the largest returns. He stated that trees planted 36 feet by 36 feet had their foliage touching at nine years old, and stigmatized close planting as false economy, but he did not recommend any particular distance.

Though, as will have been gathered, both the herring-bone pattern and the method of renewing the cut were introduced prior to 1900, it must not be supposed that the tapping then practised at all resembled the methods in vogue at the present day. The herring-bone then consisted of a short channel with small side cuts not far apart, and any number of these might be distributed over the lower 6 feet of the stem. Curtis, for example, used seven full herring-bones on one tree at the same time. It was not until much later that the necessity for regular excision of the bark, in order to ensure a smooth renewal, was recognized. Nor were the cuts continually renewed until all the cortex had been excised. They were re-opened from eight to fourteen times; but anything more than that was regarded as dangerous. Arden's renewed incisions apparently extended to the wood, and were not healed up twelve months afterwards (*T. A.*, XXII., p. 704).

The new methods were regarded as impracticable or accepted with great caution. Ridley in 1903 stated: "Much has been said of the advantage to be derived from the re-opening of fresh wounds, giving rise to the phenomenon often alluded to as the wound effect." He quoted the results of an experiment on the point, and concluded: "This certainly seems to point out that re-opening an old wound is not to be recommended" (Straits Bulletin, II., p. 112). In 1903 tapping was carried on at the Singapore Botanic Gardens by the long discarded method recommended by Cross, and the system, or lack of it, was hailed as the latest discovery. It was stated the practice hitherto had been to make large gashes, or on advanced plantations herring-bone cuts about 15 inches long, but now it had been found that the best yield was obtained by making incisions $1\frac{1}{2}$ inch long and $\frac{1}{8}$ inch wide. The cuts were made anywhere, a cup being used for each incision, and the tapping was done with a small axe and a chisel. This complete reversion to primitive methods is a striking illustration of the extent to which modern ideas had then penetrated (*T. A.*, XXII., p. 839, *ex* "Straits Times," April 16, 1903). In experimental tapping at Singapore in 1904 the cuts were not re-opened (Straits Bulletin, III., p. 340).

Parkin's acetic acid method of coagulation met with considerable opposition, especially in Malaya. Arden claims that he was the first to introduce it into the Malay Peninsula in 1900 ("Indiarubber Journal," November 1, 1913). Curtis tried it in Penang in 1901. But the process was considered unnecessary and impracticable in Singapore, and it does not appear to have been adopted there until 1903 (Straits Bulletin, II., p. 44). Ridley (Report, Singapore, 1900) stated that the addition of creosote made the rubber sticky.

In Ceylon the method of re-opening the cut is said to have been adopted in Kalutara in or about 1900. But it did not meet with universal approval. F. Holloway (Kepitigalla) described his method of tapping, &c., in the "Indiarubber World" in 1903 (see *T. A.*, XXII., p. 726); single V incisions were used, five V's in a ring round the stem, every alternate day, until twenty such rings had been made. He gave a figure of the well-known tapping knife with a triangular box head, made by the Eastern Produce and Estates Co.

XIII.—"Ceylon" Rubber.

For many years it has been customary, more especially in America, to style all plantation rubber, "Ceylon" rubber, even such well-known marks as Highlands sheet being referred to as "Ceylon Highlands sheet." "Ceylon," in this connection, is of course merely a trade term for rubber made up in plantation form, and its use is due to the fact that this type of rubber was first brought to the notice of European and American dealers by the efforts of the Ceylon planters, who exhibited their produce at International Exhibitions whenever an opportunity arose.

Ceara rubber was exhibited at the Colonial and Indian Exhibition of 1886 by Rajawella and Kandanuwora estates.

At the Paris Exhibition of 1900 rubber was sent by the Kalutara and Northern districts, and by the Royal Botanic Gardens, both Hevea and Ceara ; and the Government samples were subsequently given to the Philadelphia Commercial Museum.

At the St. Louis Exhibition of 1904 three pages were devoted to rubber in the Ceylon handbook, and samples were exhibited from Arapolakande, Culloden, Eastern Produce and Estates Co., Ellakande, Gikiyanakande, Heatherly, Hindugalla, and Pallekelle. The " Indiarubber World " stated that the Ceylon samples at this exhibition were easily the best crude rubber ever seen in the United States (Straits Bulletin, III., p. 413).

It has recently been suggested that this error of description shall be remedied by calling all plantation rubber " Malay rubber."

XIV.—Rubber Literature.

The Ceylon authorities early realized the importance of making public all possible information concerning rubber, and, except for the reports of Wickham and Cross, the literature at the disposal of the intending rubber planter prior to 1900 was chiefly of Ceylon origin. Trimen summarized Cross's reports and added other information in a six-page quarto pamphlet, which was issued as a supplement to the " Ceylon Observer " in April, 1880, and in the following year wrote a short history of the introduction of rubber, which was published in the report of the New Products Commission (Sessional Paper No. 13 of 1881), while his annual reports from 1880 onwards contain numerous notes on the subject. In 1894 he drew up an account of the progress of rubber planting in Ceylon, at the request of Kew, and this was subsequently included in the article on Para rubber in the Kew Bulletin, 1898.

In 1897 the Ceylon Government issued a Sessional Paper on the progress of rubber planting (No. XXIII. of 1897), and this was followed by Willis's Circular (14 pages) in January, 1898.

The Kew authorities issued a valuable summary of information in the Kew Bulletin for October, 1898. In this, twelve pages are based on information from Ceylon, seven from India, and three from Perak. Parkin's Circular on Hevea was published in 1899.

During the whole of this period the editors of the "Tropical Agriculturist" continued to reprint every available scrap of information concerning rubber, while in 1888, at Dr. Trimen's suggestion, they compiled and published their well-known book "All about Indiarubber and Gutta-percha," which ran through three editions.

Though not within the limits adopted for this compilation, it may be recalled that the standard work on Hevea, Wright's "*Hevea brasiliensis*," was originally published in Ceylon.

XV.—Brazilian Methods.

Several attempts have been made to introduce the tapping and curing methods of the Amazon into the East. It is not, however, always realized that the earlier tapping experiments imitated Brazilian methods as closely as possible, and that those methods have been discarded in favour of the present style.

Wickham visited Singapore in 1898, and described the methods of tapping advocated by him (Singapore Report, 1898).

In 1903 M. Bonnechaux, from the Amazons, visited Singapore, and 150 trees were tapped according to his advice (Straits Bulletin, II., p. 44). Coagulation by smoking was attempted, but abandoned in favour of acetic acid. Numerous attempts have, however, been made during the last fifteen years, by planters and others, to prepare rubber by the Brazilian method, but in all cases it has been dismissed as impracticable.

During the last two years it has frequently been asserted that Dr. Trimen was approached on the subject of preparing rubber by the method practised on the Amazon, some twenty to thirty years ago, and that he refused to consider the matter, on the ground that a better method, coagulation by acetic acid, had been discovered. The answer to this is that the acetic acid method was worked out by Parkin in 1898–99 whereas Dr. Trimen died in 1896.

XVI.—Ceara Rubber.

When Cross was returning to England in 1876 with plants of *Hevea brasiliensis*, his steamer called at the port of Ceara, and he took advantage of the few days' stay to travel inland to Maracanahu, 30 miles from Ceara, where he collected 60 plants and 700 seeds of the species which furnished the Ceara rubber of commerce. Of these, 42 plants and the seeds were deposited safely at Kew on November 23, 1876, and from these a stock of 55 plants was secured, with which to begin propagation. 41 of the plants survived, and 14 others were raised from the seeds.

The plant was identified at Kew as *Manihot Glaziovii*, by comparison with authentic specimens from Rio, where Dr. Glaziou, after whom it was named, had it under cultivation. As it happened, it was already in cultivation in the Botanic Gardens, Regent's Park, London, and in Java and Mauritius, under the erroneous name of *Hevea guyanensis*. A description of this species, with figures drawn from the Ceylon plant, was published by Trimen in the "Journal of Botany," November, 1880. All Cross's specimens were obtained in one locality, and there is no reason to doubt that the plant introduced into the East by him is the true *Manihot Glaziovii*.

Seeds were sent to Ceylon by the India Office in 1876, from which at least one plant was raised.[1] On July 11, 1877, 4 plants of this species were sent to Singapore, and on September 15 50 were sent to Calcutta and 50 to Ceylon, while at the end of the year Kew had 448 plants on hand. In 1878 these were distributed to Madras, Calcutta, Fiji, Java, Sydney, Queensland, and Zanzibar, as well as to Dominica, Jamaica, and Trinidad. They grow vigorously practically everywhere, except at Singapore and on the West Coast of Africa.

The Ceylon plants were put out at Peradeniya and Henaratgoda in October or November, 1877 ; and at the end of 1878 Thwaites was able to report that a considerable number of ripe seeds had been produced, enabling him to send supplies to Burma, Calcutta, and Madras. One plant made an

[1] Kew Report, 1877.

attempt to flower in April, 1878, about six months from planting out; this might have been one of Cross's original plants, which were well developed when collected, or a tree grown from the seeds sent in 1876. In 1879 and 1880 seeds were again produced in abundance; and in the latter year Trimen recorded the distribution of 24,550 seeds and 1879[1] rooted cuttings to Calcutta, Saharunpore, Ootacamund, Singapore, Mauritius, Queensland, Perak, Jamaica, British Guiana, and Kew, as well as to planters in Ceylon, as far afield as Trincomalee. In 1881 seed was sent to Calcutta, Singapore, and the Andamans; and in 1882 to Perak, Burma, Assam, Lucknow, Saharunpore, Jamaica, Rangoon, Bombay, and Nellore.

In 1880–81 coffee in Ceylon was in the last stages of its struggle against Hemileia, green bug, &c., and Ceylon planters were anxiously looking out for new products. Cacao was already well established, and cinchona and tea were being largely planted. Rubber plants of all descriptions, practically every available species, had been introduced, not only through the Botanic Gardens but also by private individuals, of whom Mr. T. Christy and Mr. A. Scott Blacklaw were especially prominent; and home advisers were strongly urging planters to take up rubber cultivation. Under these circumstances they naturally turned to the best species, *i.e.*, the South American rubbers, as soon as they were available. Ceara produced seed first, and there was an immediate demand for it from all parts of the Island; it grew rapidly, could be easily propagated, and produced abundance of seed; and, as far as was known, it was not inferior to the other species. The Ceylon Planters' Association about this time addressed the Government on the subject of aid in obtaining *in quantity* such seeds as Ceara; but by the end of 1881 Trimen was able to report that so much seed had been produced that the "loud and urgent demand for it had almost ceased in Ceylon in the course of one year."

The records of the Botanic Gardens show that seeds were distributed to Burma (1878, 1882); Rangoon (1882, 1892); Andamans (1881); Nilambur (1878, 1882); Assam (1878,

[1] It rather looks as if this number was originally meant for the date of the year in which the cuttings were distributed.

1882, 1883); Lucknow (1882); Bombay (1882); Nellore (1882); Poona (1884); Calcutta (1878, 1880, 1881); Ootacamund (1880); Saharunpore (1880, 1882); Singapore (1880, 1881); Perak (1880, 1882); Natal (1878); the Philippines (1883); Mauritius (1880); Queensland (1880); Sydney (1883); Adelaide (1883); Melbourne (1883); Jamaica (1880, 1882, 1884); British Guiana (1880, 1883, 1884).

Though the seeds distributed by the Botanic Gardens were all from Cross's trees, there is no doubt that Ceara seeds were introduced from other sources also. Mr. A. Scott Blacklaw visited Brazil, and made arrangements for the supply of seed, and it was obtainable at that time through the usual trade channels.

At Peradeniya the original plants were put out in the old vegetable ground (now the Palmyra Avenue), where there was still one in existence in 1898. Trimen planted a group near the herbaceous garden (South Garden) above the Hevea, and others on the river bank, in 1881. The former were soon afterwards cut out, but some still remain in the latter situation.

Seeds were distributed to Government officials in Ceylon at Hambantota, Batticaloa, Jaffna, Negombo, &c. A proposal to establish a Government plantation of Ceara at Kurunegala was not acceded to.

Trimen began the experimental tapping of Ceara in May, 1881. The method recommended by Cross was adopted, the bark being cut off in long strips. Various knives, a spoke-shave, and a plane were tried. It was found that the method was impracticable, part of the latex being removed in the strips cut off and part adhering to them, while that which exuded subsequently coagulated on the stem. From a tree 30 feet high and 25 inches in diameter at 3 feet, only ¼ oz. of rubber was obtained. Another tree was tapped by "broad-arrow" incisions terminating in a short vertical channel, a chisel, an axe, and a knife being tried; twenty-four incisions were made, but only ½ oz. of rubber, collected in strings, was obtained. The same tree was tapped the following day earlier in the morning, and yielded ¾ oz. of dry rubber, the latex being evaporated over a fire. On the next day 5 drams were obtained, making a total of 2 oz. 1 dram in three tappings.

In 1882 further trials were made, the outer papery bark being peeled off and oblique incisions made with a knife, the latter having proved the best of the tools tried. Short joints of bamboo were used to catch the latex when it flowed freely. Twenty ounces of dry rubber were obtained from nine or ten trees (apparently in three or four tappings), most of it in strings which were rolled into balls. The balls were valued by Messrs. Silver at 2*s*. 9*d*. to 3*s*. per lb., but part of which was sticky and mixed with sand was said to be worth only 1*s*. to 1*s*. 3*d*.

In 1883 there were 977 acres under Ceara rubber in Ceylon (Trimen), and the planting community was eagerly waiting to know whether to plant further extensions of Ceara or to continue the rush into tea. Many of the Ceara trees were three to four years old, and it was known from Trimen's reports that the rubber even in the young trees was of good quality. Tapping experiments were instituted wherever possible, and " rubber " provided the chief topic of discussion in the local press. Ceara grew amazingly well, but the problem was how to get sufficient rubber out of it to pay the cost of tapping. All imaginable tapping systems were tried. The papery outer bark was peeled off, and oblique incisions made with a sharp knife, or the inner green layer was punctured all over. Gilliatt, who was one of the chief experimenters, made long vertical cuts, about 6 inches apart, from as high as a cooly could reach down to 3 or 4 inches from the base of the tree, four cuts being made at the first tapping, to be followed by others thirty days later ; in this system the outer papery bark was not removed.

Patent knives soon made their appearance. Dobree's knife consisted of two parallel blades, and was intended to remove a strip of cortex which could be replaced after tapping ! There is a knife of that description now in the Peradeniya Museum. Gilliatt's knife, which met with most approval, had two cutting edges meeting to form a V, the point of which ran along the cambium ; it appears to have been practically the Eastern Produce and Estates Co.'s knife of Hevea tapping, but I have not seen a specimen of it. Although all the tapping was done by single cuts (*i.e.*, without re-opening the wound), it was regarded as much too drastic by one school, and G. Wall invented a comb-pricker, afterwards provided with a guard to prevent the cooly penetrating to the wood; apparently this was used vertically, in long lines from the top to the base of the stem, after the fashion of Gilliatt's cuts, and it was claimed that it gave just as good results. Trimen refers to another pricker used at this time, a spur wheel with guarded points. It is curious to note that Wall, when advocating the use of the comb-pricker, stated that he was satisfied that "incisions" would never do; nowadays his system and all the others tried would be styled incision methods, but what he objected to was the single continuous cut.

When pricking methods were employed, the latex was usually allowed to coagulate on the tree, and was pulled off in the form of strings or "tears." One planter invented a roller which, when rolled up and down the stem, gathered up the tears. Where oblique and V cuts were employed, small specially-made tin collecting cups were used to catch the latex, at first fastened to the tree by cobbler's wax, &c., but afterwards pushed into the bark, as in Hevea tapping before the adoption of the spout. One form of collecting cup was provided with a leather lip.

The latex was poured into plates, or tin trays, and coagulated naturally. At first it was exposed to the sun, but that was found to be detrimental, and some advocated coagulation in the dark. Adding water to the latex was found to give a cleaner rubber than allowing the undiluted latex to coagulate. Gilliatt produced excellent samples of rubber by coagulating with alcohol, but it was generally agreed that that method was too expensive. The same experimenter smoked rubber after coagulation, but when he sent the sample to Colombo, he was accused of attempting to hoax the brokers by sending them samples obtained from England. Most of the rubber appears to have been in the form of cakes; one correspondent stated that his cakes weighed half a pound when wet, and he subsequently sent to Colombo 18 cakes, weighing altogether 2½ lb. Gilliatt made small sheets in square trays.

The tappings of 1883 yielded practically nothing but samples, some of which were valued at 4*s*., with hard Para at 4*s*. 6*d*. Gilliatt stated that by his method he obtained $\frac{3}{8}$ oz. from a tree two and half years old, and $1\frac{1}{8}$ oz. nine days later; he expected to be able to tap every thirty days. On another occasion he tapped 18 trees in 53 minutes, and obtained 10 oz. of rubber. In 1884 it was reported that 15 two-year old trees on Wariapolla gave 1 lb. of dry rubber, and that another tree gave $10\frac{1}{2}$ oz. in 14 days. Another record stated that in two months 25 trees yielded 14 lb., the amount collected being rather under half a pound per day. It must be remembered that continuous tapping throughout the year was never contemplated; and indeed it would have been, and still is, impossible on any system adapted to Ceara. The yield last quoted represents therefore the total obtainable, or thought to be obtainable in the year. At the end of 1883, however, Wall stated that hundreds of young trees had been bled daily with the pricker for some weeks, the cooly collecting half a pound of rubber per day, and he considered that the cultivation would be remunerative if the trees would bear that treatment for 240 days in the year.

In 1884 it was generally agreed that the facts reported with regard to the growth of Ceara rubber trees, and the amount of rubber obtained from them under every conceivable mode of treatment, tended to but one conclusion, viz., that the cultivation of that product would not pay; and some of the oldest estate trees were uprooted to make room for tea. Trimen reported that one of the original trees at Peradeniya, nearly eight years old (a tree in the old kitchen garden), had been tapped previous to felling, and $1\frac{1}{2}$ lb. of dry rubber obtained; it had been previously tapped two years before. Over 10,000 seeds were sent to Government Agents in this year for experimental native cultivation; it had been proved to grow well in the dry zone, at Anuradhapura.

In the Planters' Association report for 1884 it was recorded that cacao planters in Dumbara were planting Ceara extensively as a shade tree; but the report for the following year regrets "that there is no advance in rubber cultivation to chronicle. The trees grow well, but it is difficult to obtain from them at a moderate cost a sufficient quantity of rubber."

Ferguson's Ceylon Handbook for 1885 gives the area under rubber as 629 acres, most of which would be Ceara; that shows a reduction of one-third since 1883. In 1888 the area under rubber, part of which was then Hevea, had been further reduced to 386 acres. This decrease was entirely due to the replacement of Ceara by other products; and the subsequent increase is due almost solely to Hevea planting. The report of the Planters' Association for 1885–6 states: "Your Committee regrets that there is no advance in rubber cultivation to be chronicled. The trees grow well, but it is difficult to obtain from them at a moderate cost a sufficient quantity of rubber."

In 1890 Trimen reported that there were considerable plantations on some estates, and now that the trees were older, it was found profitable to tap them. One shipment of 4 cwt. in this year realized 1*s.* 8½*d.* to 1*s.* 9½*d.* per lb., showing a profit of about 37 cents a lb. The trees were tapped in the dry season—January to March. The rubber was collected by removing the outer bark and pricking the inner copiously, the latex being allowed to coagulate on the tree, as in the "Ceara scrap" of commerce. The opinion of planters was that it paid to harvest but not to cultivate, and they were prepared to kill their trees to get the crop. Trimen was of opinion that it could be grown on extensive areas of poor soil, so as to provide a new block of trees for tapping each year.

An article in the "Tropical Agriculturist" for March, 1887, summarizes the opinions of various planters who had tried Ceara on areas varying from 3 to 40 acres, on estates in Matale, Panwila, Hantane, Dolosbage, Pussellawa, Uva, and the Western Province. In all cases it was stated that the rubber did not pay to harvest. The majority of the trees were then five years old.

In the "Tropical Agriculturist" for May, 1890, it is reported that one estate in Dumbara was getting over 1 lb. of rubber per cooly per day. Ten-year old trees yielded ¾ lb., and three-year old trees 2 to 3 oz. (per annum?). The rubber realized 3*s.* 9½*d.* per lb. in England in 1889; "so that, although rubber is not liked as a shade tree for cacao, it is worth while considering if the above figures should not deter the wholesale destruction of rubber trees as shade."

In the "Tropical Agriculturist" for 1893 (Vol. XII., p. 685) the editor wrote : "We regret to learn from Mr. Vollar that his rubber cultivation in Dumbara is not likely to be permanent. The Cearas were originally planted as shade trees for the cacao, but they have not proved very suitable for this purpose, and will probably have to be cut down. Meantime, perhaps 5,000 lb. of rubber will be collected on Pallekelle this season. A cooly by beginning the tapping early in the morning usually gets 3 lb. of rubber in the liquid or soft state, which hardens and dries down to perhaps half that weight. There is no fortune to be made out of this, considering how long the rubber trees have to grow before yielding an appreciable quantity of milk." Later in the year Ceara was declared a failure as a shade tree (*T. A.*, XIII., p. 318).

In 1899 (*T. A.*, XIX., pp. 91, 93) the editors of the "Tropical Agriculturist" attempted a census of the surviving Ceara trees. It was found that in general they had been rooted out. Crystal Hill reported 1 acre left out of 30 acres in 1886, the oldest trees eighteen years ; Hantane, which had 10 acres in 1886, had then none ; Kandanewera had none left out of 6,000, while from the same number Hurstpierpoint had a few seventeen-year old trees. Gikiyanakanda and Wiharegama possessed a few trees fifteen years old, while many others of the same age were scattered over the Island.

Ceylon's first rubber boom finished in 1884. By that time it was proved that, with the methods then available, Ceara rubber would not pay ; and it may be said that no methods have since been evolved which will give a return which will satisfy the Ceylon planter. Indeed, the methods now in vogue do not show any advance on those of 1883 ; and, as Trimen wrote in that year, we still "await only the discovery of a process by which the product can be cheaply and exhaustively extracted."

It is interesting to note that many of the problems of 1883 were identical with those of twenty years later in the early days of Hevea. There was the question of wide and close planting. Estimates published in the "Tropical Agriculturist" for 1881 provided for a distance 20 feet by 20 feet, but the general opinion was in favour of closer planting. Then there were two schools of tapping, pricking and incising, whose advocates were as uncompromisingly opposed as those of later days. The use of coagulants was deprecated, though rather on the ground of expense than on the quality of the rubber produced. Gilliatt smoked rubber after coagulation and claimed to have obtained a better product.

Many of the points elucidated were applicable to rubber tapping in general. Thus, it was found that it was best to tap in the early morning, that the latex ran more freely after rain, and that sunlight affected the quality of the rubber. The collecting cup then evolved is that in use at the present day, and bulking the day's collection of latex was practised instead of allowing it to coagulate in the tins; while the guarded comb-pricker, the rotating guarded pricker, and Gilliatt's knife are practical identical with later inventions.

At the present time Ceara is distinctly out of favour in Ceylon. The Ceylon planter's attitude may be summed up as follows: "If you want to grow rubber, grow Hevea; if you can't grow Hevea, go somewhere where you can." Ceara grows like a weed all over the planting districts up to an elevation of at least 2,000 feet, and trees may be found everywhere in the hedges of native compounds. But it still, in comparison with any other product, "does not pay to cultivate," and none of the Ceara experts who have visited Ceylon during the rubber boom have been able to demonstrate how a remunerative yield can be obtained. During the boom Ceara was planted on some estates, but up to the present a return is only being obtained from it in cases where it is a secondary product. On some cacao estates, where Ceara was planted for shade years ago, young trees spring up everywhere. These are allowed to grow, and are tapped when they are large enough, regardless of whether they live or die, as there are always others to take their place. Under such circumstances quite a large profit has been made from Ceara.

XVII.—CASTILLOA.

The story of Cross's journey in search of *Castilloa* has been recorded by Sir Clements R. Markham, from whose account the following details are taken :—

The collection of *Castilloa* plants for introduction into India was a very difficult service, for the trees grow in wild and unhealthy forests, with no means of transit, and no facilities of any kind. In Mr. Cross I found a man with all the requisite qualifications for undertaking it. He is an excellent gardener, possessed of great energy and determination, combined with judgment, is acquainted with the language, and has had much experience in South American travelling. No better man could be found to execute the difficult task of obtaining a supply of *Castilloa* plants, and conveying them in a healthy state from their native forests to the gardens at Kew.

Mr. Robert Cross left England on May 2, 1875, and reached Panama on the 26th of the same month, my instructions to him being to endeavour to make the collection on the isthmus. He found that great destruction was going on among the *ule* trees in all parts of the Darien isthmus, the native collectors cutting down the trees in order to tap them more easily, as is the case in the Assam forests. After obtaining all the information that could be procured in Panama, Mr. Cross determined to select the forests on the banks of the large tributaries of the river Chagres as the base of his operations.

He ascended the Chagres river in a canoe, and then made a journey on foot through the dense forest, into the heart of the *ule* district. He found the *Castilloa* saplings growing on the banks of streams, with their roots often running down to the edge of the water. They abound in rich soil along the base of the hills, and are also met with on the summits of ridges ; everywhere, except in swampy ground. The trees, which proved to be of the species named by Mr. Collins *Castilloa Markhamiana*, are from 160 to 180 feet high, with a diameter of 5 feet, and a yield of 100 lb. of indiarubber. The wood is spongy and soft, and decays rapidly when bruised or injured. Many of the leaves measure 14 inches in length and 7 inches in breadth. The temperature of the forests ranges from 75° to 80° Fahr., and they are excessively damp. The range of the *Castilloas* is so wide that, in some places, the trees must flourish in climates which at one time of the year are dry. It is probable, however, that the species with the best and largest yield of caoutchouc flourishes best in a hot and very damp and steaming atmosphere, like that of the forests of the isthmus.

Mr. Cross collected 600 plants, and also drew a quantity of milk, in order to prepare a specimen of the rubber. The sample he brought home was examined and reported upon, and was pronounced to have much less impurity than is usual for this kind of rubber, and thus proved Mr. Cross's plants to be of the best species. He left the isthmus with the plants on September 6, 1875, on board the mail steamer "Shannon," but in the morning of the 8th, when going thirteen knots an hour, the vessel ran on the Pedro reef of rocks, off the coast of Jamaica, and her bows were immovably fixed upon them, while the stern continued to bump heavily for many hours. The rest of the passengers left the ship in boats, but Mr. Cross stuck manfully by his plants, and was eventually taken on board H.M.S. "Dryad." He came home in the mail steamer "Nile," reaching Southampton on October 2. Considering all the extraordinary difficulties of the undertaking, it reflects great credit on Mr. Cross that he should have been successful, and thus have performed an important public service with ability and sound judgment. There were soon 134 of Mr. Cross's *Castilloa* plants in a flourishing condition at Kew Gardens, and in the course of 1876 a good supply of *Castilloas* was forwarded to India, to form the nucleus of a series of plantations.

According to the Kew reports, Cross brought 7,000 seeds and a number of cuttings. The seeds all failed to germinate, but plants were raised from the cuttings and distributed, in 1876, to the West Coast of Africa, Ceylon, and Java. 31 plants were sent to Ceylon, of which 28 survived the journey. In 1877 plants were sent to Liberia, Mauritius, and Singapore, and a further consignment of 24 to Ceylon. The Ceylon plants were planted out at Peradeniya and Henaratgoda.

In 1878 two plants were despatched from Ceylon to Burma; these were part of the original consignment, attempts to propagate them by cuttings having failed. In 1880 cuttings proved successful; two plants were sent to Calcutta this year, and the Burma plants were reported to be flourishing.

The trees both at Henaratgoda and Peradeniya flowered in 1881, but all the flowers were male. In this year Trimen planted Castilloa by the side of the Lake road, Peradeniya, and a group of 6 in the South Garden. Of the latter, 3 were transplanted from the Arboretum, and the other 3 were plants grown from cuttings.

In 1882 15 seeds were obtained at Peradeniya, and seedlings raised. Plants were sent to Ootacamund (2), Calcutta (2), and Nilambur (9), while plants previously sent to Nilambur were reported to be growing well. Trimen tapped the Castilloa at Henaratgoda this year, and samples of the rubber were forwarded to London for report.

In 1883 a tree at Peradeniya fruited, and a large crop of seedlings was raised. These were advertised for sale, but there was no demand for them, and in August over 1,200 remained on hand. Dr. Trimen attempted to get Government plantations of this rubber established at Ratnapura and Kalutara, but without success. 300 plants were, however, sent to the Model Farm, Kalutara, in the following year. Calcutta, Singapore, and Moulmein each received 25 plants in 1883, and Nilambur 6.

In 1884 two consignments of plants (190) were sent to Nilambur. 25 plants were forwarded to Buitenzorg, 4 to Fiji, and 12 to the Agricultural Society of Madras, while seeds were sent to Kew. In 1885 seeds were sent to Nilambur and Moulmein, and material supplied to Sir J. D. Hooker for the critical determination of the species.

Hooker's description of the *Castilloa* grown in Ceylon was published in the Transactions of the Linnean Society, Series 2, Vol. II., p. 209, and illustrated by a coloured figure of the flower, &c. He decided that though the Ceylon plant differed from the original *Castilloa elastica* in having the leaves less hairy beneath, and the seeds of a somewhat different shape, the differences were not sufficient to constitute a distinct species.

There does not appear to be any possibility of doubt that the Ceylon species is not identical with the *Castilloa elastica* cultivated in the West Indies. It will be noted that Markham refers to it as *Castilloa Markhamiana*, and that name was tentatively adopted by Willis in his Circular of 1899. But the tree has never been satisfactorily determined. All that is known is that it does not yield such an abundant flow of latex as the true *Castilloa elastica*. The late Dr. Pehr Ohlson Seffer, on the occasion of his visit to Ceylon, stated that he had never seen any other *Castilloa* like it.

In 1886 50 *Castilloa* were planted in Lady Horton's Drive, Kandy, and 250 sent to Tavoy (Burma). Seeds have been distributed from time to time, but there has never been any great demand for them. Seeds were sent to Bangalore in 1888, Singapore and Saigon in 1894, and to Perak in 1899.

The tree grew with surprising rapidity in its earlier years, but later Trimen recorded that its growth had become very unsatisfactory. The original trees at Henaratgoda were reported to be dying in 1896, and 26 more were planted that year. But Parkin found four old trees available for tapping experiments there in 1899, of girths 3 to 4 feet.

Further tappings of *Castilloa* were made in 1889 and 1891, and in the latter year a sample of the rubber was exhibited at the Colombo Exhibition. In 1892 a tree which had to be removed (at Peradeniya) was tapped prior to felling, so as to obtain as much rubber from it as possible, but the total yield was less than half a pound.

Few estates in Ceylon planted *Castilloa*. After the failure of *Ceara* both *Hevea* and *Castilloa* began to produce seed, and fortunately planters selected the former of the two. One or two estates in the Matale District, however, chose *Castilloa*, and the tree did not lack champions in the early years of the present century.

In 1893 (*T. A.*, XIII., pp. 318 and 471) Castilloa rubber from a Matale estate was valued at 2*s.* 3*d.* to 2*s.* 7*d.* per lb., when hard Para was 3*s.* In 1899 (*T. A.*, XIX., p. 48) it was stated that both *Castilloa* and *Hevea* had been tapped on Wiharegama, and that the former gave the better yield; $1\frac{1}{4}$ lb. was obtained from three trees (? at one tapping). According to later information, in the same year (*T. A.*, XIX., p. 134) there were on Wiharegama 25 trees, nine to ten years old, measuring 40 to 46 inches in circumference at 3 feet; 25 trees, seven years old, measuring 20 to 22 inches in circumference; 45 trees, four years old, measuring 12 inches in circumference; 90 trees, two to three years old; and a number of younger plants interplanted through cacao and Liberian coffee. Two trees, tapped in 1899, yielded $1\frac{1}{2}$ lb. of rubber (*T. A.*, XIX., p. 92).

Crystal Hill, Matale, reported the possession of a few hundred *Castilloa*, planted in 1898, while Gikiyanakande had trees six years old (*T. A.*, XIX., p. 93).

In 1901 Wiharegama reported that 2 lb. per tree had been obtained from trees ten to twelve years old; they were tapped from October to June, 1900–1901 (*T. A.*, XXI., p. 35). The report of the Matale Planters' Association for 1901 states that 42 acres of cacao had been interplanted with Castilloa on Ambanganga estate (*T. A.*, XXI., p. 560). It was claimed by some that Castilloa was the best tree for the Matale District (*T. A.*, XXII., p. 132). Some of the trees on Ambanganga, two and a quarter years old, were 22 to 26 inches in girth.

The advocates of *Castilloa* received unexpected support, if only temporarily, from the then Director of the Royal Botanic

Gardens, Dr. J. C. Willis, who in April, 1899, issued a Circular on " Panama Rubber," in which it was stated that " the probable return in the case of *Castilloa* is larger than in the case of Para, and its cost of collection is less" ; and " those who intend to make plantations of rubber only would do better to use *Castilloa.*" As a result of this Circular the daily press declared that ' Para may be said to be dethroned " (*T. A.*, XIX., p. 52), but Willis's views were vigorously combated by Kalutara planters (*T. A.*. XIX., p. 94), and consequently had little influence on the progress of rubber planting. They appear to have been based on the fact that Biffen had succeeded in coagulating *Castilloa* latex by a centrifugal machine.

Castilloa was introduced into Singapore from Kew in 1877, and thence was transferred to Kuala Kangsar in the same year. In 1878 there was one tree in the Singapore Botanic Gardens, and one at Kuala Kangsar, both growing well, and others had been sent to Queensland. In 1882 the tree at Singapore flowered, but no seed was produced. The report of the Singapore Botanic Gardens for 1883 states that "A Wardian case of healthy young plants of the Panama rubber (*Castilloa elastica*) was received during the year from the Botanic Gardens, Ceylon, and as there is now no fear of losing the plant, the produce of the large plant which we have on hand might be tested and its quality ascertained."

Fifty seedlings of *Castilloa* were planted at Bukit Mandai (Singapore) in 1892, and further plants were put out in the Economic Garden in 1898. Six plants, presented by Mr. G. Watson, of Selangor, were planted in the Penang Garden in 1898, there being no plants there previously, but in 1900 Curtis reported that it did not flourish.

In the annual report of the Selangor Planters' Association for 1899 it is recorded that " it has been almost impossible to procure seed of this rubber, but those plants already in the country are doing extremely well, and a large quantity of seed has been booked for 1900." Derry, in the report of the Superintendent of Government Plantations, Perak (1899–1900), stated that he had 150 seedlings raised from Ceylon seed.

G. C. Pearson, in an article on Castilloa in " Modern Mexico " for April, 1903, quotes the yields of Castilloa trees of different ages in Ceylon on the alleged authority of Dr. Trimen,[1] and similarly C. O. Weber, in his "Journey to a Rubber Plantation on the Isthmus of Colombia," cites tapping experiments on some 250 trees, also by Dr. Trimen.[2] As far as I can ascertain both these alleged quotations are incorrect, *i.e.*, they do not refer to any experiments conducted by Trimen.

XVIII.—Other Rubber Yielding Plants.

The following list gives the names of most of the rubber-producing, or reputed rubber-producing, plants which have been introduced into Ceylon since 1876 :—

	Year.
Clitandra Arnoldiana	1908
Cryptostegia madagascariensis	1882, 1907
Ecdysanthera glandulifera...	1895
Ficus populifolia	1881
Ficus Vogelii	1881
Forsteronia floribunda	1910
Funtumia elastica	1896
Hancornia speciosa	1882
Hevea Spruceana	1881, 1883
Landolphia florida	1881
Landolphia Heudelotii	1894
Landolphia Klainii	1900
Landolphia Kirkii	1880
Landolphia madagascariensis	1882
Landolphia owariensis	1900
Landolphia Petersiana	1881
Landolphia senegalensis	1897
Landolphia "bintuba"	1893
Mainhot dichotoma	1907
Manihot heptaphylla	1908
Manihot piauhyensis	1907
Mascarenhasia elastica	1901
Mimusops dissecta (?)	1890
Mimusops globosa	1884
Parameria glandulifera	1884
Parthenium argentatum	1910
Raphionacme utilis	1909
Sapium aucuparium	1909
Sapium biglandulosum	1887
Sapium verum	1909
Tabernaemontana crassa	1881
Urceola esculenta	1881
Willughbeia firma	1881
Willughbeia flavescens	1878
Willughbeia *sp.*	1881

[1] "Tropical Agriculturist," XXII., p. 844.
[2] "Tropical Agriculturist," XXII., pp. 373–4.

The above are the names under which the species have been introduced.

In 1881 a plant named *Hevea Spruceana* was received from British Guiana, but did not survive. In 1883 18 plants were sent under the same name from Kew, and were planted out at Henaratgoda. In 1884 it was recorded that only 2 of these were alive, and these died in the following year. It is now known that these plants were not *Hevea Spruceana* Muell. Arg., but *Hevea confusa* Hemsl.

A few trees of *Funtumia elastica* have been planted on estates, but more or less as curiosities. In Ceylon this species periodically defoliated by caterpillars, and its cultivation on a large scale, even if desirable, would be almost impracticable.

Landolphia Kirkii was planted on Pleasure Ground and Kennington estates in the Kelani Valley in the early eighties. The plants were cut out in 1887–88.

In the early years of the present century *Ficus elastica* was planted on estates in the Kelani Valley and Kurunegala Districts, but was subsequently replaced by *Hevea*.

During 1911–12 *Sapium Thomsoni* has been introduced into Ceylon by private enterprise.

Addendum.

While this account was in the press, a note has appeared in the Kew Bulletin (No. 4, 1914) in which doubt is expressed that the plants collected by Cross ever became fit to send to Asia. The statement that the plants sent in 1877 were Cross's was first made by Trimen in 1881, on data furnished by Kew, and it has hitherto been universally accepted. On referring to the memoranda on which Trimen may have based his statement, they are found to be somewhat contradictory. The sentences, "By the time these reached us we had done with Para rubber," and "We saved, I think, a Wardian caseful so as to do justice to Cross," would appear to support Trimen's conclusions, but the same letter certainly states "the 2,000 plants sent to Ceylon were all raised from seed obtained from Wickham." Possibly Trimen took the latter to refer to the first consignment only.

It may be noted that the Kew Report for 1877 states that "success will depend *mainly* on the plants raised from the seed brought home by Mr. Wickham," and Sir W. Thiselton Dyer, in 1878, wrote that Cross's plants "contributed *but little* to our resources for distribution" (italics mine—T. P.). But no one has hitherto alleged that they were never distributed.

The Genera Hypocrella and Aschersonia.

(A Preliminary Note.)

BY

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IN 1906 Mr. J. Parkin published in this Journal a Paper on "The Fungi Parasitic on Scale Insects," based chiefly on material from Ceylon and the East which had been accumulated by Mr. E. E. Green, the well-known authority on Coccidæ, and until recently Government Entomologist of Ceylon. After the publication of Parkin's Paper the material was returned to Ceylon, and was handed over to me by Mr. Green as a basis for further work on the subject. Additional material was subsequently collected and examined, and some idea gained of the range of variation in the Eastern species ; but it was not considered advisable to publish any further account, in view of the number of names already extant, until an opportunity had been afforded of examining the type specimens in European herbaria.

That opportunity came in 1911, when I was able to examine all the species of these genera in the herbaria of the Royal Botanic Gardens, Kew, the British Museum (Natural History), Berlin, and Paris, through the courtesy of the Directors and officers in charge of those collections, to whom I desire to record my sincere thanks.

The knowledge thus acquired was thought to justify an appeal to the possessors of those types which were not represented in the herbaria mentioned, and my request for the loan of these met with a gratifying response. To Professors von Höhnel, Möller, Patouillard, Penzig, Raciborski, Saccardo, Spegazzini, H. Sydow, Theissen, and A. Zimmermann I am indebted for kind assistance in the loan of types, and to Dr. E. J. Butler, Mr. F. W. South, Mr. H. S. Fawcett, and Dr. E. D. Merrill for general material from their collections.

The examination of this material was completed in 1912, and coloured drawings prepared of nearly all the species known. Since then publication has been delayed from various causes, and consequently it has been thought desirable to issue a preliminary notice, giving the synonymy of the species of the genera in question, as an indication that the generosity of those who have kindly lent their assistance has not been wasted.

The material of these genera in herbaria is, as a rule, remarkably scanty. One would suppose that in many cases the fungus has been accidentally gathered on phanerogamic specimens collected for distribution, and discovered subsequently in the herbarium. Types frequently consist of a single leaf bearing only two or three examples of the fungus, and in many cases the fungi on the leaf belong to more than one species. It is not to be wondered at, therefore, that in the case of the commoner species the list of synonyms is somewhat lengthy, since the material from which the species was described is often insufficient to give any idea of its range of variation. The synonymy given below is based on an examination of the types. Notes on other gatherings which are included with the type in the collections examined will be given in the complete Paper.

The examination of the herbarium collections would lead to the conclusion that species of these genera are rare. But it is not difficult, according to Ceylon experience, to collect large numbers of a species, provided one devotes the time to it. Of course, cases do occur when a single specimen is found and a thorough search fails to reveal more, but, in general, the systematic examination of a bush or tree on which a specimen has been found will result in the discovery of dozens, or even hundreds. It has to be borne in mind, however, that the fungus is parasitic on a scale insect, not on the plant, and, as far as can be ascertained, its parasitism is not specialized. A species which is parasitic on *Lecanium* can, apparently, attack any Lecaniid, and conversely any given species of Lecaniid can be parasitized by any fungus of the Lecaniicolous group. Consequently, a collection from one plant, usually all on the same scale insect, may include several species of *Aschersonia* or

Hypocrella. I have taken three species of *Aschersonia* on the same leaf.

It is not proposed to discuss the structure, &c., of these genera here. One or two points may, however, be noted. Apparently all species of *Hypocrella* and *Aschersonia*, though brightly coloured at first, will blacken with age, independently of the growth of *Meliola* or *Capnodium* on the leaf. This is especially noticeable in the case of Lecaniicolous species. In the pale coloured Aleurodiicolous species several exhibit a tendency to turn green, especially in or round the ostiola.

Hypocrella ascospores, when mature, invariably break up into short part-spores. Species said to have continuous spores have been described from immature specimens, or are not co-generic with *Hypocrella discoidea.*

The following lists give the synonymy of the species examined. I may take this opportunity of expressing the hope that the possessors of the species listed as "not seen" will kindly see their way to loan specimens for examination, and of stating that I shall always be glad to give an opinion on any specimens of these genera which may be submitted to me, and to return them as early as possible.

Hypocrella.

Lecaniicolæ.

Hypocrella palmæ (B. & C.) Sacc., Syll. Fungorum, II., p. 580.

Hypocrea palmæ B. & C., Jour. Acad. Nat. Sci. Philadelphia, New Ser., II., p. 285 (1853); *Hypocrella Spegazzinii* Sacc., Syll. Fung., II., p. 579, ex Speg., Fung. Arg. Pug., IV.; *Hypocrella guaranitica* Speg., Fungi Guar. Pug., I., No. 256; *Hypocrella filicina* Rehm, Hedwigia (1898), p. 200; *Fleischeria paulensis* v. Höhnel, Ergeb. der Bot. Exped. der K. Akad. d. Wissensch. nach Sud Brasilien, 1901, Bd. II., p. 21 (1907); *Hypocrella globosa* Syd. non Rac., Ann. Myc., V., p. 359 (1907); *Hypocrella orbicularis* Syd., in Theissen, Ann. Myc., IX., p. 67 (1911); *Hypocrella phyllophila* Theiss., Ann. Myc., IX., p. 66 (1911); *Hypocrella ambiens* Theiss., Ann Myc., IX., p. 68 (1911); *Hypocrella Sydowii* Sacc. and Trott., Syll. Fungorum, XXII., p. 503 (1913).

Hypocrella phyllogena (Mont.) Speg., F. Arg. Pug., IV., No. 209.

Hypocrea phyllogena Mont., Ann. Sci. Nat., Ser. II., XIII., p. 340 (1840) ; *? Hypocrella citrina* Speg., Fungi Puigg., No. 303 (1889), *fide* Theissen ; *Hypocrella abnormis* P. Henn., Fungi Goyazenses, Hedwigia, XXXIV., p. 106 (1895) ; *Hypocrella ochracea* Massee, Jour. of Bot. (1896), p. 150, t. 375, figs. 10–13 (in part) ; *Moelleriella sulphurea* Bres., Hedwigia (1896), p. 298 ; *Hypocrella Edwalliana* P. Henn., Hedwigia (1897), p. 223 ; *Hypocrella ochracea* Mass., Möller, Phycomyceten und Ascomyceten, 1901 ; *Hypocrella Weberbaueri* P. Henn., Engler's Bot. Jahrb., XL., p. 226 (1907) ; *Hypocrella coronata* v. Höhnel, Denkschr. Math-naturw. Kl. Akad. Wiss. Wien., LXXIII., p. 22 (1907) ; *Hypocrella verruculosa* Theiss. non Möller, Ann. Myc., IX. (1911), p. 67.

Aschersonia stage.

Aschersonia basicystis B. & C., Cuban Fungi, No. 558, Jour. Linn. Soc., X. (1869), p. 352 ; *Hypocrea amazonica* Cooke (in part), Grevillea, XVI., p. 25 (1897) ; *Aschersonia juruensis* P. Henn., Fungi Amazonici, III., Hedwigia (1904), p. 388 ; *Aschersonia puttemansii* P. Henn., in Herb. Berol. ; *Aschersonia cheloniæ* Speg., in Herb. Speg. ; "*Aschersonia oxyspora* Berk.," in Herb. Speg. ; *Aschersonia jacarandæ* Speg., Mycetes Argent., Ser. V., An. Mus. Nac. Buenos Aires, XX., p. 456 (1910).

Hypocrella scutata (Cooke) Sacc., Michelia, I., p. 580 (1878).

Hypocrea scutata Cooke, Grevillea, VII., p. 14 (1878).

Hypocrella epiphylla (Massee) Sacc., Sylloge Fungorum, XI., p. 368.

Hypocrea (*Clintoniella*) *epiphylla* Mass., Jour. of Botany (1892), p. 164.

Hypocrella Reineckiana P. Henn., Engler's Bot. Jahrbuch., XXIII., p. 286 (1896).

Hypocrella pernettyæ Pat., Ann. Bot. Jardin Buitenzorg, 1st supplement, p. 125 (1897) : non *Fleischeria sclerotioides* v. Höhnel, Fragmente zur Mykologie, VIII. Mitt., p. 26 (1909).

Aschersonia stage.

Aschersonia sclerotioides P. Henn., Hedwigia (1902), p. 146; *Aschersonia pisiformis* Pat., Bull. Soc. Myc. France, XXII., p. 59 (1906).

Hypocrella camerunensis P. Henn., Engler's Bot. Jahrbuch., XXIII., p. 540.

Hypocrella Gartneriana Möller, Phycomyceten und Ascomyceten, p. 158.

Hypocrella cavernosa Möller, Phycomyceten und Ascomyceten, p. 155.

Hypocrella verruculosa Möller, Phycomyceten und Ascomyceten, p. 157.

Hypocrella schizostachyi P. Henn., Hedwigia, XLVII., p. 253 (1908).

Hypocrella botryosa Syd., Ann. Myc., VIII., p. 40 (1910).

Hypocrella palmicola P. Henn., in Voeltzkow, Reise Ost-Afrika, III., p. 29 (1908).

Hypocrella bispora v. Höhnel, Sitzungsber. d. Kais. Akad. d. Wissensch. Wien., CXVIII., p. 826 (1908).

Hypocrella amomi Rac., Bull. Akad. Sci. Cracovie (1906), p. 908.

Hypocrella convexa Rac., Bull. Akad. Sci. Cracovie (1906), p. 908.

Hypocrella javanica (Penz. & Sacc.) Petch, Ann. Perad., IV., p. 431 (1910).

Fleischeria javanica Penz. et Sacc., Malpighia (1901), p. 230; *Hypocrella* vel *Aschersonia Randiæ* Koord., in Herb. Berol.

Hypocrella marginata (Ell. & Ev.) Petch, comb. nov.

Fleischeria sclerotioides v. Höhnel, Fragmente zur Mykologie, VIII. Mitt., p. 26 (1909); *Hypocrella scutata* Auctt., non Cooke.

Aschersonia stage.

Aschersonia marginata Ell. & Ev., Bull. Torr. Bot. Club (1895), p. 436: non *Aschersonia sclerotioides* P. Henn., Hedwigia (1902), p. 146.

Hypocrella ceramichroa (B. & Br.) Petch.

Hypoxylon ceramichroum B. & Br., Jour. Linn. Soc., XIV., p. 120 (1873); *Glaziella ceramichroa* (B. & Br.) Cooke, Grevillea, XI., p. 83 (1883); *Hypocrella ceramichroa* (B. & Br.) Petch (in part), Ann. Perad., IV., pp. 427–431 (1910); ? *Fleischeria purpurea* v. Höhnel, in litt.

Aleurodiicolæ.

Hypocrella discoidea (B. & Br.) Sacc., Michelia, I., p. 322 (1878).

Hypocrea discoidea B. & Br., Jour. Linn. Soc., XIV., p. 113 (1873); *Hypocrella zingiberis* Massee, Kew Bulletin (1899), p. 174; *Hypocrella zimmermanniana* P. Henn., Hedwigia (1902), p. 142; *Hypocrella Grewiæ* Koord., Bot. Untersuch., p. 179 (1907).

Aschersonia stage.

Aschersonia samoensis P. Henn., Engler's Bot. Jahrbuch., XXIII., p. 289 (1896); *Aschersonia cinnabarina* P. Henn., Monsunia, I., p. 37 (1899); *Aschersonia napoleonæ* Pat. and Har., Bull. Soc. Myc. France, XX., page 65 (1904).

Hypocrella sloaneæ Pat., in Duss. Enum. Champ. Guadeloupe, p. 80 (1903).

Hypocrella amazonica P. Henn., Fungi Amazonici, II., Hedwigia, XLIII., p. 246 (1904).

Hypocrella Mollii Koord., Bot. Untersuchung, p. 179 (1907).

Hypocrella cretacea v. Höhnel, Sitzungsber. d. Kais. Akad. d. Wissenschf. Wien, CXVIII., Abt. 1., p. 311 (1909).

Aschersonia stage.

Hypocrea variabilis Currey (in part), Trans. Linn. Soc. (1876), p. 130; *Aschersonia confluens* P. Henn., Monsunia, I., p. 37 (1899); *Aschersonia phthurioides* P. Henn., Hedwigia (1902), p. 145.

Hypocrella Raciborskii Zimm., Centralb. f. Bakt. Bd., VII., Abt. 2 (1901), p. 875.

Hypocrella Warneckiana P. Henn., Engler's Bot. Jahrbuch., XXXVIII., p. 113 (1905); *Barya salaccensis* Rac., Bull. Akad. Sci. Cracovie (1906), p. 909.

[The type specimen of *Hypocrella Raciborskii* has been lost (*fide* Zimmermann *in litt.*), but the description and figure are sufficient to decide this species.]

Hypocrella duplex (Berk.) Petch, comb. nov.

Aschersonia duplex Berk., Handbook New Zealand Flora, Pt. 2, p. 623.

ASCHERSONIA.

Lecaniicolæ.

Aschersonia turbinata Berk., Ann. Nat. Hist., Ser. 2, IX. (1852), p. 192.

Aschersonia pittieri P. Henn., Hedwigia (1902), p. 104.

Aschersonia cubensis B. & C., Jour. Linn. Soc., X., p. 351.

Aschersonia amazonica P. Henn., Hedwigia (1904), p. 338; *Aschersonia consociata* P. Henn., Hedwigia (1904), p. 388; *Aschersonia oxyspora* Berk., Jour. Linn. Soc., XV., p. 394.

Aschersonia oxystoma Berk., Kew Jour., Bot. VI. (1854), p. 205.

Aschersonia coffeae P. Henn., Hedwigia (1902), p. 145.

Aschersonia pediculoides P. Henn., Hedwigia (1902), p. 145; *Aschersonia Eugeniæ* Koord., Bot. Untersuch. (1907), p. 214.

Aleurodiicolæ.

Aschersonia tahitensis Mont., Ann. Sci. Nat., Ser. 3, Vol. X., (1848), p. 122.

Aschersonia placenta B. & Br., Jour. Linn. Soc., XIV., p. 89.

Aschersonia novo-guineensis P. Henn., Engl. Bot. Jahrb., XXV. (1898), p. 509; *Aschersonia javanica* Penz. et Sacc., Malpighia (1901), p. 236; *Aschersonia lecanioides* P. Henn., Hedwigia (1902), p. 145.

Aschersonia aleyrodis Webber, Bull. No. 13, U. S. Dept. of Agric., Div. of Veg. Phys. and Path. (1897), p. 20.

Aschersonia andropogonis P. Henn., Hedwigia (1900), p. 139 ; *Aschersonia parasitica* P. Henn., Hedwigia (1904), p. 149.

Aschersonia zenkeri P. Henn., Engl. Bot. Jahrb., XXII. p. 541.

Aschersonia paraphysata forma *Balanseana* Sacc., in herb.

Aschersonia Goldiana Sacc. et Ellis, Sylloge Fungorum, XIV. p. 990 (1899).

Aschersonia paraensis P. Henn., Hedwigia (1902), p. 17 ; *Aschersonia flavocitrina* of Florida writers, non *Aschersonia flavocitrina* P. Henn.

Aschersonia Tamurai P. Henn., Engl. Bot. Jahrb., XXXI. (1902), p. 741.

Aschersonia australiensis P. Henn., Hedwigia (1903), p. 87

Aschersonia viridans (B. & C.) Pat., Bull. Soc. Myc. France, VII. (1891), p. 48.

Hypocrea viridans B. & C., Jour. Linn. Soc., X., p. 756 ; *Aschersonia disciformis* Pat., Bull. Soc. Myc. France, VIII. (1892), p. 136 ; *Hypocrea amazonica* Cooke (in part), Grevillea, XVI., p. 95 ; *Aschersonia oxyspora*, in Speg., Fungi Puigg., No. 475.

Aschersonia badia Pat., Jour. de Bot. (1897), p. 370.

Hypocrea variabilis Currey (in part), Trans. Linn. Soc., Ser. 2, Vol. I. (1876), p. 130.

Aschersonia crenulata Pat. & Har., Jour. de Bot. (1900), p. 244.

Aschersonia tephrosiicola P. Henn., Fl. du Bas et Moy. Congo, Vol. II., fasc. III. (1908), p. 228.

Aschersonia blumenaviensis P. Henn., Hedwigia (1902), p. 27.

Aschersonia flavocitrina P. Henn., Hedwigia (1902), p. 307 ; *Aschersonia abnormis* P. Henn., Hedwigia (1904) p. 93 ; non *Aschersonia flavocitrina* of Florida authors.

Species non visæ.

Hypocrella citrina Speg., Fungi Puiggariani, No. 303, Bolet. de l'Academia nacional de Ciencias de Cordoba, XI. (1889), p. 381. Apparently not now represented in Herb. Spegazzini. Theissen gives the name as a synonym of *H. phyllogena* (Mont.) Speg. The description would fit that species.

Hypocrella colliculosa Speg., Fungi Puiggariani, No. 301, *loc. cit.* Apparently not now represented in Herb. Speg.

Hypocrella Moelleriana P. Henn., Hedwigia (1897), p. 222. Apparently not in Herb. Berol.

Hypocrella luteo-olivacea Wint., Grevillea, XV., p. 86. Type specimens not in Herb. Kew, Herb. British Museum, or Herb. Berol. Description suggests *Hypocrella palmæ.*

Hypocrella globosa Rac., Bull. Acad. Sci. Cracovic (1906), p. 907. The description fits *H. Reineckiana.*

Hypocrella Tamonæ Earle, Mycologia, II., p. 87.

Hypocrella melaena Syd., Philippine Jour. of Science, VIII. C, p. 494.

Aschersonia paraphysata Sacc., Florula Mycol. Lusitanica, Bol. Soc. Broter. Coimbra, XI. (1893), p. 69.

Aschersonia chætospora Sacc., *loc. cit. supra*.

Aschersonia viridula Sacc., Ann. Myc., XI., p. 547. The description suggests *Aschersonia viridans.*

Aschersonia lauricola Speg., Mycetes Argentinenses, Ser. V., An. Mus. Nac. Buenos Aires, XX. (1910), pp. 329–467. Type specimen mislaid.

Aschersonia Suzukii Miyabe et Sawada, Jour. Coll. Agric., Tohoku Imp. Univ., Sapporo, V., Pt. 3 (1913), p. 80. Evidently a Lecaniicolous species near *Aschersonia sclerotioides.*

Species dubiæ.

Hypocrella ? Gardeniæ P. Henn., Hedwigia (1893), p. 223. Asci were not seen by Hennings ; the part spores are much larger than is usual in *Hypocrella*. Specimen not in Herb. Berol.

Hypocrella Engleriana Koord., Bot. Untersuchung (1907), p. 177. Specimen in herb. Berol., labelled *Hypocrella Engleri* Koord. Koorders' note says, "Fruchtkorper ganz eingesenkt." The only things which correspond to his figs. 1 and 2 are brown spots without any external fungus. The leaf also bears two minute, black, carbonaceous bodies, pulvinate, bolster-shaped, *not* constricted below, too old for determination. No sign of any *Hypocrella*.

Hypocrella plana Rac., in herb.

Hypocrella amomi var. *plana* Rac., Bull. Acad. Sci. Cracovie (1907), p. 908 : attributed to *Hypocrella cretacea* by von Höhnel, Fragmente zur Mykologie, VI. Mitt., p. 37.

The specimens submitted to me were effete, and I was not able to find any spores, either *Aschersonia* or *Hypocrella*.

Aschersonia Ayresii Berk., in herb. Kew.

Specimens sterile.

Erratum.

Hypocrella oxyspora Massee, Jour. of Botany, April, 1896, p. 151.

The species is an *Aschersonia*, *Aschersonia oxystoma* Berk., Kew Jour. Bot., VI. (1854), p. 205. In Kew Jour. Bot., VIII. (1856), p. 278, it is cited as *Aschersonia oxyspora*, apparently in error, and this is repeated in Berk. & Cooke, Fungi of Brazil, Jour. Linn. Soc., XV., p. 394. The Brazilian and Cuban species are not *A. oxystoma*, but *A. cubensis*.

Species excludendæ.

Hypocrella bambusæ (B. & Br.) Sacc., Michelia, I., p. 323.

Hypocrea bambusæ B. & Br., Jour. Linn. Soc., XIV., p. 113.

Hypocrella cyperacearum (Berk. & Curt.) Sacc., Sylloge Fungorum, II., p. 580.

Hypocrea cyperacearum B. & C., Exot. Fungi Schwein., p. 285.

Hypocrella atramentosa (B. & C.) Sacc., Michelia, I., p. 323.

Hypocrea atramentosa B. & C., Cuban Fungi No. 758 ; *Dothichloe atramentosa* (B. & C.) Atkinson, Jour. of Mycology, XI., p. 260 (1905).

Hypocrella semiamplexa (Berk.) Sacc., Michelia, I., p. 323.

Hypocrea semiamplexa Berk., Decades Fungi, No. 483.

Hypocrella pulvinulus (B. & Br.) Sacc., Sylloge Fungorum, II., p. 581.

Epichloe pulvinulus B. & Br., Jour. Linn. Soc., XIV., p. 111.

Hypocrella hypoxylon (Peck) Sacc., Sylloge Fungorum, II., p. 581.

Epichloe hypoxylon Peck, 27th Report, p. 108 ; *Balansia hypoxylon* (Peck) Atkinson, Jour. of Mycology, XI., p. 254 (1905).

Hypocrella tuberiformis (Berk. & Rav.) Atkinson, Bot. Gazette (1891), pp. 256 and 258.

Hypocrea tuberiformis Berk. and Rav., Cooke, Grevillea, XII., p. 105.

Hypocrella axillaris Cooke, Grevillea, XX., p. 4.

Hypocrella panici Massee, Kew Bulletin, 1899, p. 173.

All the preceding belong to *Dothichloe*, or *Echinodothis*, or *Balansia*.

Hypocrella semen Bres., in Hennings, Fungi Brasiliensis, II., p. 524.

Type specimen in Herb. Berol. is Glaziov 18069, part of the same collection as *Hypocrella Glaziovii*. The packet contains a description by Hennings with the MSS. name *Hypocrea foliicola*, and it is marked outside, by Hennings, " et *Helotiella Glaziovii*." The specimens are a Discomycete.

Hypocrella Glaziovii P. Henn., Fungi Brasiliensis, II., p. 524.

This is the same species as *Hypocrella semen* Bres., and part of the same collection.

Hypocrella marginalis P. Henn., Engl. Bot. Jahrb. (1903), p. 49.

The type is a Discomycete, apparently co-generic with the foregoing, but a different species. On the other hand, the specimen from Rio Jurua in Herb. Berol. (det. Hennings) is identical with *Hypocrella semen* Bres.

Hypocrella obconica P. Henn., Fungi goyazenses, p. 106.

The type is a Discomycete.

Hypocrella juruana. P. Henn., Hedwigia, 44, p. 61.

Specimens in Herb. Berol., Ule 2831, 2832. Hennings, after the description (*loc. cit.*), writes : "Die Stromata sind meist vollig unreif und konnten nur vereinzelt sporenführende Asken aufgefunden werden." The specimens consist of circular, flattened, or lenticular bodies, which do not show any perithecia. They are composed of thin walled hyphæ, and thus differ from *Hypocrella* in general, and they do not exhibit the characteristic *Hypocrella* scar.

Moelleriella nutans Rick, Ann. Myc., II., p. 405.

Hypocrella nutans (Rick.) Theiss.

The type species of *Moelleriella* is *M. sulphurea* Bres., which is *Hypocrella phyllogena* (Mont.) Speg. The specimen of *Moelleriella nutans* in Herb. Berol. (Rick., Fungi Austro-Americani, No. 89) is not, in my opinion, *Hypocrella*. I was not able to find perithecia or pycnidia in it.

Hypocrella rubiginosa A. L. Smith, Jour. Linn. Soc., XXXV., p. 18.

This was described as occurring on the stroma of a *Hypoxylon*. The basal part, however, is not *Hypoxylon*, but *Munkia*, and the section of the fungus, which is well illustrated by Miss A. L. Smith (*loc. cit.*), shows details which suggest that the supposed *Hypocrella* stroma is not a foreign fungus growing on the *Munkia*, but an ascigerous stage of the latter.

Ordinary *Munkia* stromata at my disposal exhibit, when dry, an outer " rind," about 1 mm. thick, in which the " pycnidia " are embedded, and this rind is continuous all over the stroma. But in the specimens on which *Hypocrella rubiginosa* grows, the outer rind is interrupted beneath the *Hypocrella* stroma. There is, in fact, a more or less circular gap in the rind, and the inner, radial hyphæ grow through this to form the supposed *Hypocrella.* The specimens are certainly not *Hypocrella* parasitic on a scale insect on the *Munkia*, and it appears to me that the suggestion already made is the only one which fits the case.

"*Hypocrella rubiginosa*" differs from other species in the character of its hyphæ, and in the fact that it is not parasitic on a scale insect. If the spores are permanently continuous and multiseptate, as they appear to be, it differs from *Hypocrella* in that respect also. If the "*Hypocrella*" is really the ascigerous stage of *Munkia*, the difference in the conidial stages is extreme.

Aschersonia rufa (B. & Br.) Sacc., Sylloge Fungorum, III., p. 619.

Myriosporium rufum B. & Br., Jour. Linn. Soc., XIV., p. 88. This is not *Aschersonia*; it appears to be a Hyphomycete.

Aschersonia mellea B. & Br., Jour. Linn. Soc., XIV., p. 89.

This is a small *Crepidotus* (not *Pleurotus*, as suggested in Ann. Perad., IV., p. 63), pressed flat on the substratum. Spores 5–6 × 3–4μ.

Aschersonia carpinicola E. & D., Proc. Canad. Inst. (1897), p. 63.

I have not seen this species, but from the description it is quite evidently not an *Aschersonia.*

Aschersonia Henningsii Koord., Bot. Untersuch. (1907), p. 213.

It is evident from Koorders' figure that this species, which has multiseptate spores, is not *Aschersonia.* Only a minute fragment of the fungus now remains on the type specimen, but it is clear from the remnant that it is the *Microcera* very commonly found on *Aonidia* in the Eastern Tropics. This species has since been named *Microcera Fujikuroi* by Miyabe and Sawada; presumably the name will now stand as *Microcera Henningsii.*

Aschersonia zeylanica Berk., in Herb. Kew.

A purple-red lenticular stroma common on scale insects in the Eastern Tropics. All specimens seen up to the present (several hundreds) have been sterile. Its hyphæ differ from those of *Aschersonia*. "*Aschersonia* sp. indet" on *Saccopetalum*, Coll. Koorders, Java, in Herb. Berol., belongs here.

Aschersoniopsis globosa P. Henn.

As already recorded by v. Höhnel (Ann. Myc., IX., p. 171), this belongs to *Munkia* Speg. This is true of the type (E. Ule 788), as well as Puttemans 792, and E. Ule 872, sub *Hypocrella verruculosa*, in Herb. Berol.

The whole of the species, both *Hypocrella* and *Aschersonia*, fall into two groups, one containing those parasitic on *Lecaniidæ*, and the other those parasitic on *Aleurodidæ*. These groups are easily recognized in practice, though it is difficult to express the differences in words. In *Hypocrella*, the difference between the two has already been observed, and the genus *Fleischeria* has been split off.

Fleischeria, according to the original diagnosis, differs from *Hypocrella* in its harder stroma. This distinction, however, breaks down in practice, for species undoubtedly co-generic with *Fleischeria javanica* have a stroma which is no harder than that of *Hypocrella discoidea*. All grades of hardness exist, from *Hypocrella schizostachyi*, which is much harder than *Fleischeria javanica*, to *Hypocrella convexa*, which is fairly soft.

The difference between the two groups lies in the *Aschersonia* stage. Species of *Aschersonia* on *Aleurodidæ* possess paraphyses, while those on *Lecaniidæ* do not. *Aschersonia oxystoma* may possibly be an exception to this rule ; it has the *facies* of an Aleurodid species, but paraphyses are wanting ; its host insect has not yet been observed.

It is proposed to retain *Fleischeria* as a subgenus for those species of *Hypocrella* whose *Aschersonia* stage does not possess paraphyses, and to adopt the name *Lepricuria* as a subgenus for the corresponding species of *Aschersonia*. This is no doubt a very unsatisfactory proceeding, on paper, as far as regards the *Hypocrella* stage, but in practice it is found that, in this group, the *Hypocrella* and *Aschersonia* stages frequently occur in the same stroma. *Eu-aschersonia* and *Eu-hypocrella* are used below for the two stages of the Aleurodiicolous species.

The species may then be arranged as follows ; in a number of cases the *Aschersonia* stage is known, but has not been given a separate name :—

LECANIICOLÆ.

HYPOCRELLA ..	.. ASCHERSONIA
Subgenus **Fleischeria**	.. Subgenus **Leprieuria**
H. palmæ ..	.. —
H. epiphylla ..	.. —
H. Reineckiana	.. *A. sclerotioides*
H. camerunensis	.. —
H. ceramichroa	.. —
H. cavernosa ..	.. —
H. verruculosa	.. —
H. marginata ..	.. *A. marginata*
H. convexa ..	.. —
H. palmicola ..	.. —
H. bispora ..	.. —
H. Gartneriana	.. —
H. schizostachyi	.. —
H. javanica ..	.. —
H. botryosa ..	.. —
H. phyllogena	.. *A. basicystis*
H. amomi ..	.. —
— ..	.. *A. coffeae*
*(*H. turbinata*)	.. *A. turbinata*
— ..	.. *A. oxystoma*
— ..	.. *A. cubensis*

When only a small amount of material is available, it appears possible to split these species into well-defined groups, characterized by their form, but as specimens accumulate it is found that the forms grade into one another to such an

*The ascigerous stage of *A. turbinata* has recently been described by Thaxter, Bot. Gaz., LVII., p. 308.

extent that this character cannot be relied on. The first eight of the species of *Hypocrella* listed above are usually subglobose, roughly about two-thirds of a sphere, with a flat base. The next three are flattened convex, or scutate. But *H. marginata* occurs in both forms, according to the shape of the scale insect on which it is growing, and it appears probable that the same may ultimately be found to be true of the other species also. *H. Gartneriana*, *H. schizostachyi*, and *H. javanica* are again usually subglobose in general outline, but the surface of the stroma is lobed, strongly in the first two species, and either lobed or nearly smooth in the third. *H. amomi* is a botryose form, and resembles a cluster of perithecia seated on a stroma.

H. phyllogena is typically stud-shaped, but occurs in a merely pulvinate form also, as shown in Möller's figures. Its *Aschersonia* stage is found in the same forms.

Of the unattached species of *Aschersonia*, *A. coffeae* is subglobose, while *A. cubensis* and *A. oxystoma* are, in general, columnar-cylindric.

Aleurodiicolæ.

Hypocrella ..	.. Aschersonia
Subgenus **Euhypocrella**	.. Subgenus **Eu-Aschersonia**
H. discoidea ..	.. *A. samoensis*
— ..	.. *A. viridans*
— ..	.. *A. badia*
— ..	.. *A. crenulata*
— ..	.. *A. blumenaviensis*
H. mollii ..	.. *A. confluens*
H. duplex ..	.. *A. duplex*
— ..	.. *A. tahitensis*
— ..	.. *A. placenta*
— ..	.. *A. aleyrodis*
— ..	.. *A. zenkeri*
..	.. *A. Goldiana*
— ..	.. *A. Tamurai*
— ..	.. *A. australiensis*
H. sloaneae ..	.. —
H. Raciborskii	.. —

Hypocrella discoidea and the first five species of *Aschersonia* are, typically, discoid, *i.e.*, circular, flattened discs with a more or less abrupt margin (neglecting the hypothallus when present), and would, at first sight, appear to form a natural group. But those of which a large amount of material is available, *e.g.*, *H. discoidea*, are found to occur in irregularly pulvinate form also, and thus resemble *H. mollii*, which may be described as effused pulvinate. In these species the perithecia and pycnidia are regularly flask-shaped or almost globose, with definite ostiola.

Aschersonia placenta, *A. aleyrodis*, *A. zenkeri*, *A. Goldiana*, *A. Tamurai* form a group in which the pycnidia are irregular and ultimately widely open, so that the extruded conidia fuse into a continuous mass which usually covers the centre of the stroma. *A. tahitensis* is intermediate (in shape) between *A. placenta* and *A. samoensis;* it has the discoid stroma of the latter and the irregular pycnidial orifices of the former.

In *Hypocrella sloaneæ* and *H. Raciborskii*, the conidial stage, when present, occupies the centre of the stroma, the perithecia being developed marginally. As the perithecia are usually distinct, these are botryose forms, parallel to *H. amomi*. The extent to which this botryose character may be developed is illustrated by the assignment of *H. Raciborskii* to the genus *Barya*.

It may be noted that, with one possible exception, the species of the Eastern Hemisphere are distinct from those of the Western. Closely allied species occur in the two regions respectively, *e.g.*, *Hypocrella palmæ* and *H. marginata*, *H. epiphylla* and *H. Reineckiana*, *Aschersonia aleyrodis* and *A. placenta*, but they are sufficiently different to be maintained as distinct species.

The only exception to this rule, at present, is *Hypocrella camerunensis*, which is recorded from Brazil and Africa. The stromata of the Brazilian and African collections differ considerably in shape, but the variation is not greater than that which is known to occur in *Hypocrella marginata*. Unfortunately in none of the collections yet made are the stromata mature.

NOTES.

Smithia blanda Wall.—Mr. F. M. Mackwood has communicated to us his discovery that this is the food plant of a butterfly peculiar to Ceylon, *Cyaniris lanka* (Moore).—T. P.

Oberonia recurva Lindl.—This orchid, which is said by Trimen to be very rare, and of which only specimens from Maturata exist in the Peradeniya herbarium, appears to be fairly frequent at Hakgala. It was collected there in 1906 by Mr. A. M. Smith, and in 1914 (April) by Mr. G. Bryce.—T. P.

Heliotropium curassavicum Linn.—This plant was collected in the Jaffna District by Mudaliyar W. de Alwis Seneviratne in 1912, but remained unidentified until recently. It was collected again in the same district by Herr Rehnelt in 1913.—T. P.

Insect Visitors to Flowers.—Little has been noted in the Tropics on the subject of insect visitors to flowers. It may be of interest to record, therefore, that one of the chief visitors to the larger *Leguminosæ* at Hakgala is a carpenter bee (species ?). It has frequently been observed on *Crotalaria Walkeri* and *Atylosia Candollei* there. At Peradeniya a carpenter bee visits *Calotropis*, as is shown by the frequent occurrence of the peculiar pollen masses of that flower on the limbs of the insect.—T. P.

A new Alien.—*Hyptis suaveolens* Poit. has recently been found as a weed on a coconut estate in the Chilaw District. This is a South American plant, which has been introduced into several parts of Tropical Asia, but it has not been discovered in Ceylon previously. Hooker, in Flora of British India, records it as occurring in the Deccan Peninsula, Cachar, and the Nicobar Islands.—T. P.

Right- and Left-handed Coconut Trees.—The vascular bundles of the coconut stem do not run straight up the stem, but in a spiral inclined at an angle of about 10° to the vertical. In the course of investigations made into the structure of the coconut stem some years ago, it was found that the direction of the bundles is not constant in the same stem as one proceeds from the periphery to the centre. In one stem, 24 cms. in diameter at 12 ft., it was found that (neglecting the outer rind) the bundles sloped up to the left in the outer 3·5 cm. There then occurred an abrupt reversal of direction, and for the next 3·5 cm. the bundles sloped up to the right. This was followed by another reversal, and in the remainder of the stem (to the centre) the bundles sloped up to the left again. The central column, therefore, consisted of three regions, and the slope of the bundles was reversed on passing from one layer to the next. This is readily demonstrated if a thin disc, about 1 inch thick, is cut from a coconut stem and *broken* in two along a diameter. The change of direction is then indicated by the different slopes of the surface of the fracture.

In another tree this condition was reversed; the same three regions were present, but in the outer the bundles sloped up to the right, in the intermediate to the left, and in the inner to the right again. From an examination of a number of trees it appears that the number of reversals is always the same.

The scars left by the "bleeding disease" afford a means of ascertaining in which direction the bundles of the outer layer run, without cutting down the tree. These scars are fairly common on old trees, and they usually run obliquely up the stem, following the course of the outer layer of vascular bundles. In an examination of fifty-five of such trees taken at random, the scars were found to slope up to the right in 28 cases, and up to the left in 27. There are therefore "right-handed" and "left-handed" coconut palms, and from the count of the old disease-scars it may be presumed that they occur practically in equal numbers.—T. P.

Stereospermum xylocarpum Wight.—This tree, which normally should be covered in the flowering season with masses of white blossom, suffers severely at Peradeniya from the depredations of squirrels and birds, to such an extent that when it first comes into bloom very few of the flowers mature. When in full blossom the ground beneath the tree is strewn with flowers, and on examination it is found that the majority of these are damaged.

The striped palm squirrel (*Sciurus palmarum*) is the chief offender. It bites through the flower stalk, takes the flower in its fore paws, and after one nibble drops it. The flower thus treated exhibits an oval hole, about 4 × 3 mm., through the calyx and corolla, near the base of the flower. This hole does not give free access to the corolla tube, but is blocked on the inner side by the disc, and consequently it is clear that the squirrel cannot extract anything solid from the interior of the flower. Both expanded and unopened flowers are attacked, the former more generally.

The Loriquet (*Loriculus indicus*) works in the same way, picking off the whole flower and holding it before injuring it. It does not, however, bite a piece out, but makes two small punctures, as a rule, through the calyx and corolla at about the same level as the hole made by the squirrel.

The third offender noted is the Honeysucker (*Cinnyris zeylonicus*). It simply tears a hole through the corolla with its beak. The flower does not fall off unless it is nearly mature and ready to fall in the normal way.

In all three cases the attraction appears to be the nectar which is found, sometimes in large quantity, in the corolla tube.—T. P.

The Cherry at Nuwara Eliya.—The statement that the Cherry is an evergreen at Nuwara Eliya and does not bear fruit appears to be firmly established in botanical literature as an example of the influence of the change of climate on deciduous trees. Pfeffer refers to the Cherry in Ceylon as an evergreen in Pflanzenphysiologie, Bd. 2, p. 270, and cites De Candolle as his authority. Askenasy states that the Cherry is evergreen in Ceylon, and does not produce fruit (Über die jahrliche Periode der Knospen, Bot. Zeit., 1877, p. 841), also citing De Candolle. The latter's statement, however, in Geographie Botanique, p. 391 (1855), is that, when transferred to Ceylon, the Cherry does not lose its leaves ; he does not state that it does not produce fruit.

The origin of these statements is apparently to be found in an account of the vegetation of Ceylon, by Gardner, published in Jour. Hort. Soc., London, IV. (1849), pp. 31–40. Gardner wrote : " In place of losing their leaves for nearly six months of the year, the Peach and the Cherry are here evergreens, and hence are kept in such a continued state of excitement as to prevent their bearing. The Peach does indeed give a poor crop of fruit of a very inferior quality, but although the Cherry blossoms annually, its fruit never comes to perfection." Champion had previously recorded (1843) that the Cherry trees at Nuwara Eliya did not produce fruit.

In 1898 this statement was brought to the notice of Mr. W. Nock, who had held the post of Curator of the Hakgala Gardens since 1882. Mr. Nock wrote as follows in the "Tropical Agriculturist," XVIII., p. 187 :—

"The Cherry has not become an evergreen ; it loses its leaves at the end of every year, and for a short time is bare. It flowers abundantly in the locality of Nuwara Eliya (6,200 ft. elev. ; 57·7° av. temp.). It sets but little fruit, and that generally falls off before the stoning stage. Occasionally I have seen fruit colouring, but have never seen one ripe. It is never reproduced by seeds, but plentifully by cuttings and suckers."—T. P.

Oxalis in Ceylon.—For several years *Oxalis* has been a common weed in up-country districts in Ceylon. It has been usually known as Manickwattee Weed, and referred to *Oxalis violacea* Linn. An examination of specimens shows at once that under these names two species are included, which differ widely in the structure of their flowers, the shape of their leaves, and their methods of vegetative reproduction. The commoner species, the real Manickwattee Weed, is *Oxalis corymbosa* DC. The other species, *Oxalis violacea*, is rarer. Both species descend as far as Peradeniya, but while *O. corymbosa* occurs at that elevation on roadsides and tea estates, *O. violacea* is apparently found only in the Botanic Gardens.

O. corymbosa is a common tropical weed, and there is no need of any special explanation to account for its introduction into Ceylon. *O. violacea* was recorded by Moon in 1824, but it is doubtful which species he referred to. Trimen, in 1893, recorded that *O. violacea* was becoming a troublesome weed in some parts of the hill districts ; the herbarium specimens show that he had distinguished between *O. violacea* and the second species, which he thought might be *O. latifolia.*

Though these weeds have been in the Island for many years, they have occasionally been re-introduced under other names. *O. violacea* was received at Hakgala in 1908 under the name of *O. brasiliensis,* while in 1879 it was advertised for sale at Hakgala as a vegetable, under the name of *Oxalis Deppei.*

Both species appear to be gradually spreading to lower elevations in Ceylon, but neither has been known to produce seed in this country.—T. P.

A Note on Plant Names.—*Lycopodium cernuum,* commonly called Stags' Horn Moss, and a favourite decorative material, is known to the Sinhalese as "Badal Wanasa." The origin of this name is found in a story which tells of a King of Lanka who set his goldsmiths the impossible task of reproducing the delicate tracery of the foliage of the lycopod. The literal meaning of the name is the "Goldsmiths' despair."

"Adatodai," the Tamil name of *Adhatoda Vasica,* signifies "what goats will not touch." The generic term is clearly derived from the native name, as is also "*Mussaenda.*"

There is a pretty story which accounts for the origin of the white bracts of *M. frondosa,* relating how when Buddha was once benighted in a forest the *Mussenda* plants "blossomed" forth their white petal-like bracts in order to show the way out.

It is curious how the expression "black mouth" is perpetuated in the name of a plant whose berries leave a dark stain on the lips and tongue. Compare the Greek Melastoma, the Sinhalese "Katakalua," and the Portuguese "Bocha pretu."—C. D.

REVIEWS.

[The items which appear under this head are written primarily for Ceylon readers, and deal with papers and books of local interest.]

Fischer, Ed. Beitrage zur Morphologie und Systematik der Phalloideen. Annales Mycologici, VIII., pp. 314–322; 1 plate.

Includes an account of the development of *Clathrella delicata* (B. & Br.) Petch, from material supplied from Ceylon.

Fischer, Ed. Genea Thwaitesii (B. & Br.) Petch und die verwandtschafts-verhaltnisse der Gattung Genea. Ber. d. Deutsch. Bot. Gesell., Bd. XXVII., pp. 264–270; 1 plate.

This fungus was originally described from Ceylon as *Hydnocystis Thwaitesii* B. & Br. Fischer agrees, after an examination of material sent from Ceylon, that it should be referred to *Genea*, and gives an account of its structure with reference to allied forms.

Magnus, W. Die atypische Embryonalentwicklung der Podostemaceen. Flora (Neue Folge), Bd. V., pp. 275–336; 4 plates.

The author has carried out investigations on the embryology of *Lawia zeylanica* Tul., *Podostemon subulatus* Gardn., *Dicræa elongata* Tul., *Hydrobrium olivaceum* (Gardn.) Tul., and *Farmeria metzgerioides* (Trimen) Willis, which he collected in the Mahaweli-ganga at Hakinda during his stay at Peradeniya in 1908–9. His account consists of a special part, which includes a description of the embryo of each species, and a general account of the comparative embryology of the Podostemaceæ and its ecological and morphological significance.

Thaxter, R. Preliminary descriptions of new species of Rickia and Trenomyces. Proceedings American Academy of Arts and Sciences, XLVIII., pp. 365–386.

From material collected at Peradeniya the author describes *Rickia discopomæ* and *Rickia elegans*, both on a species of *Discopoma*.

Dingler, H. Zur oekologischen Bedeutung der Flugel der Dipterocarpaceen-Fruchte. Engler's Botanische Jahrbucher, Funfzigster Band, Supplement Band, Fest-Band für A. Engler, 1914, pp. 1–14.

The author has carried out experiments with the fruits of *Dipterocarpus zeylanicus*, *Shorea stipularis*, *Shorea* (*? oblongifolia*), and "*Hopea faginea*," obtained from Ceylon, and concludes that the well-known wings of these fruits favour their distribution by prolonging the time of descent and so permitting them to be borne by the wind to a greater distance in a horizontal direction.

Schulz, O. E. Bidens chinensis (L.) Willd. und verwandte Arten. Engler's Botanische Jahrbucher, Funfzigster Band, Supplement Band, Fest-Band für A. Engler, 1914, pp. 176–187.

The author separates *Bidens chinensis* (L.) Willd. from *Bidens pilosus* L. His references to Ceylon specimens and records are as follows :—

Bidens chinensis (L.) Willd., Moon Catal. Ceyl., p. 57. *Bidens pilosus* Trimen, Flor. Ceyl., III., p. 40 ; Thwaites, Enum. Plant. Zeyl., p. 165. *Ceylon-tea* vel *Wal-te-kola* Ceyl. ex Moon et Thwaites. *Hab.* Ceylon prope Mgandamalej, Klein ; prope Kaltura, ex Moon.

Bidens bipinnatus L. *Bidens decompositus* Wall., Thwaites Enum. Plant. Zeyl., p. 165. *Bidens pilosus* L. var. b. *bipinnatus* Trimen, Flor. Ceyl., III. (1895), p. 41. *Hab.* Ceylon in distr. Batticaloa haud frequens, ex Thwaites.

With regard to the first of these species, the author states that specimen No. 15023 in Herb. Willdenow, named *Bidens chinensis* Willd., was collected by Klein on February 29, 1796, at Mgandamalej in Ceylon. We have no knowledge of Klein or Mgandamalej.

Czapek, F. Uber die Blattentfaltung der Amherstieen. Sitzungsberichte der Kaiserl. Akad. der Wissens. in Wien, Mathem.-naturw. Klasse, Bd. CXVIII., Abt. 1.

The author carried out experiments with *Amherstia nobilis, Humboldtia laurifolia, Brownea grandiceps,* and *Saraca indica,* at Peradeniya. His conclusions are as follows :—

The hanging position of the young twigs of *Amherstia* and the young leaves of *Humboldtia, Brownea,* and *Saraca* is not a consequence of a " turgorless condition " during their early stages of development, but is correlated with the plastic condition of the tissues owing to the absence of the mechanical elements.

The erection of the leaves of *Amherstia* is brought about by a geotropic growth curvature in the primary leaf nodes.

The biological importance of the hanging position primarily depends on the protection from excessive insolation which it affords the young leaves.

Dingler, H. Versuche uber die Periodizitat einiger Holzgewachse in den Tropen. Sitzungsberichte der Koniglich Bayerischen Akademie der Wissenschaften, Math.-physik. Klasse, Jahrgang 1911.

Trees of several deciduous species were lopped and all leaves removed in November-January, prior to the normal time of leaf-fall. In general the trees produced new leaves, which persisted through the dry months, when untreated trees of the same species were leafless. The experiments were conducted at Peradeniya.

Dingler. H. Uber Periodizitat sommergruner Baume Mitteleuropas im Gebirgsklima Ceylons. Sitzungsberichte der Koniglich Bayerischen Akademie der Wissenschaften, &c., Jahrgang 1911.

Professor Dingler, who visited Nuwara Eliya in 1910, has recorded his observations on the much-debated question of the behaviour of the deciduous trees of temperate climates when transferred to the hill regions of the tropics. He deals chiefly with two of the species of oak at Hakgala, *Quercus pedunculata* and *Q. cerris*, as well as with *Fagus silvatica, Castanea vesca, Betula alba, Populus pyramidalis, Platanus acerifolia,* and the fruit trees, pear, apple, cherry, and peach. He recognizes that definite conclusions on the matter cannot be attained without continuous observations for several years on the behaviour of selected specimens, and has attempted to remedy this deficiency (1) by examining material collected subsequent to his visit and forwarded to him in Europe, and (2) by obtaining the opinions of residents on times of leaf-fall, fruiting, &c. But such opinions are merely general impressions, and they are scarcely worthy of the credence which Professor Dingler gives them, especially when they relate to species which are never, or very rarely, entirely leafless.

The observations on *Quercus pedunculata* relate to the scrub oaks in front of the laboratory at Hakgala. A comparison of the older trees would not have revealed so much difference between this species and *Q. cerris* as Professor Dingler supposes. The suggestion that the leaf-fall of these *Q. pedunculata* is correlated with the dry months of February-March is not in accordance with fact ; in these months the trees are covered with new leaf. Again, the remark that the pear and the apple behave alike must be qualified by the information that the former (a cooking variety) produces fruit, while the latter, in general, does not.

The distinction between the oaks at Hakgala and that at Nuwara Eliya, based on the supposed difference of origin of the two trees, is of doubtful accuracy, for, in the absence of any definite record, it is most probable that the Nuwara Eliya oak was transferred there from Hakgala.

One circumstance which may affect the periodicity of certain of these Hakgala trees has escaped the notice of Professor Dingler and other observers. The scrub oak at Hakgala is always, at least since the year 1904, severely attacked after each monsoon by a mildew (oidium), which does not attack *Q. cerris*. Similarly, the peach trees suffer great damage from the attacks of *Exoascus deformans* and *Uredo pruni*.

Engler, A. Das Pflanzenreich. Leipzig, 1900 (in progress) (continued from Annals, Peradeniya, Vol. III., p. 93).

11 Heft. *Marantaceæ* by K. Schumann. Of the three Ceylon species, two appear in new guise. *Clinogyne virgata* Benth. becomes *Donax virgata* (Roxb.) K. Schum. (Thwaites,

3465). *Phrynium zeylanicum* Benth. becomes *Stachyphrynium zeylanicum* (Benth.) K. Schum. (Thwaites 320). *Phyrnium capitatum* Willd. remains unchanged.

12 Heft. *Orchidaceæ—Pleonandræ* by E. Pfitzer. *Apostasia Wallichii* R. Br., the only Ceylon species, remains unchanged.

13 Heft. *Eriocaulaceæ* by W. Ruhland. *Eriocaulon longifolium* Nees is given for Ceylon, but no specimen cited. Thwaites 61, referred to *E. zeylanicum* by Hooker in Trimen, Flora Ceylon, V., 3, is described as a new species, *E. subglaucum* Ruhl. Thwaites' name *E. atratum* var. *major* is restored for *E. caulescens* Hk. f. and Th. Gardner's No. 972 is given for *E. atratum* instead of 932. Thwaites 796 is referred to *E. trilobum* Buch.-Ham. (Central Province, also Walker); it was referred to *E. collinum* by Hooker. *E. nilagirense* Steud. is new to Ceylon (Warburg 1131). *E. subcaulescens* Hook. f. is restored for *E. cristatum* Mart. var., Thwaites Enum. Pl. Zeyl., 1 (1864), 341 = *E. atratum* Thw. pr. p., ibidem non Koern. = *E. zeylanicum* Hook. f., Trm. Fl. Ceylon, V. (1900), 3, non Koern.; Nuwara Eliya (Gardner); Ramboda, Central Province (Derselbe, C. P. 789). C. P. 789 is Thwaites, not Gardner. On the other hand, *E. ceylanicum* Koern. is given for Ceylon, Nuwara Eliya, Gardner, without citation of any specimen. *E. intermedium* Koern. is also cited for Ceylon (Walker, &c.) without mention of specimen. *E. Thwaitesii* Koern. and *E. Neesianum* Koern. are maintained distinct, to the former being allotted "Ambagamuwa, Kitulgala (Thwaites)," and to the latter Gardner No. 936 in Herb. Berol. from Ramboda. *E. capillus-naiadis* Hook. f. is united to *E. setaceum* L. *E. collinum* Hook. f. is retained in the Ceylon list, but no specimen is cited; the localities Ramboda, Ambagamuwa, are quoted from Trimen and attributed to Gardner, but the C. P. specimen cited in Trimen is transferred to *E. trilobum.*

As a result of this revision, one Ceylon species *E. capillus-naiadis* disappears, another, *E. caulescens*, is reduced to a variety, and seven names, one a new species, are added. According to Ruhland, the number of species of *Eriocaulon* known from Ceylon is twenty-three.

14 Heft. *Cistaceæ* by W. Grosser. No species in Ceylon.

15 Heft. *Scheuchzeriaceæ*, *Alismataceæ*, and *Butomaceæ* by Fr. Buchenau. *Alisma oligococcum* Muell. is changed to *Caldesia oligococca* (F. Muell.) Buch. *Limnophytum obtusifolium* (L.) Miq. remains unchanged.

16 Heft. *Theophrastaceæ* by C. Mez. No species Ceylon.

17 Heft. *Lythraceæ* by E. Koehne. *Ammania peploides* Spreng. and *Amm. rotala* F. Muell. become *Rotala indica* (Willd.) Koehne and *Rotala verticillaris* L. respectively. *Ammania pentandra* Roxb. becomes *Rotala densiflora* (Roth.)

Koehne, and its sub-species *uliginosa* f. *diffusa*, and *melitoglossa* ff. *minor*, *expansa*, and *densiflora* are given for Ceylon, but no specimens are cited. *Ammania baccifera* remains unchanged, subsp. *viridis* being cited (again without specimen) for Ceylon. *Ammania cordata* Wight and Arn. and *Amm. lanceolata* Heyne become *Nesæa brevipes* Koehne and *Nesæa lanceolata* var. *stricta* (Thw. 2796) respectively. *Rotala rotundifolia* (Roxb.) Koehne and *Ammania multiflora* Roxb. var. *parviflora* are additions to the Ceylon Flora, for which no authority is given unless Flora British India.

Woodfordia floribunda Salis. becomes *W. fruticosa* (L.) S. Kurz., *Lawsonia alba* Linn. becomes *L. inermis* L., *Lagerstroemia flos-reginæ* Retz becomes *Lag. speciosa L.*, *Pemphis acidula* remains unchanged. *Nesæa triflora* (L.) Kunth. is cited for Ceylon, without mention of the fact that it is generally regarded as an introduction.

18 Heft. *Taxaceæ* by R. Pilger. No species in Ceylon.

19 Heft. *Betulaceæ* by H. Winkler. No species in Ceylon.

20 Heft. *Zingiberaceæ* by K. Schumann. Alterations in this family are comparatively few. *Amomum floribundum*, *A. involucratum*, and *A. nemorale* are attributed to "(Thw.) Benth.," instead of to Trimen, on the evidence of Genera Plant., III. A var. *induta* is described of *A. acuminatum* Thw., with the note that the type and variety are found in the same Thwaites' number, but are perhaps different species, the specimens being insufficient for decision. *A. fulviceps* and *A. ciliatum* appear as *Phæomeria fulviceps* (Thw.) Schum. and *Phæomeria ciliata* (Bak.) Schum. respectively. *Amomum rufescens* Trim. becomes *Alpinia rufescens* (Thw.) Schum. In *A. graminifolium*, "Lingheradja" is written for "Singhe Raja." *Alpinia nutans* Rosc. is changed to *A. speciosa* (Wendl.) Schum., but the Ceylon var. *sericea* Moon is not mentioned. The Ceylon form of *Costus speciosus* is attributed to var. *lasiocalyx* Schum. *Globba bulbifera* Roxb. is said to be probably an escape in Ceylon, and *Hedychium coccineum* doubtfully native, while *Amomum echinatum* presumably occurs in Ceylon; these statements are due to neglect of Ceylon records and specimens. The former name *Elettaria major* Smith is adopted for *Elettaria cardamomum* Maton var. *major*. A new species of *Cyphostigma*, *C. pedicellatum* Schum. (Thwaites 2736a) is described; it is mixed with the type, but differs in its much broader solitary leaves, broader but simpler inflorescence, and pedicellate flowers.

21 Heft. *Araceæ—Pothoideæ* by A. Engler. *Pothos ceylanicus* Engl. n. sp. is described from Herb. Peradeniya and Herb. Berlin; the remaining Ceylon species are unchanged. The Ceylon form of *Acorus calamus* is assigned to var. b. *verus*.

22 Heft. *Aponogetonaceæ* by K. Krause and A. Engler. *Aponogeton monostachyon* Linn. f. becomes *A. natans* (L.) Engl. and Krause.

23 Heft. *Halorrhagaceæ* by A. K. Schindler. Ceylon species are *Laurembergia indica* (Thw.) Schind. (*Serpicula indica* Thw. quoad spec. C. P. 451, exclus. ceter.) in Herb. Berlin, DC., Petersburg; *L. Wangerinii* Schindler n. sp., Pedrotalagala (Wawra, Iter Coburgense No. 1071, Thwaites No. 1545), " Narsh " (Warburg No. 1041); *L. hirsuta* (Wight and Arn.) Schindler, (*Serpicula indica* Thw. in part); *L. grandiflora* Schindler n. sp. (Walker in Hooker f. and Thomson), Herb. Berlin, Leyden, Vienna, Tropical region of Ceylon; *L. glaberrima* Schindler, n. sp., Thwaites C. P. 2811; *L. zeylanica* (Arn.) Schindler, Ceylon at 5,000 to 8,000 ft. (Thwaites No. 146) and var. *minor*, Adam's Peak; *Myriophyllum indicum* Willd. (Thwaites No. 1549; Deschamps).

24 Heft. *Primulaceæ* by F. Pax and R. Kunth. *Lysimachia deltoidea* var. *cordifolia*, *Lysimachia ramosa* var. *zeylanica*, and *Anagallis cærulæ* recorded for Ceylon.

25 Heft. *Juncaceæ* by Fr. Buchenau. Ceylon species unchanged.

26 Heft. *Droseraceæ* by L. Diels. Ceylon species unchanged.

27 Heft. *Polemoniaceæ* by A. Brand. No Ceylon species.

28 Heft. *Scrophulariaceæ—Antirrhinoideæ—Calceolariæ* by Fr. Kranzlin. No native Ceylon species.

29 Heft. *Erythroxylaceæ* by O. E. Schulz. Ceylon species are *Erythroxylon acuminatum* (Arn.) Walp. (*E. lucidum* Moon); *E. zeylanicum* Schulz n. sp. (Thwaites No. 222, with the previous sp.; Wahakotta, Deschamps No. 65, " Bata Kirilla"); *E. obtusifolium* (Wight) Hook.; *E. lanceolatum* (Wight) Walp.; *E. monogynum* Roxb.

30 Heft. *Styracaceæ* by J. Perkins. No Ceylon species.

31 Heft. *Potomagetonaceæ* by P. Ascherson and P. Graebner. *Potamogeton fluitans* Roth. subsp. *Americanus* (Thwaites 590), *Potamogeton indicus* Roxb. (Thwaites), *P. perfoliatus* L. (no specimens cited), *P. pectinatus* L., and *Cymodocea serratulata* (R. Br.) Aschers., given for Ceylon. Thwaites 590 is cited as *P. indicus* in Trimen, Flora Ceylon, where this and *pectinatus* are the only species admitted.

32 Heft. *Orchidaceæ—Monandræ—Cœlogyninæ* by E. Pfitzer and Fr. Kranzlin. Ceylon species unchanged.

33 Heft. *Liliaceæ—Asphodeloideæ—Aloineæ* by A. Berger. No Ceylon species.

34 Heft. *Sarraceniaceæ* by J. M. Macfarlane. No Ceylon species.

35 Heft. *Stylidiaceæ* by J. Mildbraed. The single Ceylon species remains unchanged.

36 Heft. *Nepenthaceæ* by J. M. Macfarlane. The single Ceylon species remains unchanged.

37 Heft. *Additamentum ad Araceas Pothoideas. Araceæ—Monsteroideæ. Araceæ—Calloideæ* by A. Engler and K. Krause. Ceylon species unchanged.

38 Heft. *Cyperaceæ—Caricoideæ* by G. Kukenthal. *Carex ligulata* Nees becomes *C. hebecarpa* var. *ligulata* (Nees) Kukenthal. A new species, *C. lateralis* Kukenthal, is described for Ceylon (Thw. 3198, in part).

39 Heft. *Phytolaccaceæ* by H. Walter. The form of *Rivina humilis* found in Ceylon is named var. *orientalis* (Moq.) Walt.; specimens, Badulla (Deschamps), without locality (Walker No. 35).

40 Heft. *Papaveraceæ—Hypecoideæ* et *Papaveraceæ—Papaveroideæ* by F. Fedde. No Ceylon species.

41 Heft. *Garryaceæ, Nyssaceæ, Alangiaceæ, Cornaceæ* by W. Wangerin. *Alangium Lamarkii* Thw. is referred to *A. salviifolium* (L. f.) Wangerin and *A. glandulosum* Thw. to *A. salviifolium* (L. f.) subsp. *A. hexapetalum* (Lam.) Wangerin. Thwaites 381, 760 are both cited for the latter. The Ceylon species of *Mastixia* are unchanged.

42 Heft. *Euphorbiaceæ—Jatropheæ* by F. Pax. *Jatropha glandulifera* Roxb. is not given for Ceylon. *Aleurites moluccana* (L.) Willd. is adopted instead of *A. triloba* Forst.

43 Heft. *Umbelliferæ—Apioideæ—Bupleurum, Trinia, et reliquæAmminæ heteroclitæ*, by H. Wolff. The Ceylon species of *Bupleurum* is referred to *B. mucronatum*, f. 3. *virgatum* (Wight et Walk.-Arn.) Clarke.

44 Heft. *Euphorbiaceæ—Adrianeæ* by F. Pax. Ceylon species unchanged.

45 Heft. *Orchidaceæ—Monandræ—Dendrobiinæ* by Fr. Kranzlin. *Dendrobium graminifolium* is given for Ceylon, but no Ceylon specimens are cited. *D. macræi* Lindl. is referred to *D. fimbriatum*, and *D. hæmoglossum* Thw. to *D. bambusifolium*.

46 Heft. *Menispermaceæ* by L. Diels. The following changes are made:—*Tiliacora acuminata* (Lam.) Hook. for *T. racemosa* Colebr.; *Anamirta cocculus* (L.) Wight for *A. paniculata* Colebr.; *Hypserpa cuspidata* (Wall.) Miers for *Limacia cuspidata* Hook. f. and Thoms.; *Diploclisia glaucescens* (Blume) Diels for *Cocculus macrocarpus* W. and A.; *Cocculus hirsutus* (L.) Diels for *C. villosus* DC.; *Stephania japonica* (Thun.) Miers for *St. hernandifolia* Walp.; *Cyclea peltata* (Lam.) Diels for *C. burmanni* Miers.

47 Heft. *Euphorbiaceæ—Cluytieæ* by F. Pax. *Cephalotaceæ* by J. M. Macfarlane. *Ostodes zeylanicus* var. *minor* is listed as a species, *Ostodes minor* (Thw.) Mull. Arg. *Codiæum variegatum formæ crispum et lobatum* are recorded for Ceylon (cult.).

48 Heft. *Araceæ—Lasioideæ* by A. Engler. *Lasia spinosa* (L.) Thw. is adopted instead of *L. aculeata* Lour., and *Amorphophallus sylvaticus* (Roxb.) Kunth. for *Synantherias sylvatica* Schott.

49 Heft. *Monimiaceæ* by J. Perkins (Nachtrage). No Ceylon species.

50 Heft. *Orchidaceæ—Monandræ—Dendrobiinæ* and *Orchidaceæ—Monandræ—Thelasinæ* by Fr. Kranzlin. The author discards *Alvisia* and adopts the name *Eria articulata* Lindl. for *Alvisia tenuis* Lindl. His citation of " *Alwisia* " is an error, and his discussion as to the correct form of the name is based on a misprint (" Alivis ") in Trimen's Handbook of the Flora of Ceylon, IV., p. 168. The remaining Ceylon species of *Eria* are unchanged. Figures are given of *Eria articulata, E. braccata, E. muscicola,* and *E. Thwaitesii.* With regard to the last named the author remarks, " Cl. Hooker f. labello adscribit lobos laterales parvos, 'side lobes very small,' in specimine authentico labellum stricto sensu simplex reperi, ceterum descriptio l. c. optime quadrat cum specimine a me examinato."

In the second part *Octarrhena parvula* Thw. is transferred to *Phreatia*, in agreement with Bentham and in opposition to Thwaites, Hooker, and Trimen.

51 Heft. *Sphagnales—Sphagnaceæ* by C. Warnstorf. The only species of Sphagnum known from Ceylon is *Sphagnum ceylanicum* Mitten with its varieties, a. *robustum* Warnst. and b. *brachycladum* Warnst.

52 Heft. *Euphorbiaceæ—Geloniæ* and *Euphorbiaceæ—Hippomaneæ* by F. Pax. Includes the Ceylon species *Chætocarpus castanocarpus* (Macræ; Thwaites No. 2641; Walker), *Chætocarpus pubescens* (Thwaites No. 1025), *Gelonium lanceolatum* (Thwaites Nos. 252, 696, 2101), *Excœcaria crenulata* (Thwaites No. 2523), *Excœcaria agallocha* var. a. *genuina* (Thwaites No. 2169) and *Sebastania chamælea* var. a. *asperococca* (Kandy, Meebold No. 2459). Thwaites' C. P. specimens are not quoted for the last named.

Sapium indicum Willd. and *Sapium insigne* Trimen are not given for Ceylon. The name of the latter is written *S. insigne* (Royle) Benth. *Excœcaria Camettia* Willd. is retained as a distinct variety of *E. agallocha*, but Ceylon is not cited as a locality.

53 Heft. *Geraniaceæ* by R. Kunth. *Geranium nepalense* Sweet (Thwaites 2788), the only Ceylon species.

54 Heft. *Goodeniaceæ* and *Brunoniaceæ* by K. Krause. *Scævola plumieri* (L.) Vahl (Wight 2411, Herb. Berlin, Kew ; Thwaites 1777, Herb. Kew, Brit. Museum ; Macrae, Kew, Vienna) is given tor Ceylon, but not *Scævola kœnigii* Vahl (*S. frutescens* (Mill.) Krause).

55 Heft. *Araceæ—Philodendroideæ—Philodendreæ* by A. Engler and K. Krause. *Homalomeninæ* and *Schismatoglottidinæ* by A. Engler. No Ceylon species.

56 Heft. *Cannaceæ* by Fr. Kranzlin. There is no reference to any Ceylon specimens. The name *Canna indica* L. is reserved for an American species. With regard to this name, the author writes that it is frequently cited, especially in Floras of Tropical Colonics, sometimes correctly but more often incorrectly. Elsewhere he remarks that *Canna indica* appears to have been considered an inevitable constituent of every colonial flora. The Ceylon species would appear to be *Canna orientalis* Rosc., as stated in Trimen's Flora, IV., p. 265.

57 Heft. *Euphorbiaceæ—Acalypheæ—Chrozophorineæ* by F. Pax. Includes *Agrostistachys indica* Dalz. (Thw. 2156 ; Gardner) subsp. *genuina ; A. Hookeri* (Thwaites) Benth. (Thw. 3429) ; and *A. longifolia* (Wight) Benth. (Thwaites 596 ; Walker). *Chrozophora rottleri* (Geisel) Juss. is held to be distinct from *Ch. plicata* (Vahl) Juss., but Ceylon is not cited as a locality for either.

58 Heft. *Euphorbiaceæ—Porantheroideæ et Ricinocarpoideæ* by G. Gruning. No Ceylon species.

59 Heft. *Hydrophyllaceæ* by A. Brand. Includes *Hydrolea zeylanica* (L.) (Thwaites No. 1884), and var. b. *glabra* Brand n. var.—sepala et ovarium glaberrima (Thwaites No. 1883).

60 Heft. *Philodendrinæ* by K. Krause. No Ceylon species.

61 Heft. *Umbelliferæ—Saniculoideæ* by Hermann Wolff. The only Ceylon species, *Sanicula europæa*, is referred to var. b. *elata* (Ham.) Wolff (Thwaites No. 2,813).

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