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

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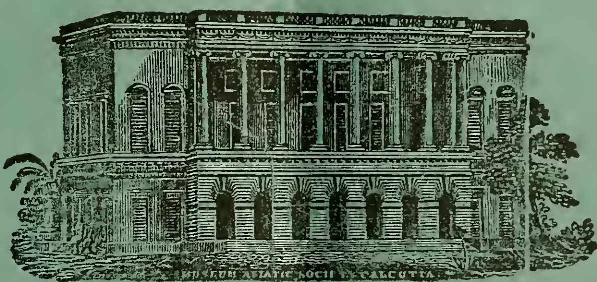

"The bounds of its investigation will be the geographical limits of Asia: and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."—SIR WILLIAM JONES.

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JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL,

Vol. LXXI. Part II.—NATURAL SCIENCE.

No. I.—1902.

I.—*A List of the Butterflies of Hongkong in Southern China, and the food-plants of the larvæ.—By* Lionel dè Nicéville, F.E.S., C.M.Z.S., &c.

[Received 1st September; Read 6th November, 1901.]

The Butterflies of Southern China appear to have been largely neglected by modern Entomologists, though a considerable number of the larger species were known to the ancients. For instance, Linnæus and Fabricius described many species from "China," many of these and a few others were figured by Drury, Cramer, Herbst and Donovan at the end of the eighteenth century. In 1861 Wallengren described two new species and mentioned a third obtained during the voyage of the frigate "Eugénie" which touched at Hongkong; in 1862 Felder described four species and mentioned a fifth captured by the officers of the frigate "Novara" which visited the island; in 1886 Röber described two new species of *Lycænidæ* from Hongkong; while in 1899 Kirby recorded five species from thence. The first list of the butterflies known to occur in Hongkong was compiled by Messrs. Sydney B. J. Skertchly and James J. Walker, and is published in a little book entitled "Our Island. A Naturalist's Description of Hongkong" by Mr. Sydney B. J. Skertchly, F.G.S., M.A.I. (1893). This list embraces 116 species. Of these I have omitted from the present list *Ideopsis daos*, Boisduval, *Amathusia phidippus*, Doubleday, and *Pandita* sp., all of which are species found in the Malay Peninsula and are not likely to occur in Hongkong. But a much more important list is that by Mr. James J. Walker, R.N, F.L.S., entitled "A Preliminary List of the Butterflies of Hongkong; based on Observations and Captures made during the Winter and Spring months of 1892 and 1893," published in the Transactions of the Entomological Society of London for 1895, pp. 433–477. In this list 125 species are noted. In the present list I have omitted *Ideopsis daos* and *Amathusia phidippus* for the reason noted above. Moreover, Mr. Walker records what I consider to be five species under two names each, these being 8. *Euplœa* (*Isamia*) *superba*, Herbst, and 9. *Euplœa* (*Trepsichrois*) *midamus*, Linnæus. 16. *Ypthima hübneri*, Kirby, and 17. *Ypthima argus*, Butler. 78. *Catopsilia catilla*, Cramer, and 79. *Catopsilia crocale*, Cramer. 80. *Terias hecabe*, Linnæus, and 81. *Terias mandarina*, de l'Orza. 85. *Pieris* (*Huphina*) *nereisa*, Fabricius, and 86. *Pieris* (*Huphina*) *pallida*, Swinhoe. This reduces Walker's list to 118 species. In the present list 140 species are given, of which 22 marked with an asterisk (*) have not been seen by me. The gain in number of species observed in Hongkong in the six years since Walker wrote is therefore twenty-two. Walker also mentions a specimen of *Hestia lynceus*, Drury, which he had seen "taken more than twenty years ago on the wharf at Kowloon—an obvious importation." This species is omitted from his list and also the present one.

My friend, Mr. E. F. Skertchly, son of Mr. Sydney B. J. Skertchly in collaboration with Mr. Kershaw, proposes to bring out an elaborate work illustrated with coloured plates on the *Rhopalocera* of Hongkong. A specimen of these plates I have seen chromo-lithographed in Japan, and it is an excellent production. To help in the good work of publishing this volume I have written this paper, as entomological books are scarce in Hongkong, and my assistance has been asked as regards identification of the various species and the necessary synonomy. My share of this work appears in the list below; the particulars given of the food-plants of the same are closely-allied species occurring in India and elsewhere is a help to the discovery of the transformations of the various species of butterflies in Hongkong itself. A knowledge of the food-plant of any particular butterfly is more than half the battle in discovering its larva. I may note that Messrs. Skertchly and Kershaw have for the last few years sent me consignments from time to time of Hongkong butterflies for identification; moreover, I have a superficial knowledge of them from having twice visited the colony for short periods. The butterflies of Hongkong are on the whole remarkably similar to those of India, not a single genus being found in the island or on the adjoining mainland, which does not occur in India, while about ninety per cent. of the species are identical or extremely closely allied, the "local variation" being remarkably slight. This is perhaps not so much to be wondered at, as there is continuous land connection between India and Hongkong save the narrow strait about a mile wide which separates Kowloon or the mainland from the island. Moreover, Hongkong is on the same parallel of latitude as Calcutta, and has a very similar climate, though it is on the whole slightly cooler. The most interesting butterfly mentioned is, I think, *Danais* (*Anosia*) *erippus menippe*, Hübner, the well-known "Wanderer," a pair of which was taken in Hongkong in August last. This butterfly continues to extend its range, but has not as far as I know been yet obtained on the mainland of Asia, though it has spread from its original home in North America to Europe on the east, and right round through the Pacific Islands, Australia, and the Malayan Archipelago to the Straits of Malacca.*

Family NYMPHALIDÆ.

Sub-family DANAINÆ.

1. DANAIS (*Radena*), SIMILIS, Linnæus.

Papilio similis, Linnæus, Mus. Ulr., p. 299, n. 117 (1764); *Radena similis*, Moore, Proc. Zool. Soc. Lond., 1883, p. 223, n. 1; Lep. Ind., vol. i, p. 28 (1890); Fruhstorfer, Berl. Ent. Zeitsch., vol. xliv, p. 79 (1899); *Danais* (*Radena*) *similis*, Walker, Trans. Ent. Soc. Lond., p. 445, n. 5; *Danais similis*, var. *chinensis*, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, n. 148 (1862); *Papilio aventina*, Cramer, Pap. Ex., vol. i, p. 92, pl. lix, fig. F (1775).

The larva of the subgenus *Radena* has two pairs only of fleshy filaments. Though species of *Radena* occur in Ceylon, Burma and the Nicobar Isles within Indian limits, the larva and its food-plant has escaped detection.

2. DANAIS (*Tirumala*) LIMNIACE, Cramer.

Papilio limniace, Cramer, Pap. Ex., vol. i, p. 92, pl. lix, figs. D, E, *male* (1775); *Tirumala limniace*, Moore, Proc. Zool. Soc. Lond., 1883, p. 230, n. 2; Lep. Ind., vol. i, p. 33 (1890); Fruhstorfer, Berl. Ent. Zeitsch., vol. xliv, p. 115; *Danais* (*Tirumala*) *limniace*, Walker, Trans. Ent. Soc. Lond., 1895, p. 445, n. 3.

The larva of *Tirumala*, like that of *Radena*, has two pairs only of fleshy filaments. It has been recorded in India to feed on many plants of the Natural Order *Asclepiadeæ*, such as *Calotropis*, *Asclepias*, *Marsdenia*, *Dregea* and *Hoya*.

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* *Vide* de Nicéville, Journal A. S. B., vol. lxiv, pt. 2, pp. 366-367 (1895).

3. Danais (*Tirumala*) septentrionis, Butler.

Danais septentrionis, Butler, Ent. Month. Mag., vol. xi, p. 163 (1874).

New to the Hongkong list; I have an undoubted female from there captured in March. The food-plant of the larva has never been discovered.

4. Danais (*Anosia*) erippus menippe, Hübner.

Papilio erippus Cramer, Pap. Ex., vol. i, p. 4, pl. iii, figs. A, B, *male* (1775); *Anosia menippe*, Hübner, Verz. bek. Schmett., p. 16, n. 86 (1816); *Papilio plexippus* Cramer (*nec* Linnæus), Pap. Ex., vol. iii, p. 24, pl. ccvi, figs. E, F, *female* (1779); Herbst, Pap., vol. vii, p, 19, n. 8, pl. clvi, figs. 1, 2, *male* (1794).

A pair of this species was taken at Hongkong on the 4th August, 1901. The larva feeds on plants of the Natural Order *Asclepiadeæ.*

5. Danais (*Limnas*) chrysippus, Linnæus.

Papilio chrysippus, Linnæus, Syst. Nat. Ins., ed. x., vol. i, pt. 2, p. 471, n. 81 (1758); *Limnas chrysippus*, Moore, Proc. Zool. Soc. Lond., 1883, p. 237, n. 1; *Danais* (*Limnas*) *chrysippus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 446, n. 7; *Limnas bowringi*, Moore, Proc. Zool. Soc. Lond., 1883, p. 239, n. 6; Fruhstorfer, Stet. Ent. Zeit., vol. lix, p. 412 (1898); *Limnas bowringii* [sic], Moore, Lep. Ind., vol. I, p. 44 (1890).

Dr. F. Moore in 1893 recorded *L. chrysippus* from South China, but described *L. bowringi* as a new species from Hongkong, which also is in South China. In 1890, he says that it is "doubtfully of racial value." The larva of *Limnas* has three pairs of fleshy filaments; in Hongkong it has been reported to feed on *Asclepias curassavica*, Linn., and in India it feeds on plants of the Natural Order *Asclepiadeæ*, such as *Calotropis* and *Asclepias.*

6. Danais (*Salatura*) plexippus, Linnæus.

Papilio plexippus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 471, n. 80 (1758); *Papilio genutia*, Cramer, Pap. Ex., vol. iii, p. 23, pl. ccvi, figs. C, D, *male* (1779); *Salatura genutia*, Moore, Proc. Zool. Soc. Lond., 1883, p. 240, n. 1; Lep. Ind., vol. i, p. 48 (1890); *Danais* (*Salatura*) *genutia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 445, n. 6.

The larva of *Salatura* has three pairs of fleshy filaments, and in India feeds on plants of the Natural Order *Asclepiadeæ*, such as *Cynanchum*, *Ceropegea* and *Passularia*, in Ceylon on *Raphis*, *Ceropegea* and *Raphanus.*

7. * Danais (*Parantica*) melanoides, Moore.

Parantica melanoides, Moore, Proc. Zool. Soc. Lond., 1883, p. 847, n. 1; *Danais* (*Parantica*) *melanoides*, Walker, Tran Ent. Soc. Lond., 1895, p. 445, n. 4.

The larva of *Parantica* has two pairs only of fleshy filaments. The larva has never been discovered, but that of the allied species, *P. aglea*, Cramer, has been recorded to feed on plants of the natural order *Asclepiadeæ*, such as *Cryptolepis*, *Calotropis*, *Tylophora*, in South India and Ceylon.

8. DANAIS (*Caduga*) SITA, Kollar.

Danais sita, Kollar, Hugel's Kaschmir, vol. iv, pt. 5, p. 424, n. 1, pl. vi, figs. 1, 2, *male* (1844); *Danais* (*Caduga*) *sita* Mackinnon and de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. xi, p. 213, n. 6, pl. U, figs. 1*a*, 1*b*, *larva*; 1*c*, 1*d*, *pupa* (1897); *Danais* (*Caduga*) *tytia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 444, n. 2.

The larva of *Caduga* has two pairs only of fleshy filaments, and feeds in India on *Marsdenia*, natural order *Asclepiadeæ*. Hongkong specimens of *D. sita* agree absolutely with Indian ones.

9. EUPLŒA (*Crastia*) GODARTII, Lucas.

Euplœa godartii, Lucas, Rev. et Mag. Zool., second series, vol. v, p. 319 (1853); *Euplœa* (*Crastia*) *godarti* (sic), Walker, Trans. Ent. Soc. Lond., 1895, p. 447, n. 10.

The larva of *Crastia* has four pairs of fleshy filaments. Major (now Colonel) C. H. E. Adamson, C.I.E., in "Notes on the *Danainæ* of Burmah," p. 12 (1889), records that he has "bred *E. godartii* from caterpillars found feeding on orange trees," *Citrus* sp., natural order *Rutaceæ*. More probable plants would, I think, be species of *Holarrhena*, *Nerium* and *Ichnocarpus* of the natural order *Apocynaceæ*, or *Streblus* and *Ficus* of the *Urticaceæ*.

10. EUPLŒA (*Crastia*) KINBERGI, Wallengren.

Euplœa kinbergi, Wallengren, Wien, Ent. Monatsb., vol. iv, p. 35, n. 8 (1860); Kongl. Svensk. Fregatten Eugenies Resa, Zoologi, pt. v, p. 352, n. 4 (1861); *Tronga kinbergi*, Moore, Proc. Zool. Soc. Lond., 1883. p. 269, n. 12; *Crastia kinbergi*, de Nicéville, Journ. A. S. B., vol. lxx, pt. 2, pp. 20, 22 (1901), *Euplœa* (*Crastia*) *kinbergi*, de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. xiii, p. , n. , pl. , fig. , *female*; *Euplœa lorquinii*, Felder, Reise Novara, Lep., vol. ii, p. 340, n. 472 (1865); *Crastia lorquini* (sic), Moore, Lep. Ind., vol. i, page 91 (1890); *Euplœa felderi*, Butler, Proc. Zool. Soc. Lond., 1866, p. 275, n. 20; *Crastia felderi*, Moore, Lep. Ind., vol. i, p. 91 (1890); *Euplœa* (*Crastia*) *frauenfeldi* (sic), Walker (nec) Felder, Trans. Ent. Soc. Lond., 1895, p. 447, n. 11; *Crastia frauenfeldii*, Moore, Lep. Ind., vol. i, p. 87, pl. xxviii, figs. 1, 1*a*, *male* (1890).

This very variable and common butterfly is restricted to Southern China, and has been bred on *Strophanthus divergens*, Grah.—natural order *Apocynaceæ*. The larva will probably be found to feed on *Nerium*, natural order *Apocynaceæ*, or on *Ficus*, natural order *Urticaceæ*.

11. Euplœa (*Isamia*) midamus, Linnæus.

Papilio midamus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 470, n. 75 (1758); *Isamia midamus*, Moore, Proc. Zool. Soc. Lond., 1883, p. 312, n. 5, pl. xxxii, fig. 5, *male*; Lep. Ind., vol. i, p. 132 (1891); *Euplœa* (*Trepsichrois* [sic !]) *midamus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 446, n. 9; *Papilio superbus*, Herbst, Pap., vol. vi, p. 14, n. 3, pl. cxix, fig. 3, *female*; pl. cxx, figs. 1, 2, *male* (1793)*; *Euplœa superba*, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 488, n. 147 (1862); *Isamia superba* [sic], Moore, Proc. Zool. Soc. Lond., 1883, p. 311, n. 3; Lep. Ind., Vol. i. p. 132 (1891); Kirby in Hübner's lx. Schmett., new edition, Vol. 1, p. 4, pl. xxiv, figs. 3, 4, *female* (*Limnas Mutabilis Midamus* [sic] on plate) (1894); *Euplœa* (*Isamia*) *superba* [sic], Walker, Trans. Ent. Soc. Lond., 1895, p. 446, n. 8; *Danais alopia*, Godart, Enc. Meth., vol. ix, p. 177, n. 4 (1819); *Isamia alopia*, Moore, Proc. Zool. Soc. Lond., 1883, p. 313, n. 6, pl. xxxii, fig. 7, *male*; Lep. Ind., vol. i, p. 132 (1891); *Isamia sinica*, Moore, Proc. Zool. Soc. Lond., 1883, p. 312, n. 4, Lep. Ind., vol. i, p. 132 (1891).

There are several mistakes in the references as usually given. Herbst calls his fig. 3 on pl. cxix a ♂, while it is a ♀, and his figs. 1 and 2 on pl. cxx a ♀, while it is a ♂. Dr. F. Moore sets this right in Proc. Zool. Soc. Lond., 1883, page 311, n. 3, as regards the ♀; but on page 313, n. 6, erroneously calls figs. 1 and 2 ♀ instead of ♂. He also uses *superba* instead of *superbus* as originally written, and refers to plate 102 instead of plate 122. He makes two species out of Herbst's figures, while they represent one species only.

Dr. F. Moore in 1883 and again in 1891 records and keeps distinct four species of *Isamia* from South China. These four species are in my opinion one and the same species, which at Hongkong, and doubtless wherever it occurs in Southern China, is a most variable one. In Hongkong the larva has been reported to feed on *Strophanthus divergens*, Grah., Natural Order *Apocynaceæ*.

Subfamily SATYRINÆ.

12. Mycalesis (*Calysisme*) mineus, Linnæus.

Papilio mineus Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 471, n. 84 (1758); *Calysisme mineus* Moore, Trans. Ent. Soc. Lond., 1880, p. 162; Lep. Ind., vol. i, p. 187 (1892); *Mycalesis mineus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 447, n. 13; *Mycalesis mineus*, var. *confucius*, Leech, Butt. China, Japan and Corea, p. 12, pl. ii, fig. 7, *male* (1892); Kirby, The Entomologist, vol. xxxii, p. 31 (1899).

The var. *confucius* is the dry-season form of *M. mineus* found in China. The larva in India feeds on grasses.

13. Mycalesis (*Calysisme*) horsfieldii, Moore.

Calysisme horsfieldii, Moore, Lep. Ind., vol., i, p. 197, pl. lxvi, figs. 2, 2*a*, 2*b*, *male, wet-season form; 2c, male, dry-season form* (1892); ? *Mycalesis perseus*, Wallace (*nec* Fabricius), Trans. Ent. Soc. Lond., 1895, p. 447, n. 12.

Only two species of *Mycalesis* have hitherto been found in Hongkong. Walker gives *mineus* and *perseus*. The latter is stated by Dr. F. Moore in Lep. Ind., vol. i, pp. 177, 178, to have a very wide range, being found almost throughout India, Ceylon, Burma, the Malay Peninsula and many of the islands of the Malay Archipelago, and in Hainan and Formosa. It may, as Walker states, be found in Hongkong, but it is more probable, I think, that what he identified as *M. perseus* is the comparatively common *M. horsfieldii*, which has been described since Mr. Walker wrote his paper. It has never been bred, but its larva will almost certainly be found on grasses.

14. Lethe europa, Fabricius.

Papilio europa, Fabricius, Syst. Ent., p. 500, n. 247 (1775); *Lethe europa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 14; Moore, Lep. Ind., vol. i, p. 256 (1892).

The larva feeds on *Bambusa* Sp., natural order *Gramineæ*.

15. Lethe confusa, Aurivillius.

Lethe confusa, Aurivillius, Ent. Tids., vol. xviii, p. 142, n. 15 (1897); ? *Lethe verma*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 15; *Lethe rohria*, Kirby (*nec* Fabricius), The Entomologist, vol. xxxii, p. 31 (1899).

Mr. James J. Walker records *Lethe verma*, Kollar, from a single specimen taken in the Happy Valley, Hongkong, in March. This is, I think, probably an incorrect identification, the present species being meant. *L. verma* is a common species in the hills of Northern India, and is found in the hills of Western China, but not I believe in Western China. As the name implies, there has been much confusion regarding this species. Until recently it has been always known as *L. rohria* Fabricius, until Dr. Aurivillius pointed out that the true *rohria* is an older name for the *Lethe dyrta* of Felder. The larva will almost certainly be found to feed on the leaves of bamboo.

16. Ypthima avanta, Moore.

Ypthima avanta, Moore, Proc. Zool. Soc. Lond., 1874, p. 567; Elwes and Edwards, Trans. Ent. Soc. Lond., 1893, p. 33, n. 38, pl. i, fig. 27, *clasp of male*; *Ypthima ordinata*, Butler, Proc. Zool. Soc. Lond., 1880, p. 148, pl. xv, fig. 3; *Ypthima hubneri*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 16; ? *Ypthima argus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 17.

T. avanta is seasonally dimorphic, *avanta* is the dry-season form, while *ordinata* is the wet-season form. I have ventured to put Walker's two species *hübneri* [recte *huebneri*] and *argus* under *avanta*, as I do not believe that either of them are found in Hongkong, and that they have been wrongly identified. *T. avanta* is found in the Western Himalayas, in the plains of the North-Western Provinces, at Ranchi and Bholahat in Maldah, both in the plains of Bengal, in the Eastern Himalayas, in the Ganjam district of Eastern India, throughout Burma, and on the West River in Southern China. It has not been bred, but the larva will be found on grasses.

17. Melanitis ismene, Cramer.

Papilio ismene, Cramer, Pap. Ex., vol. i, p. 40, pl. xxvi, figs. A, B, *male, dry-season form* (1775); *Melanitis determinata*, Butler, Proc. Ent. Soc. Lond., 1885, p. vi, *Melanitis leda*, Walker, Trans. Ent. Soc. Lond., 1895, p. 449, n. 18.

This species in seasonally dimorphic, the dry-season form being *ismene*, the wet-season form is *determinata*. The larva feeds on rice, *Oryza sativa*, Linnæus, on large, coarse grasses, all of the natural order *Gramineæ.*

18.* Melanitis bela, Moore.

Melanitis bela, Moore, Horsfield and Moore, Cat. Lep. E.I.C., vol. i, p. 223, n. 465 (1857); *Cyllo aswa*, Moore, Proc. Zool. Soc. Lond., 1865, p. 769; *Melanitis aswa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 449, n. 19.

This species is also seasonally dimorphic, *bela* being the wet-season form, *aswa* the dry-season form. Walker records one specimen taken at Kowloon late in 1891. I have not seen it from thence, but do not doubt the correctness of the record. It occurs in Western China, and as far westwards again as Kashmir. It has not been bred.

Subfamily AMATHUSIINÆ.

19. Discophora tullia, Cramer.

Papilio tullia, Cramer, Pap. Ex., vol. i, p. 127, pl. lxxxi, figs. A, B, *female* (1775); *Discophora tullia*, Staudinger, Ex. Schmett., p. 189, pl. lxiii, *female* (1887); Walker, Trans. Ent. Soc. Lond., 1895, p. 449, n. 20; Moore, Lep. Ind., vol. ii, p. 197 (1895); Fruhstorfer, Berl. Ent. Zeitsch., vol. xlv, p. 13 (1900).

As far as is known, the larvæ of all the species of this genus feed on *Bambusa* sp., Natural Order *Gramineæ*, and are gregarious, very hairy, and are frequently mistaken for the larvæ of moths.

20. Clerome eumeus, Drury.

Danais Festivus eumeus, Drury, Ill. Ex. Ins., vol. i, p. 4, pl. ii, figs. 3, *male, upper—and underside* (1770); *Clerome eumeus*, Westwood, Trans. Ent. Soc. Lond., second series, vol. iv, p. 183, n. 2 (1858); Butler, Cat. Fab. Lep. B. M., p. 44, n. 1 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 450, n. 21; Moore, Lep. Ind., vol. ii, p. 209 (1895); Kirby, The Entomologist, vol. xxxii, p. 31 (1899); *Papilio eumea* (sic), Cramer, Pap. Ex., vol. ii, p. 132, pl. clxxxiii, figs. C, D, *female* (1777); *Papilio gripus* Fabricius, Syst. Ent., App., p. 829, n. 178-79 (1775); Sp. Ins., vol. ii, p. 58, n. 255 (1781); Ent. Syst., vol. iii, pt. 1, p. 149, n. 457 (1793); Herbst, Pap., vol. vi, p. 77, n. 41, pl. cxxxv, figs. 3, 4, *female* (1793); *Satyrus gripus*, Godart, Enc. Meth., vol. ix, p. 497, n. 70 (1819); *Papilio grispus* (sic), Fabricius, Mant. Ins., vol. ii, p. 28, n. 294 (1787); *Papilio decempunctatus* Goeze, Ent. Beytr., vol. iii, pt. 1, p. 212, n. 31 (1779).

No species of *Clerome* has, I believe, ever been bred. The larva will almost certainly be found to feed on *Bambusa* sp., Natural Order *Gramineæ*.

It is remarkable that no species of the subfamily *Elymniinæ* has been recorded from Hongkong. As the importation of ornamental palms on which the larvæ feed is probably considerable from countries where species of the group are common, it is more than probable that species of *Elymniinæ* will become naturalised in the island and on the adjoining mainland.

Subfamily NYMPHALINÆ.

21.* Charaxes (*Eulepis*) athamas, Drury.

Papilio Eques achivus athamas, Drury, Ill. Ex. Ins., vol. i, p. 5, pl. ii, figs. 4, *male, upper and underside* (1770); *Papilio athamas*, Cramer, Pap. Ex., vol. i, p. 140, pl. lxxxix, figs. C, D, *male* (1776); Walker, Trans. Ent. Soc. Lond., 1895, p. 458, n. 52; Moore, Lep. India., vol. ii, p. 254 (1895); *Eulepis athamas*, Rothschild and Jordan, Nov. Zool., vol. v, pl. x, figs. 1, 2, 3, 5, 7, 8, 9, 10, 11, *male*; 4, *female*; pl. xi, figs. 1, 2, 5, 6, 7, 10, 11, 12, *male*; 3, 4, 8, 9, *female* (1898); vol. vi, p. 245, n. 12 (1899).

Mr. James J. Walker records that he once saw this butterfly in Hongkong. Messrs Rothschild and Jordan under *b. E. athamas athamas* record it from South China (Hongkong), but add "Authentic Chinese specimens we have not examined." I have seen no specimen from Hongkong. The larva in Ceylon feeds on *Cæsalpinia*, Natural Order *Leguminosæ*; in South India on *Grewia* sp. Natural Order *Tiliaceæ*, on *Cæsalpinia*, *Painciana*, *Adenanthera*, *Acacia*, and *Albizzia*, Natural Order *Leguminosæ*; and in the Western Himalayas on *Acacia* and *Albizzia*.

22. Charaxes polyxena polyxena, Cramer.

Papilio polyxena, Cramer, Pap. Ex., vol. i, p. 85 pl. liv, figs. A, B, *female* (1775); *Haridra polyxena*, Moore, Lep. Ind., vol., ii, p. 247 (1896); *Charaxes polyxena polyxena*, Rothschild and Jordan, Nov. Zool., vol. vii, p. 334 (1900); *Nymphalis polyxo*, Godart, Enc. Meth., vol. ix, p. 399, n. 169 (1819); *Papilio bernardus*, Fabricius, Ent. Syst., vol. iii, pt. i, p. 71, n. 223 (1793); *Nymphalis (Charaxes) bernardus*, Donovan, Ins China (Westwood's edition), p. 63, pl. xxxiv, figs. 1, 2, *female* (1842); *Charaxes bernardus*, Butler, Cat. Fab. Lep. B. M., p. 50, n. 2 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 53; *Haridra bernardus*, Moore, Lep. Ind., vol. ii, p. 246 (1896); *Doxocopa epilais*, Hubner, Verz. bek. Schmett., p. 50, n. 464 (1816).

My material from Hongkong can superficially be broken up into two distinct groups, one with pale tawny bands on the upper side of both wings, of which I have four males and one female, the males are dated 17th and 26th April, and 5th December, while one has no date; the female also bears no date: the other with white bands, of which I have two pairs, one male is dated 14th July, the other is undated; one female is dated 21st July, the other bears no date. *P. polyxena* was originally described from China, and my single tawny banded example of that sex agrees very well with Cramer's figure, but that the "tail" to the binding from the third median nervule is much longer (in Cramer's specimen it was probably broken off), and the dark and light markings of both wings on the underside are more strongly contrasted in Cramer's figure than in my specimen. The tawny banded males are extremely constant, and differ but little from my female; the "tail" to the hindwing is of course much shorter, and the submarginal series of black spots on the upperside of that wing instead of being each centred with a white spot has the anteriormost spot in one instance and the two anteriormost spots in three instances so marked. Of the white banded group in one male the band consists of four portions divided by the veins, the anterior the smallest, the posterior the largest, with a minute white spot anterior to the first of these with no spots beyond it whatever; in my other male the band consists of eight spots, there being two (instead of one as in the first-described specimen) in the upper discoidal interspace, and another in the subcortal interspace, as well as the one on the sutural area. The markings of the hindwing on the upperside also differ in my two male specimens, in the first described of these the discal band is fulvous, in the latter it is anteriorly white. My two white banded females also differ the one from the other, and neither of them agree with Donavon's figure, as that figure shows no discal band on the upperside of the hindwing, while in my specimens this band is prominent. In my two examples one has on the upperside of the forewing three fulvous-white spots anterior to the third median nervule, which are absent in the other. My specimens agree fairly well with Dr. Moore's description of that sex under the name of *H. bernardus*. Mr. J. O. Westwood remarked on Donovan's figures that "This uncommonly rare Chinese butterfly has not been figured in any other work. Fabricius described it only from the drawings of Jones. I possess a specimen in which the central fascia is nearly white, and is continued half way across the posterior wings, and the black spots in the latter are very broad and confluent, without white in the centre." Dr. Moore separated *H. bernardus* from *H. polyxena*, and noted that "This species [*bernardus*] is distinct from *H. polyxena*, Cramer, and is allied to the Indian *H. jalinder*, Butler, and *H. hippanax*, Felder." Fabricius described the medial band across the forewing on the upperside in *P. bernardus* as "flava," which is yellow, while Dr. Moore calls it "bluish-white." Donovan's figure of *P. bernardus* shows this band white just tinged with yellow. Fabricius' description of *P. bernardus* evidently applies to Cramer's figure of *P. polyxena*. In describing the male of *H. bernardus* Dr. Moore says that the white band on the upperside of the forewing ends "At the lower [first] median veinlet." This is probably a slip for submedian nervure. Messrs. Rothschild and Jordon give seven local races of *Charaxes polyxena*, of which the Chinese form "*G. polyxena polyxena*" is the last. They consider the white and yellow banded forms to be one and the same species, the species being dichromatic. It has never been bred.

23. APATURA (*Rohana*) PARYSATIS, Westwood.

Apatura parisatis, Westwood, Gen. Diurn. Lep., vol. ii, p. 305, n. 20, *note* (1850); *A. parisatis*, Staudinger, Ex. Schmett., p. 156, pl. lv, *male* and *female* (1886); *Rohana parisatis*, Moore, Lep. Cey., vol. iii, p. 17, pl. cxciv, figs. 2, 2*a*, *male*; 2*b*, 2*c*, *female* (1896); *Apatura parysatis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 452, n. 27.

The larva of *A. parysatis* has been bred in Hongkong on (*hiatus in MS.*)

That of the allied *A. carniba*, Moore, feeds in Ceylon and South India on *Celtis*, Natural Order *Urticaceæ*.

24. PARHESTINA ASSIMILIS, Linnæus.

Papilio assimilis, Linnæus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 479, n. 129 (1758); Mus. Ulr., p. 300, n. 118 (1764); Clerck's Icones Ins., vol. i, pl. xvi, fig. 1 (1759); Drury, Ill. Ex. Ins., vol. i, p. 33, pl. xvii, figs. 3, 4, *male* (1770); Cramer, Pap. Ex., vol. ii, p. 90, pl. cliv, fig. A, *female* (1777); Herbst, Pap., vol. vi, p. 43, n. 24, pl. cxxvi, figs. 4, 5, *male* (1793); Esper, Ausl. Schmett., p. 230, pl. lvii, fig. 1 (?1798); *Nymphalis assimilis*, Godart, Enc. Méth., vol. ix, p. 393, n. 151 (1819); *Hestina assimilis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 452, n. 28.

The larva of this species feeds in Hongkong on (*hiatus in MS.*)

25. PARHESTINA MENA, Moore.

Hestina mena, Moore, Ann. and Mag. of Nat. Hist., third series, vol. i, p. 48, n. 3 (1858); Leech, Butt. from China, Japan, and Corea, vol. i, p. 143, pl. xx, figs. 3, 4 *male* (1892); Walker, Trans. Ent. Soc. Lond., 1895, p. 452, n. 29; *Diadema* *mena*, Butler, Ann. and Mag. of Nat. Hist., vol. xvi, p. 398, n. 3 (1865); *Parhestina mena*, Moore, Lep. Ind., vol. iii, p. 36, pl. ccii, figs. 1, 1*a*, *female* (1896); *Hestina nigrivena*, Leech, The Ent., vol. xxiii, p. 31 (1890); Grose-Smith and Kirby, Rhop. Ex., pl. *Hestina* i, figs. 1, 2, *male* (1891); *Hestina viridis*, Leech, The Ent., vol. xxiii, p. 32 (1890).

Mr. Leech has himself sunk *H. viridis* to the rank of a variety of *H. mena*. From his figure of it (l.c., fig. 3) the underside of the hindwing has "the costa above the costal nervure and the abdominal fold yellow." Mr. Leech notes, however, that male specimens of var. *viridis* received subsequent to the description of the species have none of this yellow coloration. I am a little doubtful if this character is not sufficient to separate *H. viridis*, Leech, and *H. nicevillei*, Moore, from *P. assimilis*, Linnæus, and *P. mena*, Moore. *H. mena* was originally described from "North India," in 1895 Mr. Walker recorded it from Hongkong, but Dr. Moore in 1896 said the habitat is unknown. I have seen but a single pair from Hongkong, the female of which agrees very closely with Dr. Moore's figure of that sex (not a male as stated). I would draw especial attention to a series of four or five submarginal pink spots on both surfaces of the hindwing which are visible in my specimens, in Messrs. Grose-Smith and Kirby's figures and in Mr. Leech's figure No. 4 of var. *nigrivena*. These spots occupy the same position exactly as the crimson spots in *P. assimilis*, which has led me to suspect that *P. mena* is not improbably a dimorphic form of that species. The genus *Parhestina* is evidently in a very plastic state, and it appears to me that the process of mimicry to species of *Danais* is now actively going on. Typical *P. assimilis* with its brilliant crimson spots is a conspicuous species, and it is evident that it would be advantageous to it to become less gaudily coloured and to be able to pass itself off as a nauseous *Danais*. Mr. James J. Walker records the breeding of a specimen in Hongkong, but does not mention the foodplant of the larva, which still remains unknown.

26. Euthalia phemius, Doubleday and Hewitson.

Adolias phemius, Doubleday and Hewitson, Gen. Diurn. Lep., vol. ii, p. 291, n. 13 (1850); *Itanus phemius*, pl. xl, fig. 4, *male* (1850); id., Moore, Trans. Ent. Soc. Lond., new series, vol. v, p. 65, n. 4, pl. iii, fig. 3, *male* (*nec female*) (1859); *Euthalia phemius* Staudinger, Ex. Schmett., p. 153, pl. liv. *male* (*nec female*) (1886); Walker, Trans. Ent. Soc. Lond., 1895, p. 457, n. 47; Moore, Lep. Ind., vol. iii, p. 123, pl. ccxxxviii, figs. 1, 1*a*, *male*; 1*b*, 1*c*, *female* (1896); *Adolias sancara*, Moore, Horsfield and Moore, Cat. Lep. Mus. E.I.C., vol. i, p. 195, n. 394 (1857); Trans. Ent. Soc. Lond., new series, vol. v, p. 78, n. 34, pl. ix, fig. 1, *female* (1859).

Mr. James J. Walker having taken a pair coupled of this butterfly in Hongkong finally settles the question as to the opposite sexes of the insect. He also obtained a pupa attached to a twig under some litchi trees (*Nephelium Lit-chi*, Camb., Natural Order *Sapindaceæ*), but that cannot be the food-plant of the larva in India, as it grows wild nowhere in this country, while the butterfly is common in the Eastern Himalayas, Assam, Upper Burma, and Indo-China. Its food-plant still remains unknown.

27. Limenitis (Ladaga) camilla, Linnæus.

Papilio camilla, Linnæus, Mus. Ulr., p. 304, n. 122 (1764); *Nymphalis camilla*, Aurivillius, Kongl. Svenska Vet.—Akad. Hand., vol. xix, n. 5, p. 101, n. 122 (1882); *Limenitis camilla*, Kirby in Allan's Nat. Hist., Butterflies, vol. i, pt. 1, p. 142, p. 145, *underside of normal imago, upper and underside of black variety;* pl. xxiii, fig. 3, *upperside of normal imago;* pl. iii, fig. 7, *larva* (1896); *Papilio prorsa*, Linnæus, Mus. Ulr., p. 303, n. 121 (1764), *nec Papilio prorsa*, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 480, n. 134 (1758); *Papilio sibilla*, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 781, n. 186 (1767); *Limenitis sibylla*, Leech, Butt. from China, Japan, and Corea, vol. i, p. 185 (1892); *Limenitis sidii*, var. *japanica*, Ménétriès, Cat. Lep. Pét., pt. 2, p. 103, n. 566 (1855); *Ladaga japonica*, Moore, Lep. Ind., vol. iii, p. 174 (1896).

This is a new record from Hongkong, though common in Japan, Corea, Amurland and Europe. Dr. Moore keeps the Japan form as a distinct species under the name *L. japanica*. Mr. Leech says that in Japan the larva feeds on *Lonicera japanica*, Thunberg, Natural Order *Caprifoliaceæ*. In England "The White Admiral" feeds also on honey-suckle.

28.* Athyma sulpitia, Cramer.

Papilio sulpitia, Cramer, Pap. Ex., vol. iii., p. 37, pl. ccxiv, figs. E, F (1779); Herbst, Pap., vol. ix., p. 95, n. 19, pl. ccxl, figs. 3, 4 (1798); *Athyma sulpitia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 456, n. 45; *Parathyma sulpitia*, Moore, Lep. Ind., vol. iii, p. 176 (1896). *Nymphalis strophia*, Godart, Enc. Meth., vol. ix, p. 431, n. 257 (1823).

The larva of this butterfly has never been found.

29. Athyma perius, Linnæus.

Papilio perius, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 471, n. 79 (1758); *Athyma perius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 456, n. 43; Moore, Lep. Ind., vol. iii, p. 186 (1896); *Papilio leucothoë*, Linnæus, Syst. Nat., ed. x, p. 478, n. 122 (1758); *Limenitis leucothoë*, Donovan, Ins., China, new edition, p. 65, pl. xxxv, fig. 3 (1842); *Papilio polyxina*, Donovan, Ins., China, first edition, pl. xxxv, fig. 3 (1799).

The larva has been recorded to feed in Java on a species of *Phyllanthus*, Natural Order *Euphorbiaceæ;* in South India it feeds on two species of *Glochidion*, Natural Order *Euphorbiacæ.*

30. Athyma asita, Moore.

A. asita, Moore, Proc. Zool. Soc. Lond., 1858, p. 13, n. 8; *Pantoporia asita*, Moore, Lep. Ind., vol. iii, p. cclxiii, figs. 2, *male*; 2*a*, *female* (1897); *Athyma nefte*, Walker (*nec* Cramer) Trans. Ent. Soc. Lond., 1895, p. 456, n 44.

This insect has never been bred.

31. Athyma selenophora, Kollar.

Limenitis selenophora, Kollar, Hügel's Kaschmir, vol. iv, pt. 2, p. 426, n. 1, pl. vii, figs. 1, 2, *male* (1844); *Athyma selenophora*, Walker, Trans. Ent. Soc. Lond., 1895, p. 457, n. 46; *Pantoporia selenophora*, Moore, Lep. Ind., vol. iii, p. 205 (1897); *Athyma bahula*, Moore, Proc. Zool. Soc. Lond., 1858, p. 12, n. 3, pl. i, fig. 2, *female*.

The larva in South India feeds on *Adina cordifolia*, Hook. f., Natural Order *Rubiaceæ*.

32.* Neptis antilope, Leech.

Neptis antilope, Leech, The Entomologist, vol. xxiii, p. 35 (1890); Butt. from China, Japan, and Corea, vol. i, p. 197, pl. xviii, fig. 2, *male* (1892).

Mr. Leech records having taken two specimens of this species at Hongkong in March, 1886. It has never been bred.

33. Neptis columella, Cramer.

Papilio columella, Cramer, Pap. Ex., vol. iv, p. 15, pl. ccxcvi, figs. A, B, *female* (1780); *Neptis columella*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 36; *Andrapana columella*, Moore, Lep. Ind., vol. iii, p. 220 (1897); *Neptis ophiana*, Moore, Proc. Zool. Soc. Lond., 1872, p. 561; *Neptis martabana*, Moore, Trans. Ent. Soc. Lond., 1881, p. 310; *Neptis ophiana*, var. *nilgirica*, Hampson, Journ. A.S.B., vol. lvii, pt. 2, p. 353, n. 57 (1888); *Andrapana columella singa*, Fruhstorfer, Berl. Ent. Zeitsch., vol. xliv, p. 286 (1899).

This butterfly has never been bred.

34. Neptis eurynome, Linnæus.

Papilio eurynome, (? *Papilio hylas*, male, *nec*. female), Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 486, n. 173 (1758); *Limenitis eurynome*, Westwood's ed. Donovan's Ins. China, p 66, pl. xxxv, fig. 4, *female* (1842); *Neptis eurynome*, Moore, Proc. Zool. Soc. Lond., 1874, p. 570; Lep. Ind., vol. iii, p. 244 (1897); Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 35; *Papilio leucothoë*, Clerck, Icones Ins., vol. iii, pl. v, fig. 4 ( ); Donovan, Ins. China, first edition, pl. xxxv, fig. 3, *female* (1799); *Papilio aceris*, Esper, Eur. Schmett., vol. i, pt. 2, pl. lxxxii, fig. 1, *female* (1783); *Neptis hainana*, Kirby (*nec* Moore), The Entomologist, vol. xxxii, p. 31 (1899).

The synonymy given above is mainly taken from Dr. Moore's Lep. Ind. Linnæus' Syst. Nat. Ins., tenth edition, is not available, so I am unable to check the first entry; though apparently the name given therein on p. 486, n. 173, is *hylas* and not *eurynome.* If this be so, *eurynome* cannot be ascribed to Linnæus, but should be credited to Westwood, as was done by Dr. Moore in 1874. Donovan's fig. 4 of pl. xxxv applies to this insect: he called it *leucothoë*, mistaking the insect for the *Athyma leucothoë* described by Linnæus as *Papilio leucothoë*, which itself is a synonym of the older Papilio [*Athyma*] *perius*, Linnæus. As there is an older *Neptis* named *leucothoë* of Cramer the species under consideration cannot be called *Neptis leucothoë*, Donovan. Mr. Kirby records *Neptis hainana*, Moore, originally described from Hainan Island, China, from Hongkong, but Dr. Moore considers that species to be distinct from the Hongkong one, so as I have no Hainan specimens I have followed him in this. This group of the genus occurs almost everywhere in the East, and in my opinion has received far too many names. Wherever the seasons are markedly wet and dry, seasonal dimorphism is very strongly marked, particularly so in Hongkong. The insect in Hongkong has not been bred, but the transformations of its Indian allies are well known, *N. varmana*, Moore, in South India being found in the larval state on peas of various kinds, Natural Order *Leguminosæ.*

35.* Precis atlites, Linnæus.

Papilio atlites, Linnæus, Cent. Ins., p. 24, n. 72 (Amoen., vol. vi, p. 407), (1763); *Junonia atlites*, Walker, Trans. Ent. Soc. Lond., 1895, p. 453, n. 31, Moore, Lep. Ind., vol. iv, p. 69 (1899).

The larva in Java feeds on a species of *Achyranthes*, Natural Order *Amarantaceæ*, and in South India on *Hygrophila* and *Barleria*, Natural Order *Acanthaceæ.*

36. Precis orithya, Linnæus.

Papilio orithya, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 473, n. 94 (1758); Cramer, Pap. Ex., vol. i, p. 28, pl. xix, figs. C, D, *female*; pl. xxxii, figs. E, F, *male* (1775); *Cynthia orithya*, Westwood, Donovan's Ins., China, new edition, p. 64, pl. xxxv, fig. 2, *female* (1842); *Junonia orithya*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 34; Moore, Lep. Ind., vol. iv, p. 71 (1899); *Precis orithya*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. viii, p. 200, n. 12 (1901).

The larva has been recorded in the Himalayas to feed on *Antirrhinum Orontium* Linn., Natural Order *Scrophularineæ*; in South India on *Hygrophila*, Natural Order *Acanthaceæ*; and in Ceylon on acanthads.

37. Precis hierta, Fabricius.

Papilio hierta, Fabricius, Ent. Syst., Suppl., p. 424, n. 281-2 (1798); *Junonia hierta*, Moore, Lep. Ind., vol. iv, p. 75 (1899); *Papilio œnone*, Cramer (*nec* Linnæus), Pap. Ex., vol. i, p. 55, pl. xxxv, figs. A, B, *female*; C, *male* (1775); *Cynthia œnone*, Westwood, Donovan's Ins. China, new edition, p. 66, pl. xxxvi, fig. 1, *male* (1842); *Junonia œnone*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 33; *Precis œnone* [*sic*], Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. viii, p. 203, n. 22 (1901).

The larva feeds in South India on *Hygrophila*, Natural Order *Acanthaceæ*, also on two plants of which the vernacular names are "Kolay Mooloo" and "Byle Choolee."

38. Precis lemonias, Linnæus.

Papilio lemonias, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 473, n. 93 (1758); *Junonia lemonias*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 32; Moore, Lep. Ind., vol. iv, p. 76 (1899); *Papilio aonis*, Cramer, Pap. Ex., vol. i, pp. 55, 56, pl. xxxv, figs. D, E, F, *male* (1775).

In India the larva feeds on *Nelsonia*, *Hygrophila*, *Strobilanthes* and *Barleria*, all Natural Order *Acanthaceæ*.

39. Precis almana, Linnæus.

Papilio almana, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 472, n. 89 (1758); Cramer, Pap. Ex., vol. i, p. 90, pl. lviii, figs. F, G, (1775); *Cynthia almana*, Westwood, Donovan's Ins. China, new edition, p. 67, pl. xxxvi, fig. 2 (1842); *Junonia almana*, Moore, Lep. Ind., vol. iv, p. 79 (1899); *Papilio asterie*, Linnæus, Syst. Nat., ed. x, vol. i, p. 472, n. 90 (1758); Cramer, Pap. Ex., vol. i, p. 90, pl. lviii, figs. D, E (1775); *Junonia asterie*, Walker, Trans. Ent. Soc. Lond., 1895, p. 453, n. 30.

The larva in Java has been found feeding on *Justicia*, Natural Order *Acanthaceæ*; in South India on *Hygrophila*, Natural Order *Acanthaceæ*; in Calcutta on *Gloxinia* or *Osbeckia*, the latter Natural Order *Melastomaceæ*.

40. Vanessa canace, Johanssen.

Papilio canace, Johanssen, Amœn. Acad., vol. vi, p. 406, n. 68 (1764); Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. ii, p. 779, n. 173 (1767); *Vanessa canace*, Walker, Trans. Ent. Soc. Lond., 1895, p. 458, n. 50; *Papilio charonia*, Drury, Ill. Ex. Ent., vol. i, p. 28, pl. xv, figs. 1, 2, *female* (1770); Cramer, Pap. Ex., vol. i, pp. 73, 74, pl. xlvii, figs. A, B, C (1775); Herbst, Pap., vol. vii, p. 42, n. i, pl. xlx, figs. 1, 2 (1794); *Vanessa charonia*, Godart, Enc. Méth., vol. ix, p. 308, n. 27 (1819); *Kaniska charonia*, Moore, Lep. Ind., vol. iv, p. 94 (1899); *Papilio kollina*, Meerburgh, Afb. Zeldz. Gew., pl. xliii (1775).

Dr. Moore records this species as *Kaniska Charonia*, Drury, from Hongkong, but specimens from thence are identical with Indian examples of *V. canace*, Linnæus. Mr. James J. Walker has bred it in Hongkong on a species of *Smilax*, Natural Order *Liliaceæ*.

41. Vanessa indica, Herbst.

Papilio atalanta (part), Herbst, Pap., vol. vii, p. 171, n. 64, *Papilio atalanta* *indica*, pl. clxxx, figs. 1, 2 (1794); *Vanessa indica*, Walker, Trans. Ent. Soc. Lond., 1895, p. 485, n. 49; *Papilio atalanta* Cramer (*nec* Linnæus), Pap. Ex., vol. i, p. 132, pl. lxxxiv, figs. E, F (1775); *Hamadryas decora calliroë* Hübner, Sarmnl. Ex. Schmett. (1806-16); *Pyrameis callirhoë* [*sic*], Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 138, n. 879 (1857); *Vanessa vulcania*, Godart, Enc. Méth., vol. ix, p. 320, n. 55 (1819).

The larva of this butterfly in Ceylon feeds on *Urtica*, and in the Western Himalayas on different nettles of the Natural Order *Urticaceæ*.

42. Vanessa cardui, Linnæus.

Papilio cardui, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 475, n. 107 (1758); *Vanessa cardui*, Walker, Trans. Ent. Soc. Lond., 1895, p. 457, n. 48; Moore, Lep. Ind., vol. iii, p. 107 (1899).

The larva has been recorded in Ceylon to feed on *Artemisia*, Natural Order *Compositæ;* at Kandahar on different species of thistles; at Jutogh in the Western Himalayas on the common artichoke and on mallow; in the same region on nettles, but this is a doubtful food-plant, on thistles, on *Debregeasia*, Natural Order *Urticaceæ*, and on *Carduus*, Natural Order *Compositæ;* in South India on *Zornia*, Natural Order *Leguminosæ*, and on *Blumea*, Natural Order *Compositæ ;* and at Lucknow on *Gnaphalium*, Natural Order *Compositæ.*

43. Symbrenthia lucina, Cramer.

Papilio lucina, Cramer, Pap. Ex., vol. iv, p. 82, pl. cccxxx, figs. E, F, *female* (1780); *Symbrenthia lucina*, Moore Lep. Ind., vol. iv, pp. 113, 114 (1906); *Symbrenthia hyppoclus lucina*, Fruhstorfer, Berl. Ent. Zeitsch., vol. xlv, p. 20 (1900); *Symbrenthia khasiana*, Moore, Proc. Zool. Soc. Lond., 1874, p. 569 ; *Symbrenthia daruka*, Moore, Proc. Zool. Soc. Lond., 1874, p. 570, pl. lxvi, fig. 18, *male*; *Symbrenthia hyppoclus* [*sic*], Walker [*nec Cramer*], Trans. Ent. Soc. Lond., 1895, p. 458, n. 51.

In Sikkim the larva feeds on the stinging nettle *Girardinia* sp., in the Western Himalayas on nettles, *Debregeasia* sp., Natural Order *Urticaceæ.*

44. Hypolimnas bolina, Linnæus.

Papilio bolina, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 479, n. 124 (1758); *Hypolimnas bolina*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 39; *Apatura bolina*, Moore, Lep. Ind., vol. iv, pp. 140, 144 (1900); *Papilio iacintha*, Drury, Ill. Ex. Ins., vol. ii, p. 36, pl. xxi, figs. 1, 2, *female*, (1773) ; *Nymphalis jacintha*, Westwood, Donovan's Ins. China, new edition, p. 68, pl. xxxvii, fig. 1, *female* (1842).

Mr. Gervose F. Mathew has found the larva of *H. holina* feeding on *Sida rhombifolia* Linn., and *Sida retusa* Linn., Natural Order *Malvaceæ*, also upon a *Convolvulus*, Natural Order *Convolvulaceæ*, in the Australian region; in South India it feeds on *Portulaca*, Natural Order *Portulaceæ*, *Fleurya* and *Elatostema*, both Natural Order *Urticaceæ*; in

Central India it has been found on *Rostellulria*, Natural Order *Acanthaceæ.*

45*. Hypolimnas misippus, Linnæus.

Papilio misippus, Linnæus, Mus. Ulr., p. 264, n. 83 (1764); *Hypolimnas misippus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 40; *Apatura misippus*, Moore, Lep. Ind., vol. iv, pp. 146, 150 (1900).

Mr. James J. Walker reports having seen a male of this species close to Kowloon in February. I have no other record of its occurrence in the colony. I do not know what form or forms of the female are found in China, three forms, *diocippus*, Cramer, *alcippoides*, Butler, and *inaria*, Cramer, are known from India. In India the larva feeds on *Portulaca*, Natural Order *Portulaceæ*. In Ceylon it feeds on *Abutilon* and *Abelmoschus*, Natural Order *Malvaceæ*.

46. Cethosia biblis, Drury.

Papilio biblis, Drury, Ill. Ex. Ins., vol. i, p. 9, pl. iv, figs. 2, 2*a*, *male* (1770); Cramer, Pap. Ex., vol. ii, p. 120, pl. clxxv, figs. A, B, *male* (1777); *Cethosia biblis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 26; Moore, Lep. Ind., vol. iv, pp. 185, 186 (1900).

The larva in Hongkong feeds on *Passiflora fœtida*, Linn., Natural Order *Passifloreæ*. In India it feeds also on passion-flowers.

47. Atella phalantha, Drury.

Papilio phalantha, Drury, Ill. Ex. Ins., vol. i, p. 41, pl. xxi, figs. 1, 2 (1770); *Atella phalantha*, Moore, Lep. Ind., vol. iv, p. 198 (1900); *Atella phalanta* [*sic*], Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 25; *Papilio columbina*, Cramer, Pap. Ex., vol. iii, p. 76, pl. ccxxxviii, figs. A, B (1779); vol. iv, p. 92, pl. cccxxxvii, figs. D, E (1781).

In Java the larva feeds on *Ixora*, Natural Order *Rubiaceæ*; in Ceylon and on *Flacourtia*, Natural Order *Bixineæ*; on *Salix*, Natural Order *Salicineæ*, in India and the Isle of Réunion off the coast of Africa on the former genus of plants.

48. Cupha erymanthis, Drury.

Papilio erymanthis, Drury, Ill. Ex. Ins., vol. 1, p. 29, pl. xv, figs. 3, 4 (1770); Cramer, Pap. Ex., vol. iii, p. 77, ccxxxviii, figs. F, G (1779); *Argynnis erymanthis*, Westwood, Donovan's Ins. China, new edition, p. 64, pl. xxxv, fig. 1 (1842); *Cupha erymanthis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 24; Fruhstorfer, Berl. Ent. Zeitsch., vol. xlii, p. 325 (1897); Stet. Ent. Zeit., vol. lx, p. 344 (1899); Moore, Lep. Ind., vol. iv, pp. 205, 206 (1900).

Mr. James J. Walker has bred the larva in Hongkong on *Glochidion eriocarpum*, Champ., Natural Order *Euphorbiaceæ*; in South India the larva has been found on a species of willow, and on *Flacourtia*, Natural Order *Bixineæ*.

49. Cirrhochroa mithila, Moore.

Cirrochroa mithila, Moore, Proc. Zool. Soc. Lond., 1872, p. 558; *Cirrhochroa mithila*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 38; *Cirrochroa rotundata*, Butler, Trans. Linn. Soc. Lond., Zoology, second series, vol. i, p. 543, n. 4 (1877).

This butterfly has never been bred.

50*. Cirrhochroa satellita, Butler.

Cirrhochroa satellita, Butler, Cist. Ent., vol. i, p. 9 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 37; *Cirrochroa satéllita* [*sic*], Moore, Lep. Ind., vol. iv, p. 223 (1900).

The transformations of this butterfly are unknown.

51*. Argynnis childreni, Gray.

Argynnis childreni, Gray, Zool. Misc., vol. i, p. 33 (1831); Walker, Trans. Ent. Soc. Lond., 1895, p. 456, n. 42; *Dryas childreni*, Moore, Lep. Ind., vol. iv, p. 229 (1900).

This fine butterfly has never been bred.

52. Argynnis hyperbius, Linnæus.

Papilio hyperbius, Linnæus, Cent. Ins., p. 25 (1763); *Papilio niphe*, Linnæus Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 785, n. 208 (1767); Drury, Ill. Ex. Ins., vol. i, p. 12, pl. vi, figs. 1, 1*a*, *female* (1770); Cramer, Pap. Ex., vol. i, p. 21, pl. xiv., figs. D, E, *male*; B, C, *female* (1775); *Argynnis niphe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 41; *Acidalia hyperbius*, Moore, Lep. Ind., vol. iv, pp. 234, 235 (1900); *Papilio argynnis*, Drury, Ill. Ex. Ins., vol. i, p. 13, pl. vi, figs. 2, 2*a*, *male* (1770).

The larva of this interesting butterfly feeds on violets and pansies, *Viola*, Natural Order *Violaceæ*.

53. Ergolis ariadne, Johanssen.

Papilio ariadne, Johanssen, Amœn. Acad., vol. vi, p. 407 (1764); *Ergolis ariadne*, Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 23; Moore, Lep. Ind., vol. v, pp. 18, 19 (1901).

The larva in India feeds on *Tragia*, Natural Order *Euphorbiaceæ*.

Family RIODINIDÆ.

Subfamily Nemeobiinæ.

54. Zemeros flegyas, Cramer.

Papilio flegyas, Cramer, Pap. Ex., vol. iii, p. 158, pl. cclxxx, figs. E, F, *male*

(1780); *Zemeros flegyas*, Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 54; *Papilio allica*, Fabricius, Mant. Ins., vol. ii, p. 52, n. 510 (1787); *Zemeros phlegyas indicus*, Fruhstorfer, Berl. Ent. Zeitsch., vol. xlii, p. 333 (1897); *Zemeros confucius*, Kirby (*nec.* Moore), The Entomologist, vol. xxxii, p. 31 (1899).

Papilio flegyas was originally described from China, *i.e.*, Southern China, probably from the Canton region in which Hongkong is situated, as this is the region from which all the old writers received all the species from China which they described. Mr. Fruhstorfer doubts Cramer's locality and records *Z.* "*phlegyas*" from East and West Java only. He names the North Indian form *Z. phlegyas indicus*, but Indian specimens are identical with those from China. Mr. Kirby records *Z. confucius*, Moore, from Hongkong, a species originally described from the Island of Hainan off the coast of China. Whether this species is a good one or not I am unable to say, as I possess no butterflies from Hainan. Dr. Holland says that it is a good species. In India the larva feeds on *Mæsa*, Natural Order *Myrsineæ*.

55. Abisara echerius, Stoll.

Papilio echerius, Stoll, Cramer's Pap. Ex., Suppl., vol. v, p. 140, pl. xxxi, figs. 1, 1A, *male*; 1B, *female* (1790); *Abisara echerius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 55; *Papilio odin*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 56, n. 175 (1793); *Lycæna xenodice*, Hübner, Verz. bek. Schmett., p. 23, n. 174 (1816).

I have not included in the synonymy given above the *Papilio coriolanus* of Fabricius, as it was described from "The Indies," and is said to have a common [on both wings] ferruginous band, which does not apply to the present species. Dr. Butler says it is well figured in the unpublished "Icones" of Mr. Jones, a book not available in Calcutta. The larva of the closely-allied *A. fraterna*, Moore, in Southern India on *Embelia* and *Ardisia*, Natural Order *Myrsineæ*; in Ceylon *A. prunosa*, Moore, feeds on *Ardisia* of the same Natural Order.

Family LYCÆNIDÆ.

56. Gerydus chinensis, Felder.

Miletus chinensis, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 488, n. 146 (1862); Reise Nov., Lep., vol. ii, p. 284, n. 364, pl. xxxv, figs. 35, 36, *female* (1865); *Gerydus chinensis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 57.

The transformations of no species of *Gerydus* is known.

57. Neopithecops zalmora, Butler.

Pithecops zalmora, Butler, Cat. Fab. Lep. B. M., p. 161 (1869); *Neopithecops zalmora*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 58.

The larva of this little butterfly feeds on *Glycosmis*, Natural Order *Rutaceæ* in South India.

58. Chilades laius, Cramer.

Papilio lajus, Cramer, Pap. Ex., vol. iv, p. 62, pl. cccxix, figs. D, E, *female* (1780); *Lycæna laius*, Butler, Cat. Fab. Lep. B. M., p. 171, n. 19 (1869); *Chilades laius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 63; *Hesperia cajus*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 296, n. 126 (1793); *Lycæna cajus*, Wallengren, Kongl. Svenska Fregatten Eugenies, Zoologi, pt. 1, p. 356, n. 12 (1861); *Plebeius leucofasciatus*, Röber, Iris, vol. i, p. 59, pl. iv, fig. 32, *male, wet-season form* (1886).

In India the larva feeds on *Citrus*, Natural Order *Rutaceæ*.

59. Zizera maha, Kollar.

Lycæna maha, Kollar, Hügel's Kaschmir, vol. iv, pt. 2, p. 422, n. 9 (1844); *Zizera maha*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 60; *Lycæna bohemanni*, Wallengren, Wien, Ent. Monatsb., vol. iv, p. 37, n. 16 (1860); Kong. Svenska Fregatten Eugenies, Zoologi, pt. 1, p. 355, n. 11 (1861); *Lycæna argia*, Elwes, Proc. Zool. Soc. Lond., p. 888, 1881); *Plebeius albocæruleus*, Röber, Iris, vol. i, p. 59, pl. iv, fig. 7, *male* (1886).

Dr. A. G. Butler in Proc. Zool. Soc. Lond., 1900, p. 107, n. 3, pl. xi, figs. 5, 6, *male*, gives *Lycæna opalina*, Poujade, with *L. marginata*, Poujade, and *Plebeius albocæruleus* [*sic*], Röber, from Burma, Tibet and China as distinct from *Lycæna maha*, Kollar, with *Polyammatus chandala*, Moore, and *Zizera ossa*, Swinhoe, from Western India, occurring in the Lower Himalayas to Madras [? Bombay]; he also keeps distinct the *Lycæna diluta* of Felder, with *Lycæna squalida*, Butler, from the Eastern Himalayas southwards to Ganjam in the Madras Presidency. The latter species was originally described from Cachar, so the province of Assam must be added to the region of *Zizera diluta*. I am unable to follow Dr. Butler in his division of the wide-ranging *Z. maha* into three geographical races. No hard and fast geographical line can be drawn between them, *Z. maha* occurring from Kashmir at least (and probably still further to the west) on the west to Hongkong on the east. In Calcutta the larva feeds on *Oxalis*, Natural Order *Geraniaceæ*.

60. Zizera otis, Fabricius.

Papilio otis, Fabricius, Mant. Ins., vol. ii, p. 73, n. 689 (1787); *Lycæna serica*, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 487, n. 145 (1862); *Polyammatus sangra*, Moore, Proc. Zool. Soc. Lond., 1865, p. 772, pl. xli, fig. 8, *male*; *Zizera sangra*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 59.

Dr. A. G. Butler in Proc. Zool. Soc. Lond., 1900, p. 111, retains *Lycæna indica*, Murray, described from Allahabad in the North-Western

Provinces, but which Dr. Butler restricts to Central and South India and Ceylon, as distinct from *Papilio otis*. I have nothing to add to my note in Journ. A. S. B., vol. xlvi, pt. 2, p. 611 (1897) with regard to these two supposed distinct species. In Calcutta the larva feeds on *Alysicarpus*, Natural Order *Leguminosæ*; in South India on *Zornia*, Natural Order *Leguminosæ*.

61. Everes argiades, Pallas.

Papilio argiades, Pallas, Reise, vol. i, app., p. 472, n. 65 (1771); *Lycæna argiade* Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 61.

The larva in South India feeds on *Cylista*, Natural Order *Leguminosæ*.

62. Nacaduba atrata, Horsfield.

Lycæna atratus, Horsfield, Cat. Lep. E. I. Co., p. 78, n. 13 (1828).

In Ceylon the larva feeds on *Vateria*, Natural Order *Dipterocarpeæ;* in South India on *Wagatea*, Natural Order *Leguminosæ;* and on *Embelia* and *ardisia*, both Natural Order *Myrsineæ*.

63. Jamides siraha, Kheil.

Plebeius siraha, Kheil, Rhop. Nias., p. 30, n. 91, pl. v, fig. 35, *male* (1884); *J. bachus*, var., Distant, Rhop. Malay., p. 222, n. 1, pl. xxi, figs. 19, *male*; 16, *female* (1884).

The larva of this butterfly has never been found, but the allied *J. bachus*, Cramer, in South India feeds on *Butea*, *Pongamia* and *Xylia*, all of the Natural Order *Leguminosæ*.

64*. Lampides celeno, Cramer.

Papilio celeno, Cramer, Pap. Ex., vol. i, p. 51, pl. xxxi, figs. C, D, *male* (1775); *Hesperia ælianus*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 280, n. 79 (1793); *Lampides ælianus* [*sic*], Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 64.

In Java the larva feeds on *Butea*, Natural Order *Leguminosæ*; in Calcutta on *Heynea*, Natural Order *Meliaceæ*; and on *Pongamia*, Natural Order *Leguminosæ*; in South India on *Abrus*, *Pongamia* and *Saraca*, all Natural Order *Leguminosæ*.

65. Catochrysops strabo, Fabricius.

Hesperia strabo, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 287, n. 101 (1793); *Catachrysops* [*sic*] *strabo*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 65.

The larva in Orissa feeds on *Dolichos*, Natural Order *Leguminosæ;* and in South India on *Schleichera*, Natural Order *Sapindaceæ*, and on *Ougeinia* and *Cylista*, Natural Order *Leguminosæ*.

66. CATOCHRYSOPS CNEJUS, Fabricius.

Hesperia cnejus, Fabricius, Ent. Syst., Suppl., p. 430, n. 100-101 (1798).

Dr. A. G. Butler in "The Entomologist," vol. xxxiii, p. 1 (1900), places *cnejus* in *Enchrysops*, which has the eyes smooth, and *strabo* in *Catochrysops*, as it has the eyes hairy. The larva in Calcutta feeds on *Phaseolus*, in Orissa on *Dolichos*, and in South India on *Ougeinia* and *Cylista*—all Natural Order *Leguminosæ*.

67. POLYOMMATUS BŒTICUS, Linnæus.

Papilio bœticus, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 789, n. 226 (1767); *Lycæna bœtica*, Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 62.

The larva in Calcutta feeds on *Crotalaria*; in South India on *Butea* and *Cajanus*; in Europe on *Colutea*; and in South Africa on *Crotalaria*; and in the Hawaiian Islands on *Melilotus*—all Natural Order *Leguminosæ*.

68. IRAOTA TIMOLEON, Stoll.

Papilio timoleon, Stoll, Suppl. Cramer, Pap. Ex., vol. v, p. 146, pl. xxxii, figs. 4, 4D, *female* (1790); *Deudorix (Iraota) timoleon*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 72; *Hesperia mæcenas*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 271, n. 45 (1793); *Theela mæcenas*, Westwood, Donovan's Ins. China, new edition, p. 70, pl. xxxix, fig. 2, *male* (1842); *Deudorix (Iraota) mæcenas*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 73.

The larva in South India feeds on three species of *Ficus*, Natural Order *Urticaceæ*; in Ceylon it feeds on the same plants.

69. CURETIS ACUTA, Moore.

Curetis acuta, Moore, Ann. and Mag. of Nat. Hist., fourth series, vol. xx, p. 50 (1877); Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 56.

The larva of this butterfly has never been found, but closely-allied species in Calcutta feed on *Heynea*, Natural Order *Meliaceæ*, on *Pongamia* and *Derris*, Natural Order *Leguminosæ*; and in South India on *Abrus*, *Pongamia*, *Derris*, *Wagatea* and *Xylia*—all Natural Order *Leguminosæ*.

70. ILERDA PHŒNICOPARYPHUS, Holland.

Ilerda phœnicoparyphus, Holland, Trans. Amer. Ent. Soc., vol. xiv, p. 120, n. 52, pl. ii, fig. 1, *male* (1877).

This butterfly has never been bred.

71. CAMENA DEVA, Moore.

Amblypodia deva, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 46, n. 74 (1857).

The larva in India feeds on *Loranthus* Natural Order *Loranthaceæ*.

72. APHNÆUS LOHITA, Horsfield.

Amblypodia lohita, Horsfield, Cat. Lep. E. I. Co., p. 106, n. 38 (1829); *Aphnæus zebrinus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 66.

In South India the larva feeds on *Zizyphus*, Natural Order *Rhamneæ*, *Wagatea* and *Xylia*, Natural Order *Leguminosæ*, *Terminalia*, Natural Order *Combretaceæ*, *Psidium*, Natural Order *Myrtaceæ*, *Lagerstrœmia*, Natural Order *Lythraceæ*, *Argyreia*, Natural Order *Convolvulaceæ* and *Dioscorea*, Natural Order *Dioscoreaceæ*; and in Ceylon in plants of the Natural Order *Convolvulaceæ*.

73*. TAJURIA CIPPUS, Fabricius.

Hesperia cippus, Fabricius, Ent. Syst., Suppl., vol. v, p. 429, n. 43-44 (1798); *Tajuria longinus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 67.

In Java and South India the larva of this butterfly feeds on *Loranthus*, Natural Order *Loranthaceæ*.

74. TAJURIA JANGALA, Horsfield.

Amblypodia jangala, Horsfield, Cat. Lep. E. I. Co., p. 113, n. 4 (1899); *Sithon jangala*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 68.

This species has never been bred.

75. LEHERA ERYX, Linnæus.

Papilio eryx, Linnæus, Mant. Plant., p. 537 (1771); *Deudorix* (*Lehera*) *eryx*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 69.

In British Bhutan in North-Eastern India the larva of this butterfly has been found feeding on the fruit of the wild pomegranate (? *Randia*) Natural Order *Rubiaceæ*).

76. DEUDORIX EPIJARBAS, Moore.

Dipsas epijarbas, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. Co., vol. i, p. 32, n. 40 (1857); Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 71.

The larva in the Western Himalayas feeds on the fruit of the pomegranate, *Punica Granatum*, Linn., Natural Order *Lythraceæ*, and on the fruit of the horse-chestnut, *Æsculus indica*, Colebr., Natural Order *Sapindaceæ*; in South India on the pods of *Connarus Ritchiei*, Hook. f., Natural Order *Connaraceæ*.

77. RAPALA SCHISTACEA, Moore.

Deudorix schistacea, Moore, Proc. Zool. Soc. Lond., 1879, p. 140.

In Calcutta the larva feeds on *Antidesma*, Natural Order *Euphor-*

biaceæ; in the Western Himalayas on *Spiræa*, Natural Order *Rosaceæ;* in South India on *Acacia*, Natural Order *Leguminosæ* and *Quisqualis*, Natural Order *Combretaceæ*.

78*. Rapala varuna, Horsfield.

Theela varuna, Horsfield, Cat. Lep. Mus. E. I. Co., p. 91, n. 24 (1829); *Deudorix orseis*, Hewitson, Ill. Diurn. Lep., p. 23, n. 20 (1863); *Deudorix* (*Rapala*) *orseis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 70.

The larva in South India feeds on *Zizyphus*, Natural Order *Rhamneæ*, *Xylia*, Natural Order *Leguminosæ* and *Quisqualis*, Natural Order *Combretaceæ*.

Family PAPILIONIDÆ.

Subfamily Pierinæ.

79. Delias hierte, Hübner.

Delias hierte, Hübner, Zutr. Ex. Schmett., figs. 77, 78, *male* (1818); Mitis, Iris, vol. vi, p. 107, n. 38 (1893); Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 75.

This species has never been bred, but the larva will almost certainly be found on *Loranthus*, Natural Order *Loranthaceæ*.

80. Delias aglaia, Linnæus.

Papilio aglaia, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 465, n. 44 (1758); *Delias aglaia*, Butler, Ann. and Mag. of Nat. Hist., sixth series, vol. xx, p. 162, n. 78 (1897); *Papilio pasithoë*, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 755, n. 53 (1767); *Pieris pasithoë*, Westwood, Donovan's Ins. China, new edition. p. 59, pl. xxx, figs. 2, 2*a*, *male* (1842); *Delias pasithoë*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 74; *Papilio dione*, Drury, Ill. Ex. Ins., vol. ii, pl. viii, figs. 3, 4, *male* (1773); *Papilio porsenna*, Cramer, Pap. Ex., vol. i, p. 68, pl. xliii, figs. D, E, *male* (1775).

Larva probably feeds on *Loranthus*.

81. Catopsilia crocale, Cramer.

Papilio crocale, Cramer, Pap. Ex., vol. i, p. 87, pl. lv, figs. C, D, *female* (1775); *Catopsilia crocale*, Leech. Butt. from China, Japan, and Corea, p. 424 (1893); Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 79; *Papilio catilla*, Cramer, Pap. Ex., vol. iii, p. 63, pl. ccxxix, figs. D, E, *female* (1779); *Catopsilia catilla*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 78.*

The larva in India feeds on various species of *Cassia*, Natural Order *Leguminosæ*.

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* Mr. James J. Walker keeps these two species distinct, and has reversed the references to them; moreover one of his dates is incorrect.

82. Catopsilia pyranthe, Linnæus.

Papilio pyranthe, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 469, n. 66 (1758); *Colias phyranthe*, Westwood, Donovan's Ins., China, new edition, p. 61, pl. xxxi, fig. 1, *male* (1842); *Papilio chryseis*, Drury, Ill. Ex. Ent., vol. i, p. 24, pl. xii, figs. 3, 4, *male* (1773); *Catopsilia chryseis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 77.

The larva of this butterfly in India feeds on *Cassia*, Natural Order *Leguminosæ*.

83*. Terias libythea, Fabricius.

Papilio libythea, Fabricius, Ent. Syst., Suppl., vol. v, p. 427, n. 598, 599 (1798); *Terias libythea*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 58, n. 3 (1898); *Terias brigitta*, Walker (*nec* Cramer), Trans. Ent. Soc. Lond., 1895, p, 465, n. 83.

In South India the larva of this butterfly feeds on *Cassia*, Natural Order *Leguminosæ*.

84*. Terias subfervens, Butler.

Terias subfervens, Butler, Ann. and Mag. of Nat. Hist., fifth series, vol. xi, p. 278 (1883); seventh series, vol. i, p. 65, n. 24 (1898); *Terias læta*, Walker (*nec* Boisduval), Trans. Ent. Soc. Lond., 1895, p. 465, n. 82.

This species has been bred in Japan on *Cassia*. Natural Order *Leguminosæ*.

85. Terias hecabe, Linnæus.

Papilio hecabe, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 470, n. 74 (1758); *Terias hecabe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 80; Butler, Ann. and Mag. of Nat., Hist., seventh series, vol. i, p. 69, n. 36 (1898); *Terias anemone*, Felder, Wien. Ent. Monatsb., vol. vi, p. 23, n. 7 (1862); Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 69, n. 36 (1898); *Terias mandarina*, de l'Orza, Cat. Lép. Jap., p. 18, n. 23 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 465, n. 81.

Dr. A. G. Butler in his latest revision of the genus records both *T. anemone*, Felder, and *T. hecabe*, Linnæus, from Hongkong. Had he seen these common insects in life and noted the marvellous seasonal changes which takes place in them I do not think he would have wasted time in trying to make two distinct species out of them, each with wet-season, intergrade or intermediate, and dry-season forms. The larva in India has been recorded to feed on a great variety of plants of the Natural Order *Leguminosæ*, such as *Sesbania*, *Æschynomene*, *Cassia* and *Albizzia*.

86. Dercas verhuelli, van der Hoeven.

Colias verhuelli, van der Hoeven, Tijdsch. voor Nat. Gesch. en Phys., vol. v,

p. 341, n. 3, pl. vii, figs. 3*a*, 3*b*, *female* (1839); *Dercas verhuelli*, de Nicéville, Ann. and Mag. of Nat Hist, seventh series, vol. ii, p. 480, n. 1 (1898).

The larva and pupa of this species are unknown.

87. Dercas skertchlyi, de Nicéville.

Dercas skertchlyi, de Nicéville, Ann. and Mag. of Nat. Hist., seventh series, vol. ii, p. 481, n. 2 (1898).

The transformations of this genus are quite unknown.

88. Ixias pyrene, Linnæus.

Papilio pyrene, Linnæus, Mus. Ulr., p. 241, n. 60 (1764); *Ixias pyrene*, Walker, Trans. Ent. Soc. London, 1895, p. 467, n. 89; *Pieris (Thestias) pyrene*, Westwood, Donovan's Ins., China, new edition, p. 61, pl. xxxi, fig. 2, *male* (1842); *Papilio enippe*, Drury, Ill. Ex. Ins., vol. i. p. 11, and Index (two places), pl. v, figs. 2, 2*a*, *male* (1770); *Ixias evippe* (*sic !*), Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 136, n. 11 (1898); *Papilio ænippe* (*ænippa* in one place in text), Cramer, Pap. Ex., vol. ii, p. 13, pl. cv, figs. C, D, *female* (1777); vol. iii, p. 63, pl. ccxxix, figs. B, C, *female* (1779).

The larva in India feeds on *Capparis*, Natural Order *Capparideæ.*

89. Hebomoia glaucippe, Linnæus.

Papilio glaucippe, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 469, n. 65 (1758); Drury, Ill. Ex. Ins., vol. i, p. 20, pl. x, figs. 3, 4, *male* (1773); *Hebomoia glaucippe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 467, n. 90; Fritze, Zool. Jahr., vol. xi, p. 259 (1898); Fruhstorfer, Berl. Ent. Zeitsch., vol. xliii, p. 174 (1898); Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 290, n. 1 (1898); *Pieris (Iphias) glaucippe*, Westwood, Donovan's Ins., China, new edition, p. 60, pl. xxxi, fig. 1, *male* (1842).

The larva of the allied *H. australis*, Butler, in South India feeds on *Cratæva* and *Capparis*, both of the Natural Order *Capparideæ.*

90*. Prioneris clemanthe, Doubleday.

Pieris clemanthe, Doubleday, Ann. and Mag. of Nat. Hist., first series, vol. xvii, p. 23 (1846); *Prioneris clemanthe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 76.

The larvæ of allied species of this genus in India feed on *Capparis*. Natural Order *Capparideæ.*

91*. Appias albina, Boisduval.

Pieris albina, Boisduval, Sp. Gen., vol. i, p. 480, n. 62 (1836); *Tachyris (appias) albina*, Walker, Trans. Ent. Soc. Lond., 1895, p. 467, n. 88.

The larva in South India feeds on *Hemicyclia*. Natural Order *Euphorbiaceæ.*

92. Huphina nerissa, Fabricius.

Papilio nerissa, Fabricius, Syst. Ent., p. 471, n. 123 (1775); *Pieris (Huphina) nerissa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 466, n. 85; *Huphina nerissa*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. iii, p. 212, n. 53 (1899); *Papilio amasone*, Cramer, Pap. Ex., vol. 1, p. 68, pl. xliv, fig. A, *male* (1775); *Papilio coronis*, Cramer, Pap. Ex., vol. 1, p. 69, pl. xliv, figs. B, C, *female* (1775); *Huphina pallida*, Swinhoe, Proc. Zool. Soc. Lond., 1885, p. 137, n. 103; *Pieris (Huphina) pallida*, Walker, Trans. Ent. Soc. Lond., 1895, p. 466, n. 86.

The larva in India feeds on *Capparis*, Natural Order *Capparideæ.*

93*. Huphina aspasia, Stoll.

Papilio aspasia, Stoll, Suppl. Cramer, Pap. Ex., p. 148, pl. xxxiii, figs. 3, 3c, *male* (1790); *Pieris (Hupina) aspasia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 466, n. 87; *Huphina olga*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. iii, p. 210, n. 43 (1899).

Mr. James J. Walker records a single specimen from Hongkong in the collection of the British Museum. True *H. aspasia*, Stoll, appears to be confined to the Moluccas, but the variety or local race, *Pontia olga*, Eschscholtz, is extremely common in the Philippines, and a specimen may easily have been blown over to Hongkong from thence in a typhoon. It has apparently not been bred, but like all *Huphinas* the larva probably feeds on capers, Natural Order *Capparideæ.*

94. Pieris canidia, Sparrman.

Papilio canidia, Sparrman, Amœn. Acad., vol. vii, p. 504, note *m* (1768); *Pieris canidia*, Leech, Butt. from China, Japan, and Corea, p. 456 (1893); *Pieris (Ganoris) canidia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 465, n. 84.

The larva of this butterfly, which is by far the commonest species in Hongkong, feeds on various species of *Brassica*, Natural Order *Cruciferæ.*

Subfamily PAPILIONINÆ.

95. Papilio aristolochiæ, Fabricius.

Papilio aristolochiæ, Fabricius, Syst. Ent., p. 443, n. 3 (1775); Rothschild, Nov. Zool., vol. ii, p. 245, n. 39 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 468, n. 91.

The larva in India feeds on *Aristolochia*, Natural Order *Aristolochiaceæ.*

96*. Papilio xuthus, Linnæus.

Papilio xuthus, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 751, n. 34 (1767); Walker, Trans. Ent. Soc. Lond., 1895, p. 472, n. 104; Rothschild, Nov. Zool., vol. ii. p. 503 (1895); *Papilio xanthus*, Rothschild, Nov. Zool., vol. ii, p. 278, n. 66 (1895).

In China and Japan the larva of this butterfly has been recorded to feed on *Zanthoxylum* and *Ægle*, Natural Order *Rutaceæ*, and on *Phellodendron*.

97. Papilio demoleus, Linnæus.

Papilio demoleus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 464, n. 35 (1758); Westwood, Donovan's Ins., China, new edition, p. 57, pl. xxviii, fig. 2, *female* (1842); Rothschild, Nov. Zool., vol. ii, p. 279, n. 67 (1895); *Papilio erithonius* Cramer, Pap. Ex., vol. iii, p. 67, pl. ccxxxii, figs. A, B, *male* (1782); Walker, Trans. Ent. Soc. Lond., 1895, p. 470, n. 98; *Papilio epius*, Westwood, Donovan's Ins., China, new edition, p. 56, pl. xxviii, fig. 1, *male* (1842).

The larva in India feeds on *Ruta*, *Glycosmis*, *Murraya*, *Citrus* and *Ægle*, all Natural Order *Rutaceæ*, *Psoralea*, Natural Order *Leguminosæ*, while the local race *P. demoleus sthenelus*, MacLeay, is said to feed on *Salvia*, Natural Order *Labiatæ*, New Guinea.

98. Papilio helenus, Linnæus.

Papilio helenus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 459, n. 4 (1758); Elwes, Proc. Zool. Soc. Lond., 1881, p. 873; Rothschild, Nov. Zool., vol. ii, p. 284, n. 72 (1895); Walker, Trans. Ent. Soc. Lond., 1895, pl. 469, n. 96.

The larva in India feeds on *Zanthoxylum*, *Glycasmis* and *Citrus*, Natural Order *Rutaceæ*.

99. Papilio memnon agenor, Linnæus.

Papilio agenor, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 460, n. 13 (1758); Westwood, Donovan's Ins., China, new edition, p. 53, pl. xxiv, fig. 2, *female, second form* (1842); Walker, Trans. Ent. Soc. Lond., 1895, n. 469, n. 94; *Papilio memnan agenor*, Rothschild, Nov. Zool., vol. ii, p. 316 (*d*) (1895); *Papilio memnon*, Leech, Butt. from China, Japan and Corea, p. 544 (1893).

The larva of this butterfly does not appear to have been fonnd in India, but it almost certainly feeds on plants of the arangeaceous group, Natural Order *Rutaceæ*. True *P. memnon*, Linnæus, in Sumatra feeds on *Citrus*.

100. Papilio protenor, Cramer.

Papilio protenor, Cramer, Pap. Ex., vol. i, p. 77, pl. xlix, figs. A, B, *male* (1775); Westwood, Donovan's Ins., China, new edition, p. 56, pl. xxvii, *female* (1842); Elwes, Proc. Zool. Soc. Lond., 1881, p. 872, Leech, Butt. from China, Japan and Corea, p. 546 (1893); Rothschild, Nov. Zool., vol. ii, p. 331, n. 108 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 469, n. 95.

The larva of this butterfly in the Western Himalayas feeds on *Zanthoxylum*, Natural Order *Rutaceæ*.

101. Papilio polytes borealis, Felder.

Papilio polytes, var. *borealis*, Felder, Wien. Ent. Monatsb, vol. vi, p. 22, n. 2 (1861); *P. polytes borealis*, Rothschild, Nov. Zool., vol. ii, p. 348 (*b*) (1895); *Papilio polytes*, Walker, Trans. Ent. Soc. Lond., 1895, p. 469, n. 97.

Mr. James J. Walker records the larva of this species in Hongkong feeding on orange, lime, and pumilo (*Citrus*, Natural Order *Rutaceæ*).

102. Papilio clytia panope, Linnæus.

Papilio panope, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 479, n. 131 (1758); *Papilio saturata*, Moore, Proc. Zool. Soc. Lond., 1878, p. 697; *Papilio clytia panope*, Linnæus, (g^2): ab. loc. *saturatus*, Rothschild, Nov. Zool., vol. ii, p. 369 (1895); *Papilio clytia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 470, n. 99.

In Hongkong the larva has been found on *Morinda umbellata*, Natural Order *Rubiaceæ;* in South India a local race of this species feeds in the larval state on *Cinnamomum*, *Alseodaphne* and *Litsæa*, Natural Order *Laurineæ;* in the Western Himalayas on *Litsæa;* in Calcutta on *Antiaris*, Natural Order *Urticaceæ;* and in Bombay on *Tetranthera*, Natural Order *Laurineæ;* the latter genus being apparently a synonym of *Litsæa*.

103. Papilio bianor, Cramer.

Papilio bianor, Cramer, Pap. Ex., vol. ii, p. 10, pl. ciii, fig. c (1777); Rothschild, Nov. Zool., vol. ii, p. 378, n. 142 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 468, n. 93.

The food-plant of the larva of this butterfly does not appear to have been recorded.

104. Papilio paris, Linnæus.

Papilio paris, Linnæus Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 459, n. 3 (1758); Westwood, Donovan's Ins., China, new edition, p. 51, pl. xxii, figs. 1, 2, *female* (1842); Walker, Trans. Ent. Soc. Lond., 1895, p. 468, n. 92.

The food-plant of the larva of this common butterfly is apparently unknown.

105. Papilio antiphates, Cramer.

Papilio antiphates, Cramer, Pap. Ex., vol. i, p. 113, pl. lxxii, figs. A, B, *male* (1775); Rothschild, Nov. Zool., vol. ii, p. 410, n. 170 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 100.

I cannot find that the food-plant of this species has been recorded, though Mynheer Piepers has described the transformations of the local race *Alcibiades*, Fabricius, in Java.

106. Papilio eurypylus axion, Felder.

Papilio axion, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xiv, p. 305, n. 224, p. 350, n. 128 (1864); *Papilio eurypylus axion*, Rothschild, Nov. Zool., vol. ii, p. 433 (*h*) (1895); *Papilio eurypilus* [*sic !*], Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 102.

The larva at Balasore near Calcutta has been recorded to feed on *Michelia*, Natural Order *Magnoliaceæ*, and *Uvaria*, Natural Order *Anonaceæ*. In Calcutta I have bred it on *Michelia*, Natural Order *Magnoliaceæ*, and on *Polyalthia*, Natural Order *Magnoliaceæ;* while the local race *yasan*, Esper, feeds on *Unona* and *Saccopetalum*, Natural Order *anonaceæ* in Southern India.

107. Papilio sarpedon semifasciatus, Honrath.

Papilio sarpedon, var. *semifasciatus*, Honrath, Ent. Nach., vol. xiv, p. 161 (1888); *Papilio sarpedon semifasciatus*, Rothschild, Nov. Zool., vol. ii, p. 442 (*b*) (1895); *Papilio sarpedon*, Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 101.

The larva of different local races of *P. sarpedon* feed in Japan on *Machilus*, Natural Order *Laurineæ;* in the Western Himalayas on the same plant; and in South India on *Cinnamomum*, *Alseodaphne* and *Litsæa*, all of the same Natural Order.

108. Papilio agamemnon, Linnæus.

Papilio agamemnon, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 462, n. 21 (1758); Westwood, Donovan's Ins., China, new edition, p. 55, pl. xxvi, fig. 2, *female* (1842); Rothschild, Nov. Zool., vol. ii, p. 447, n. 198 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 101.

The larva of this butterfly in Java and Celebes has been found on *Anona*, Natural Order *Anonaceæ ;* in the Philippine Isles on *Arctacarpus*, *Unona*, and *Michelia ;* in Sumatra on *Anona* and *Michelia ;* and in India on *Unona*, *Polyalthia*, *Anona*, and *Saccopetalum*—all Natural Order *Anonaceæ*.

109. Leptocircus curius, Fabricius.

Papilio curius, Fabricius, Mant. Ins., vol. ii, p. 9, n. 71 (1787); *Leptocircus curius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 472, n. 105.

In October, 1892, on the Daunat Range, Central Tenasserin, Burma, I observed a female of the allied *Leptocircus mages*, Zinken-Sammer, ovipositing on the underside of the leaves of a creeper with compound leaves, each leaf consisting of three leaflets, the *Illigera burmannica* of King, Natural Order *Combretaceæ*. The egg is spherical, smooth, pale green, almost transparent, and of the usual papilionid form. Unfortunately I was not able to breed the larva.

Family HESPERIIDÆ.

110. Tagiades atticus, Fabricius.

Hesperia atticus, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 339, n. 288 (1793); *Tagiades atticus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 119.

In Southern India the larva of this butterfly feeds on *Dioscorea*, Natural Order *Dioscoreaceæ*, and *Smilax*, Natural Order *Liliaceæ*.

111. Odontoptilum angulata, Felder.

Pherygospidea angulata, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 488, n. 149 (1862); *Achlyodes Sura*, Moore, Proc. Zool. Soc. Lond., 1865, p. 786; *Antigonus sura*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 120.

The larva in South India feeds on *Allophylus Cobbe*, Blunæ, Natural Order *Sapindaceæ*.

112. Caprona alida, de Nicéville.

Caprona alida, de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. vi, p. 394, n. 37, pl. G, fig. 40, *male* (1891).

The transformations of this butterfly are unknown.

113. Caprona elwesii, Watson.

Caprona elwesii, Watson, Journ. Bomb. Nat. Hist. Soc., vol. x, p. 674 (1897); *Caprona syrichthus*, var., Elwes, Proc. Zool. Soc. Lond., 1892, p. 656, pl. xliii, fig. 2.

The transformations of this butterfly are unknown.

114. Astictopterus olivascens, Moore.

Astictopterus olivascens, Moore, Proc. Zool. Soc. Lond., 1878, p. 692; *Asticopterus* [*sic!*] *olivascens*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 124; *Cyclopides chinensis*, Leech, The Entomologist, vol. xxiii, p. 48 (1890); *Steropes nubilus*, Mabille, Bull. Soc. Ent. Belg., vol. xxxv, p. lxiv (1891); Leech, Butt. from China Japan and Corea, p. 630 (1893).

This obscure skipper has never been bred.

115. Suastus gremius, Fabricius.

Hesperia gremius, Fabricius, Ent. Syst., a Suppl., vol. v, p. 433, n. 282-283 (1798); *Suastus gremius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 115.

The larva in India feeds on the leaves of palms, *Areca*, *Caryota*, *Phœnix*, *Calamus*, and *Cocos*, Natural Order *Palmeæ*.

116. Iambrix stellifer, Butler.

Astictopterus stellifer, Butler, Trans. Linn. Soc. Lond., Zoology, second series, vol. i, p. 555, n. 7 (1877); *Asticopterus* [*sic !*] (*Iambryx sic !*) *salsala*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 125.

This butterfly has never been bred, but the closely-allied *I. salsala*, Moore, in India feeds on bamboos and grasses, Natural Order *Gramineæ*.

117. Taractrocera atropunctata, Watson.

Taractrocera atropunctata, Watson, Journ. Bomb. Nat. Hist. Soc., vol. x, p. 676, n. 275, pl. A, fig. 9, *male* (1897).

Transformations unknown.

118. Hyarotis adrastus, Cramer.

Papilio adrastus, Cramer, Pap. Ex., vol. iv, p. 62, pl. cccxix, figs. F, G, *male* (1780); *Hyatotis adrastus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 122.

The larva in Sumatra feeds on *Calamus*, and in India on *Phœnix* and *Calamus*, Natural Order *Palmeæ*, and doubtless on other palms.

119. Matapa aria, Moore.

Hesperia aria, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 254, n. 587 (1857); *Matapa aria*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 108.

The larva in India feeds on the leaves of bamboos, *Bambusa*, *Dendrocalamus* and *Ochlandra*, Natural Order *Gramineæ*.

120*. Erionota thrax, Linnæus.

Papilio thrax, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 794, n. 264, (1767); *Erionota thrax*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 121.

Mr. James J. Walker records the breeding of this large skipper at Hongkong on banana leaves. In India also the larva feeds on species of *Musa*, Natural Order *Scitamineæ*.

121. Notocrypta feisthamelii, Boisduval.

Thymele feisthamelii, Boisduval, Voy l'astrolahe, Lep., p. 159, pl. iii, fig. 6 (1832); *Plesioneura alysos*, Moore, Proc. Zool. Soc. Lond., 1865, p. 789; *Notocrypta. alysos*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 109.

In the Western Himalayas the larva of this butterfly feeds on *Hedychium*, Natural Order *Scitamineæ;* in South India it feeds on *Curcuma*, *Hedychium*, and *Amomum*, all Natural Order *Scitamineæ*.

122. Udaspes folus, Cramer.

Papilio folus, Cramer, Pap. Ex., vol. i, p. 118, pl. lxxiv, fig. F, *female* (1775); *Udaspes folus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 123.

The larva of this species in India feeds on *Curcuma*, *Kæmpferia*, *Hedychium*, and *Amomum*—all Natural Order *Scitamineæ*.

123. Telicota bambusæ, Moore.

Pamphila bambusæ, Moore, Proc. Zool. Soc. Lond., 1878, p. 691, pl. xlv, fig. 11, *male*; 12, *female*; *Telicota bambusæ*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 116.

The larva in India feeds on the leaves of bamboos, *Bambusa* and *Oxytenanthera*, Natural Order *Gramineæ*.

124. Telicota augias, Linnæus.

Papilio augias, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 794, n. 257 (1767); *Telicota augias*, Elwes and Edwards, Trans. Zool. Soc. Lond., vol. xiv, p. 251 (1897).

This species does not appear to have been bred. Messrs Elwes and Edwards record it from Hongkong, but it is very difficult to say from examining the markings only whether any particular specimen of this group of the genus from Hongkong is *T. bambusæ* or *T. augias*; in markings the specimens seem to be intermediate. Those gentlemen apparently make out differences between the two species in the form of the clasp in the males, which from the figures given by them (l. c., pl. xxv, figs. 62, 62*a*, *augias*, and 63, *bambusæ*) seem to be sufficient to distinguish the males.

125. Padraona dara, Kollar.

Hesperia dara, Kollar, Hugel's Kaschmir, vol. iv, pt. 2, p. 455, n. 4 (1844); *Telicota dara*, Elwes and Edwards, Trans. Zool. Soc. Lond., vol. xiv, p. 255 (1897); *Telicota mæsoides*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 117.

The larva in South India feeds on *Bambusa*, *Oxytenanthera*, and *Ochlandra*, Natural Order *Gramineæ*.

126. Halpe ceylonica, Moore.

Halpe ceylonica, Moore, Proc. Zool. Soc. Lond., 1878, p. 690, pl. xlv, fig. 9, *male*; *Halpe moorei*, Watson, Proc. Zool. Soc. Lond., 1893, p. 109; Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 118.

In South India the larva feeds on *Bambusa* and *Oxytenanthera*, Natural Order *Gramineæ*.

127. Baoris oceia, Hewitson.

Hesperia oceia, Hewitson, Desc. Hesperidæ, p. 31, n. 22 (1868); *Baoris oceia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 110.

The larva in South India feeds on *Bambusa*, *Dendrocalamus*, and *Ochlandra*, Natural Order *Gramineæ*.

128. Chapra mathias, Fabricius.

Hesperia mathias, Fabricius, Ent. Syst., Suppl., p. 433, n. 289-290 (1798); *Chapra mathias*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 113.

The larva in India feeds on rice *Oryza sativa*, Linn., and on grasses, Natural Order *Gramineæ*.

129. Parnara conjuncta, Herrich-Schäffer.

Goniloba conjuncta, Herrich-Schaffer, Prodr. Syst. Lep., vol. iii, p. 75, n. 44 (1869); *Hesperia narosa*, Moore, Proc. Zool. Soc. Lond., 1878, p. 687, pl. xlv, fig. 4, *male*; *Baoris narosa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 111.

The larva in South India has been bred on Indian Corn or Maize, *Zea Mays*, Linn., and on coarse broad-leaved grasses, Natural Order *Gramineæ*.

130. Parnara assamensis, de Nicéville.

Parnara assamensis, de Nicéville, Journ. A. S. B., vol. li, pt. 2, p. 65, n. 202 (1882); Wood-Mason and de Nicéville, Journ A. S. B., vol. lv, pt. 2, p. 382, n. 215, pl. xviii, figs. 5, 5*a*, *male*; pl. xvii, figs. 7, 7*a*, *female* (1886); *Baoris assamensis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 112.

This species has never been bred.

131. Parnara guttatus, Bremer and Grey.

Endamus guttatus, Bremer and Grey, Schmett. N. China's, p. 10, n. 43 (1853); *Parnara guttatus*, Walker, Trans. Ent. Soc. Lond , 1895, p. 474, n. 114.

The larva in India feeds on grasses and rice, *Oryza*, Natural Order *Gramineæ*.

132. Parnara contigua, Mabille.

Pamphila contigua, Mabille, Bull. Soc. Zool., France, vol. ii, p. 232, *male* (1877); Elwes and Edwards, Trans. Zool. Soc. Lond., vol. xiv, p. 282 (1897).

This butterfly has never been bred.

133. Parnara pellucida, Murray.

Pamphila pellucida, Murray, Ent. Month. Mag., vol. xi, p. 172 (1875).

Has never been bred to my knowledge.

134. Parnara colaca, Moore.

Hesperia colaca, Moore, Proc. Zool. Soc. Lond., 1877, p. 594, pl. lvii, fig. 7, *male*.

In South India the larva of this butterfly feeds on soft, small grasses, Natural Order *Gramineæ*.

135. Parnara bevani, Moore.

Hesperia bevani, Moore, Proc. Zool. Soc. Lond., 1878, p. 688.

The larva in South India feeds on rice, *Oryza*, Natural Order *Gramineæ.*

136*. Ismene ataphus, Watson.

Ismene ataphus, Watson, Proc. Zool. Soc. Lond., 1893, p. 126; Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 106.

The larva in Ceylon and the Western Himálayas feeds on *Hiptage*, Natural Order *Malpighiaceæ.*

137*. Hasora vitta, Butler.

Hesperia vitta, Butler, Trans. Ent. Soc. Lond., 1870, p. 498, Lep. Ex., p. 167, n. 3, pl. lix, fig. 9 (1874); *Hasara vitta*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 107.

Originally described from Sarawak in Borneo. The sex of the type specimen is not stated by the describer. It has never been bred.

138. Parata alexis, Fabricius.

Papilio alexis, Fabricius, Syst. Ent., p. 533, n. 387 (1775); *Papilio cramus*, Cramer, Pap. Ex., vol. iii, p. 163, pl. cclxxxiv, fig. E, *male* (1780).

This is probably the species Mr. J. J. Walker records from Hongkong as *Hasora vitta*, Butler. The larva in Calcutta feeds on *Pangamia*, Natural Order *Leguminosæ*, and on *Heynea*, Natural Order *Meliaceæ;* in South India it feeds on the first-named plant.

139. Rhopalocampta benjaminii, Guérin.

Thymele benjaminii, Guérin, Delessert 's Souv. voy. dans l'Inde, vol. ii, p. 79, pl. xxii, fig. 2.

The larva in Sikhim in the Eastern Himálayas feeds on *Sabia* Natural Order *Sabiaceæ;* and in the Western Himālayas on the same plant.

140*. Cyclopides etura, Mabille.

Cyclopides etura, Mabille, Soc. Ent. Belg., vol. xxxv, p. lxxv (1891).

Described from a female from Hongkong. I have not been able to identify it, and Messrs. Elwes and Edwards omit it from their Revision of the Oriental *Hesperiidæ* in Trans. Zool. Soc. Lond., vol. xiv, pp. 101-324 (1897). Its food-plant is unknown.

II.—*Descriptions of some new species of* Orchideæ *from North-West and Central India.*—*By* J. F. Duthie, B.A., F.L.S., *Director, Botanical Department, North India.*

[Received 25th November, 1901. Read 4th December, 1901.]

Since the publication in 1898 of the four volumes on the Sikkim orchids by Sir George King and Mr. R. Pantling, I have been engaged during my spare time in the preparation of a similar work on the orchids of North-West and Central India. As, owing to more pressing work, there may be some delay in its completion, I have decided to publish at once the descriptions of some new species, which have been discovered within the period during which I have been able to make a special study of the subject.

For the greater portion of the material, on which the following descriptions are based I am indebted to my friend, Mr. P. W. Mackinnon, who for many years has taken a keen interest in the botany, and especially the orchids, of the Mussoorie district. Also, by his having carefully trained some intelligent hillmen in his service to work as collectors, some very interesting results have been obtained. I wish to express also my appreciation of Sir William Thiselton-Dyer's kindness in allowing me to consult Mr. R. A. Rolfe, the eminent orchidologist at the Royal Herbarium at Kew, from whom I have received great assistance.

1. Microstylis Mackinnoni Duthie, n. sp.

Whole plant 1-1·7 dm. high. Stem 3-4 cm., swollen below and rising from the base of the previous year's pseudo-bulb; lower portion enclosed within the leaf-sheaths. *Leaves* 2 or 3, horizontal, unequal in size, the larger one about 6 cm. long and 4 cm. broad, ovate, obtuse, 3-7-nerved, cordate and amplexicaul at the base, fleshy; upper surface dark brownish-green; main nerves 3-7, prominent beneath and purple-coloured, the interspaces raised above, and giving the whole leaf a bullate appearance. *Scape* reddish-purple, sharply 4-angular. *Raceme* shorter than the scape; *bracts* subulate, persistent, reflexed, longer than the ovary. *Flowers* sessile, very small, reddish-purple, resupinate. *Dorsal sepal* ovate-lanceolate, subacute; *lateral* shorter, subfalcate, edges of all reflexed. *Petals* linear, shorter than the sepals, much reflexed. Basal and apical portions of *lip* divided by a raised rim, basal lobes falcately ovate-lanceolate, contiguous, or overlapping at the tips; apical portion of lip deeply bifid and protruded, deep crimson-purple. *Column* with fleshy rounded arms. *Anther* with a truncate or emarginate lip. *Ovary* clavate, curved, not twisted.

Western Himālaya, near Mussoorie, on the southern face of the Park Hill, up to 6,000 feet, *P. W. Mackinnon;* also on the Kalanga Hill in Dehra Dun, 2-3,C00 feet, *Mackinnon's collector.*

Although most nearly related to *M. Wallichii*, the very different leaves at once distinguish this plant from any of the many forms of that species. It has also much smaller flowers and a very differently shaped lip.

2. Oreorchis Rolfei Duthie, n. sp.

Pseudo-bulb globose. *Leaves* two or three, about 2 dm. long by 1 to 1·5 cm. broad, deflexed at the tips. 3-5-nerved, plicate. *Scape* about as long as the leaves, rising from near the top of the pseudo-bulb. *Peduncle* firm, with 3 or 4 close-fitting tubular sheaths. *Raceme* many-flowered, about 6·7 cm. long. *Flowers* sessile, rather crowded, about 1·4cm. across. *Floral bract* minute, less than half the length of the ovary. *Sepals* about equal, 1·4 cm. long, lanceolate, subacute, pale yellowish-green, slightly spreading. *Petals* as long as the sepals, but narrower, oblanceolate, subacute, pure white with a few purple blotches. *Lip* obovate-oblong (when spread out), narrowed at the base into s short sac-like claw, side-lobes linear, fleshy, white, half the length of the mid-lobe; mid-lobe deflexed, white, and like the petals blotched with purple, apex with a shallow sinus, base of disc with a prominent fleshy oval channelled callus. Column curved, dilated at the base, concave in front. *Pollinia* globular, united to a short thick conical caudicle.

Western Himālaya, on Nág Tiba in Tehri-Garhwal, at an elevation of about 8,000 feet. *Mackinnon's collector.* Flowers in June.

This species is most nearly allied to *O. micrantha*, but the spike is shorter and the flowers are more crowded; it differs also by having a saccate base to the lip, and both the lip and petals are pure white spotted with purple. The callus at the base of the lip is oval and not linear. I have much pleasure in naming this orchid after Mr. R. A. Rolfe, of the Royal Herbarium at Kew.

3. Cirrhopetalum Hookeri Duthie, n. sp.

Cæspitose. *Pseudo-bulbs* crowded, ovoid or nearly round, 1·5-1·7 cm. long. *Leaves* solitary on each pseudo-bulb, 3-4 cm. long and 1-1·2 cm. broad, linear-lanceolate or falcately so, tapering to the base, hardly petioled, notched at the obliquely obtuse or acute apex, coriaceous, dark green above, paler beneath, margin narrowly hyaline. *Scape* equalling or exceeding the leaves, issuing from near the base of the pseudo-bulb, lower portion enclosed within sheaths. *Flowers* 3-4, umbellate. *Floral bracts* 5 m. long, lanceolate, acuminate, membranous, shorter than the long-stalked ovary, margins incurved. *Dorsal sepal* 5 m. long, quite free at its base from the lateral pair, ovate, emarginate, concave and embracing the column, pale yellow with three broad reddish-purple veins; *lateral sepals* 2·1 m., cohering at their base and adnate to the foot of the column, twisted and constricted above their auricled base, linear-lanceolate and with acuminate cucullate tips, yellow with three to four bright red veins, which become indistinct upwards. *Petals* a little shorter than the dorsal sepal, broadly and obliquely ovate, rounded at the apex, yellow tinged with reddish-purple at the base. *Lip* deflexed from about the middle, oblong, with the margins incurved and forming a deep furrow on the upper surface, very thick and fleshy, yellow with reddish-purple blotches on the basal portion of the raised margins. *Column* thick, with a long incurved foot; apical processes 2, triangular, setaceous.

Western Himālaya: in Tehri-Garhwal, east of Tehri, epiphytic on *Rhododendron arboreum*, at elevations between 5 and 6,000 feet, *Mackinnon's collector.*

This species is most nearly related to *C. cæspitosum* of Wallich. It differs by having almost globular pseudo-bulbs and much longer scapes, the lateral sepals cohere at the base only; the petals are obtuse and quite entire; the shape of the lip is different, as is also the colouring of the flower. I have dedicated the species to my friend and benefactor, Sir Joseph D. Hooker, G.C.S.I., F.R.S.

4. Eulophia campanulata Duthie, n. sp.

Height of plant 9-15 dm., the leaves and scape rising from a horizontal, oblong tuber. *Pseudo-stem* formed by the sheaths enclosing the bases of the leaves and scape. *Leaves* few, linear, acuminate, 3-4·5 dm. long, and about 3 cm. broad; veins sharply prominent. *Scape* exceeding the leaves, with a few long tight-fitting acuminate sheaths towards the base. *Flowers* 6-10, in a lax raceme, appearing with the leaves, about 2·5 cm. in diam., erect in bud, drooping and campanulate when open. *Floral bracts* lanceolate, acuminate, less than half the length of the ovary. *Sepals and petals* prominently veined on the back, bright yellow outside and pale lemon-coloured within. *Dorsal sepal* obovate, cuspidate, 2 cm. long; *lateral*, rather shorter, falcately oblong, obtuse, or mucronate, adnate to the base of the column. *Petals* obovate, obtuse, about as long as the lateral sepals. *Lip* 3-lobed, longer than the sepals, with a short subacute conical sac at the base; side-lobes erect, large, rounded, pale yellow tinged with purple; mid-lobe bent upwards, and with reflexed undulate margin, suborbicular when flattened out; the disc with 5-8 prominent ridges terminating within the apex of the apical lobe in an oblong grooved callus, and prolonged at the base into two sets of finger-like projections. *Column* about 1 cm. long, oblong, narrowly winged, curving into a short foot at the base. *Pollinia* 2, globose, attached by a cylindric caudicle to a triangular gland.

North-West India: Dehra Dun, at Karwapáni, *W. Bell*, and *P. W. Mackinnon's collector;* N. Oudh, at Chandanpur in the Gonda district. *Duthie's collector.*

Amongst the Indian species this very handsome orchid appears to be most nearly related to *E. Mannii*, Hk. f., which is found in Sikkim and in Upper Assam. It was originally discovered in Dehra Dun in 1879 by Mr. W. Bell, formerly Head Gardener at the Saharanpur Botanical Garden, after whom I have named it.

5. Eulophia Mackinnoni Duthie, n. sp.

Rhizome composed of a series of triangular flattened tubers. *Leaves* few, plicate, 5 to 6·5 dm. long and 5 to 8 cm. broad, appearing with the flowers, broadly lanceolate, acuminate, tapering into long sheaths, and with a few leafless sheaths below; nerves prominent. *Scape* 6-4 dm., arising from the swollen base of the pseudo-stem. *Flowers*, rather large, arranged in a lax raceme, spreading and afterwards deflexed. *Bracts* as long as, or shorter than, the ovary, linear, acuminate, persistent. *Sepals* and *petals* fleshy, yellow, tinged with reddish-brown, veins prominent outside. *Dorsal sepal* 1·7 cm. long, ovate, obtuse, subcordate at the base, 9-veined, margin inflexed at the apex; *lateral*, a little longer than the dorsal, unequal at the base. *Petals* shorter than the sepals, oblong-obovate, obtuse, overlapping and with their margins reflexed at the apex. *Lip* 3-lobed, with long erect rather shallow side-lobes, its body with 5-7 parallel purple-coloured ridges which extend into a carunculate area within the apical lobe; apical lobe rounded, its margin undulate. *Spur* short, geniculate. *Column* rather broad, winged, with no foot. *Anther* bicornute at the apex, its lip 2-toothed. *Stigma* transverse, placed immediately under the anther. *Pollinia*, tranversely oval, attached by a broad caudicle to a shallow crescent-shaped gland.

North-West India: Dehra Dun, *Mackinnon*; Siwalik range, *Vicary* (in Herb. Calc.); Bahraich district in N. Oudh, *Duthie's collector;* Raipur district in Cent. Provinces, *J. Marten*. In the Saharanpur herbarium there is an old specimen named "*E. bicolor*" which is said to have been collected near Mussoorie in October 1842.

This species is evidently allied to *E. geniculata*, King and Pantling, an extremely rare Sikkim orchid. It differs chiefly in the shape of the rhizome, the very much broader leaves, the colour of the flowers, and in the shape of the lip.

6. Cymbidium Mackinnoni Duthie, n. sp.

Terrestrial, cæspitose. *Pseudo-stem* short, emitting many thick spongy roots. *Leaves* linear, acuminate, 3-4 dm. long and about 1·3 cm. broad; margins not serrulate, the lowest ones sheath-like and membranous. *Scape* 1-flowered, much shorter than the leaves, clothed to the base with loose lanceolate acuminate cymbiform hyaline sheaths. *Floral bract* longer than the much curved ovary, pale yellow with purple veins. *Flowers* about 5 cm. across, nodding. *Sepals and petals* spreading, green. *Sepals* lanceolate, obtuse, a little longer than the petals. *Petals* elliptic-lanceolate, obtuse, 5-nerved. *Lip* about as long as the petals, obovate-oblong (when spread out), 3-lobed, saccate at the base, very pale yellow blotched with purple; lateral lobes narrow, erect; the terminal one abruptly deflexed, rounded at the apex and nearly entire; the disk with two raised smooth lamellæ extending from the base to a little beyond the side-lobes. *Column* short, stout, curved, concave in front, marked with purple blotches like the lip. *Pollinia* 4, obliquely obovoid, plano-convex, the segments of each pair unequal, attached to a hemispherical gland. *Ripe capsule* 1·5 dm. long (including the long pedicel), ellipsoid-clavate, prominently ribbed.

Western Himālaya: near Mussoorie, at an elevation of about 5,500 feet, growing under trees; in flower during February, *P. W. Mackinnon.*

Mr. Rolfe informs me that its nearest ally is *C. virescens*, Lindl., a native of Japan. Of Indian species it most nearly resembles *C. cyperifolium* in habit. It is, however, a much smaller plant, the scape is always 1-flowered, and the colouring of the lip and the shape of the pollinia and gland are very different; also the margins of the leaves are entire and not serrulate as in *C. cyperifolium.* The latter is also found in similar localities near Mussoorie, but always at a slightly higher elevation, and it comes into flower several weeks later.

7. Listera Inayati Duthie, n. sp.

Whole plant 1·5 to 2 dm. high. *Roots* fibrous. *Stem* stout, about as long as the raceme, and bearing 3-6 loosely-fitting, blunt sheaths, the two upper ones sometimes opposite and leaflike. *Flowers* in dense racemes, 4 m. long; rachis glandular-pubescent. *Floral bract* ovate or lanceolate-acuminate, a little longer than the stalk of the ovary. *Sepals and petals* connivent; *dorsal sepal* oval, concave, about 2 m. long; *lateral sepals* a little longer than the dorsal, obliquely ovate, tapering to an obtuse apex. *Petals* about as long as the dorsal sepal, spathulate, subacute.

Lip twice as long as the lateral sepals, narrowly oblong, deeply cleft at the apex, with two slightly spreading obtuse lobes, midrib thickened. *Column* short, stout, dilated at the base and apex. *Anther* suborbicular, bifid at the apex. *Pollinia* narrowly obovoid. *Ovary* oval or subglobose, about as long as its stalk, glandular-pubescent.

Western Himālaya; in the Kagán valley of the Hazāra district. Discovered in July 1897 by *Inayat Khán*, head plant-collector of the Botanical Department of N. India (No. 22,596).

A shorter and much stouter plant than *L. Lindleyana*, and with shorter and more densely-flowered racemes. The shape of the sepals, petals, anther and pollinia are altogether different.

8. Listera microglottis Duthie, n. sp.

A leafless parasite, 2-3·3 dm. in height. *Root-fibres* clylindrical, brittle, pale yellowish-brown. *Stem* about as long as the receme, nearly white, bearing 2-4 loose-fitting obtuse pale sheaths. Rachis of raceme, pedicels and bracts glandular-pubescent. *Flowers* crowded, about 7 m. in diameter, pale green; pedicel a little longer than the ovary; *floral bract* equalling or exceeding the pedicel, oblong, obtuse or subacute. *Sepals* ovate, subacute, about 4 m. long; the lateral ones somewhat oblique. *Petals* as long as the sepals, linear, margins reflexed. *Lip* linear-spathulate, equalling the petals in length, entire at the apex, margins reflexed. *Column* erect, a little shorter than the petals, dilated towards its base and apex. *Pollinia* 2, globose, without caudicles, extremely deliquescent. *Ovary* with pedicel 8 m. long. *Capsule* turgid, its ridges thick and often bearing short, broad-based, tooth-like projections.

Western Himlāaya: in Tehri-Garhwál, east of Tehri, growing under oaks and rhododendrons at elevations between 5,000 and 6,000 feet, *P. W. Mackinnon's collector;* also on the wooded hillsides below Mussoorie at similar elevations. Flowers during August and September. This plant, although resembling *L. Lindleyana* in general habit, differs from any known species of *Listera* (including *Neottia)* by its very remarkably restricted petal-like lip.

9. Aphyllorchis Gollani Duthie, n. sp.

A tall leafless terrestrial herb, from 4 to 5 dm. in height. *Rhizome.* with numerous far-extending fleshy roots, not scaly. *Stem* erect, stout, bearing several unequal tubular blunt sheaths. *Raceme* about 1 dm. long, *Flowers* several, 2 cm. long. *Floral bract* a little longer than the ovary, elliptic-lanceolate, acuminate, 5-7-nerved, at first deflexed, ultimately erect. *Sepals* 2 cm. long, erect, ovate-lanceolate, acuminate, with spreading tips; their nerves, as also the ridges of the clavate ovary, dark reddish-brown on a pale green ground. *Petals* shorter than the sepals, lanceolate, acuminate, pale green with purple veins, midrib thickened on the back. *Lip* shorter than the petals, somewhat deflexed from a concave winged claw attached to the base of the column; apical portion ovate-acuminate, its sides towards the base erect and with a reflexed erose margin, with no convexity near the apex. *Column* 1·2 cm. long, stout, curved, narrowed towards the base. *Anther* 2-celled, cells parallel. *Pollinia* ovate-oblong, mealy. *Ovary* (in flower) 1·7 cm. long, its apex with conspicuous grandular projections between the ribs; *stigma* with an overlapping irregularly lobulate border.

Wetsern Himālaya: Tehri-Garhwál, on Nág Tiba, at elevations between 8,000 and 10,000 feet, *Gollan* (No. 2,062) and *Mackinnon's collector* (No. 23,000). The original specimens, discovered in 1881 by Mr. W. Gollan, after whom I have named this plant, were in too young a condition even for determining the genus. Its nearest ally is *A. alpina*, King and Pantling, a high-elevation Sikkim species. From the above it differs chiefly in the rhizome not being scaly, the bracts become erect as the flowers open, it has much shorter racemes, the lip is attached to the base of the column and does not form a pouch, the epichyle has no concavity at its apex, the colouring of the flowers is also very different.

10. Pogonia Mackinnoni Duthie, n. sp.

Tuber globose, annular and warted, about 1·2 cm. in diameter. *Leaf* and *scape* frequently from the same tuber, but not contemporaneous. *Leaf* about 5 cm. long and broad, cordate at the base, 7-lobed, terninal lobe acute, the others rounded, principal veins terminatiug at the end of each lobe, with many less conspicuous intermediate ones; *petiole*, 2·5 cm. long. Leaves from the flowering tubers much smaller. *Scape* 1-flowered, about 10 cm. long when in flower, elongatng till fruiting, enclosed by two or three rather loose tubular sheaths. *Flower* shortly pedicelled, spreading; *bract* erect, shorter than the cylindrical truncate ovary. *Sepals* spreading, linear-lanceolate, acuminate, 1·6 to 1·7 cm. long, light green blotched with reddish-brown outside. *Petals* very similar to the sepals, but a little shorter and not so acute at the apex. *Lip* shorter than the petals, oblong when spread out, strongly 3-nerved, white tinged with green towards the base; side-lobes erect, acute; terminal-lobe blotched with purple. *Column* slender, 7·8 m. long. *Pollinia* 2, narrowly clavate, connate below and without a gland.

Western Himālaya: near Mussoorie, at elevations between 4,500 and 6,000 feet, *P. W. Mackinnon*. Flowers during May and June.

Very similar in habit to *P. macroglossa*, King and Pantling, but the leaves are more distinctly lobed; the flowers are much smaller, and are spreading, not drooping. Leaves and fruiting scapes are sometimes found on the same tuber.

11. Herminium Mackinnoni Duthie, n. sp.

Whole plant upwards of 2·2 dm. high. *Tubers* narrowly oblong. Lower portion of the stem clothed with a few close-fitting tubular subacute sheaths. *Leaves* two, 12-14 cm. long by 1-2 cm. broad, oblong or linear-lanceolate, acuminate, with loosely amplexicaul tubular bases, 3-5-veined. *Spike* cylindric, rather broad, about 11 cm. long, many-flowered. *Flowers*, spreading, crowded, about 10 m. across. *Floral bract*, 5 m. long, broadly lanceolate, acuminate, a little shorter than the ovary. *Sepals* 3-4 m., ovate-oblong, acute, subterete, green. *Petals* as long as the sepals, linear-lanceolate, divergent, white. *Lip* trifid, a little longer than the petals, deflexed from near its base, white with a slight tinge of green, margins inflexed, lower portion very thick and with a small concavity at the base; side-lobes filiform, curved inwards; midlobe about half as long as the side-lobes, lanceolate, obtuse. *Anther-cells*, diverging below; *pollinia* obovate; *caudicles*, very short, the *glands* discoid, naked; *staminodes* large, spreading. *Stigmas* 2, transversely oblong and lying between the pollinia-glands and the concavity of the lip. *Ovary* about 6 m. long, ovate-oblong, beaked.

Western Himālaya: near Mussoorie, at about 6,500 feet, on oak trees, *P. W. Mackinnon*. Flowers in August.

A very distinct species, its nearest ally being *H. angustifolium*. It differs from the latter by its fewer much shorter and broader leaves, its shorter and broader flowering spike, white petals and lip, and with the mid-lobe of the latter much longer; the shape of the ovary is also very different.

12. Habenaria Elisabethæ Duthie, n. sp.

Height of plant up to 4·5 dm. *Bulbs* ovoid. *Leaves* 2-3, approximate towards the base of the stem, with a few lanceolate finely acuminate sheaths above and a few loose ones below them, 6·12 cm. long and 1 to 2 cm. broad, lanceolate, the upper acuminate, the lowest one acute or obtuse, amplexicaul at the base, midrib prominent beneath. *Spike* long and slender, sometimes up to 2·5 dm. *Flowers* sessiles, small, green, rather crowded, horizontal or deflexed. *Bracts* lanceolate, acuminate, about half as long as the ovary. *Sepals* erect, the dorsal one ovate, concave, the lateral ones obliquely ovate. *Petals* a little longer than the sepals, obliquely ovate, obtuse. *Lip* 3-cleft, fleshy, longer than the sepals, with a long concave claw; lateral lobes linear, spreading, gibbons at their basal edges; midlobe oblong, obtuse, not exceeding the lateral ones. *Spur* a short obovate sac, $\frac{1}{5}$ the length of the ovary. *Anther-cells* parallel. *Pollinia* obovate, curved, attached by a short caudicle to an oval gland. *Stigmatic processes* clavate. *Ovary* tapering upwards and curved.

WESTERN HIMĀLAYA: Song, at 8,000 ft. *Brandis*; near Simla, *Edgeworth*, *Lady E. Babington-Smith;* near Naini Tal, up to 8,000 feet, *Colonel Davidson;* Tehri-Garhwál, 7,000 to 10,000 feet., *Duthie* (524 and 22,990), *P. W. Mackinnon;* also at Mussoorie, between 6,000 and 7,000 feet, frequently as an epiphyte on oak trees.

Of the Himālayan species of *Habenaria* this plant appears to be most nearly related to *H. goodyeroides.* It differs principally in having much narrower and thinner leaves, and they are placed much lower down on the stem. The flowering spikes are longer and narrower; the flowers are much smaller and altogether green; the floral bracts are shorter, and the shape of the lip is very different. I have much pleasure in dedicating this species to Lady Elizabeth Babington-Smith, whose keen and practical interest in the botany of Simla during the Viceroyalty of her father, Lord Elgin, resulted in several interesting discoveries.

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

No. 13.

The present contribution carries these *Materials* to the end of the *Calycifloræ.* The orders included in it are *Datiscaceæ, Droseraceæ, Passifloraceæ, Begoniaceæ, Ficoideæ, Umbelliferæ,* and *Cornaceæ.* It has not been possible for me to prepare my account of the Calycifloral orders in the exact sequence followed in Hooker's Flora of British India; each order, however, bears the ordinal number given to it in that work. The species described in the present paper are 47 in number, and of these fourteen belonging to the genus *Begonia*, and two belonging to *Mastixia*, are new to science. I hope in future contributions to take up the orders belonging to the groups *Corollifloræ* and *Incompletæ.*

Order LXVII. DATISCACEÆ.

Trees or herbs. *Leaves* petioled, simple or pinnate; stipules 0. *Flowers* small, diœcious in the Indian species, clustered, racemed or panicled. Male: calyx-tube short, teeth 3–9; petals 0; stamens 4–25. Female: calyx-tube adnate to the ovary, lobes 3–8 short; petals 0; ovary 1-celled, open or closed at the vertex; styles lateral, alternating with as many parietal placentæ, simple or 2-partite; ovules very many, ascending or horizontal. *Capsule* coriaceous or membranous, opening at the vertex between the styles. *Seeds* very many, small, albuminous; embryo straight, radicle next the hilum.—Distrib. Species 4; natives of the Mediterranean, Central Asia, Java, and North-West America.

Tetrameles, R. Br.

A large tree. *Leaves* petioled, ovate, pubescent beneath at least on the nerves. *Flowers* diœcious, appearing before the leaves; males panicled, females in elongate racemes, clustered near the ends of the branchlets. Male: calyx-lobes short; teeth 4, ovate, one or two smaller teeth sometimes added; petals 0; stamens 4, opposite the calyx-teeth, inserted round a depressed disc; rudiment of the ovary 0 or quadrangular. Female: calyx-tube ovoid; teeth 4 short; petals 0; styles 4, short, stigmas simple somewhat club-shaped. *Capsule* ovoid, with 4 lines or slight ridges, membranous, opening at the top between the styles. *Seeds* very many, minute, flattened, ellipsoid, testa very lax and extending much beyond the nucleus as a loose membrane.

1. T. NUDIFLORA, R. Br. in Benn. Pl. Jav. Rar. 79, t. 17; A.DC. Prodr. XV. pt I. 411; Bedd. Fl. Sylv. t. 212; Brand. For. Fl. 245: Kurz For. Fl. 535; Clarke in Hook. f., Flor. Brit. Ind. II, 657. *T. Grahamiania*, Wight Ic. t. 1956; A.DC. l. c. *T. rufinervis*, Miq. Fl. Ind. Bat. I. pt. I. 726; A.DC. l.c. *Anictoclea Graham-iana*, Nimmo in Grah. Cat. Bomb. Pl. 252.—*Indeterminata*, Wall. Cat. 9045.

Andaman Islands; *Kurz.*—DISTRIB. Eastern Himālaya, Burma and Java.

Order LIV. DROSERACEÆ.

Herbs with large glandular hairs, exuding a viscid fluid. *Flowers* hermaphrodite, regular. *Petals* 5 hypogynous, rarely perigynous, thin, nerved, imbricate, marcescent, free or slightly united. *Stamens* 4 to 20, hypogynous or slightly perigynous; filaments free or slightly monadelphous, subulate or filiform: anthers 2-celled; disc none. *Ovary* free or adherent by its base to the calyx, globose or ovoid, 1-celled; *styles* 5, sometimes 3, simple or bifid; *stigmas* capitate; placentas parietal, equal in number to the styles; *ovules* and *seeds* numerous. *Capsule* membranous, 1-to 5-celled. *Seeds* with fleshy albumen; *embryo* cylindric or minute.—DISTRIB. Species about 100; in temperate and tropical regions generally, but absent from the Pacific Islands.

DROSERA, Linn.

Small perennial herbs. *Leaves* radical and rosulate, or cauline and alternate, bearing many large glandular viscid hairs, usually circinate in vernation, with scarious stipules adnate to the petiole, or exstipulate. *Calyx* persistent, free from the ovary, 4-to 8-partite or sepals free. *Petals* 4 to 8, hypogynous or very slightly perigynous, marcescent. *Stamens* equal in number to the petals, hypogynous or slightly perigynous. *Ovary* 1-celled; *styles* 2 to 5; *ovules* parietal, numerous. *Capsule* loculicidally 2-to 5-valved. *Seeds* numerous, obovoid-ellipsoid (in the Indian species); testa black, smooth, reticulate.—DISTRIB. Species about 90, cosmopolitan, but absent in Polynesia; Australia.

Leaves cuneate-spathulate, all radical ... ... 1 *D. Burmanni.*
Leaves peltate-lunate with long narrow petioles, some radical the others cauline ... ... 2 *D. peltata.*
Leaves linear, all cauline ... ... 3 *D. indica.*

1. DROSERA BURMANNI, Vahl Symb. III, 50. *Leaves* all radical, rosulate, cuneate-spathulate, ·5 to 1·5 in. long, stipules half as long as the petiole. Peduncles erect, 3 to 8 inches high, naked, glabrous. *Flowers* racemose, their pedicels glabrous, erect in fruit; calyx minutely papillose: styles 5, simple. Don, Prod. Fl. Nep. 212; DC. Prod. I, 318; Roxb. Fl. Ind., II, 113; Wall. Cat. 1242; Wight, Ill. t. 20; Wight, Ic.

944; W. & A. Prod. Fl. Penins. Ind. 34; Planch. in Ann. Sc. Nat. Ser. III. Vol. IX, 190; Miq. Fl. Ind. Bat., Vol. 1, pt. II, 120; Suppl. 160; Hf. & Th. in Journ. Linn. Soc. II., 82; Dalz. & Gibs. Fl. Bomb., 12; Kurz in Journ., As. Soc., Beng., 1876, pt. II, 310; Clarke in Hook. fil. Fl. Br. Ind. II, 424; Trimen, Fl. Ceyl. pt. II, 145.

Malacca: Province Wellesley, and probably in the other provinces.—Distrib. British India, Ceylon, the Malay Archipelago, China, Japan, Africa, Australia, up to elevations of 8,000 feet.

2. Drosera peltata, Sm. ex Willd. Sp. Pl. I, 1546. *Stem* erect, leafy, 3 to 12 in. high, simple or branched near the apex. *Leaves* sub-rosulate, also scattered and alternate on the stem, peltate-lunate, with very long glandular hairs, ·2 to ·25 in. broad (including the radiating hairs); the petiole much longer than the laminæ, very slender. *Racemes* 1 to 3 in. long, terminal or sub-terminal; flower-pedicels ·35 to ·75 in. long, glabrous. *Sepals* ovate, glabrous, erose or fimbrirate. *Styles* 3, fimbriate. *Seeds* as in *D. indica*, III. DC. Prod. I, 319; Sm. Exot. Bot., I, 41; Don Prod. Fl. Nep., 212; Wight. t., 20; W. & A. Prod. Fl. Penins. Ind., I, 34; Planch. in Ann. Sc. Nat. Ser. III, Vol. IX, 296; Kurz in Journ. As. Soc. Beng., 1876, pt. 2, 310; Clarke in Hook. fil. Fl. Br. Ind., II, 424; Trimen, Fl. Ceyl. pt. II, 146. *D. lunata*, Ham.: DC. Prod. 1, 319; Wall. Cat., 1243; Hook. Ic. Pl. 54; Planchon l.c., 296; Miq. Fl. Ind. Bat., II, Pt. 2, 120. *D. lunata*, *gracilis* et *D. foliosa*, Hook. fil. Journ. Linn. Soc., II, 82; 297, 298. *D. Lobbiana* Turcz. (fide Kurz).

Malacca, Singapore, and probably in some of the other provinces.—Distrib. Malay Archipelago, British India, and Australia.

3. Drosera indica, Linn. Sp. Pl. 282. *Stem* 2 to 12 in. long, decumbent, usually simple. *Leaves* alternate, scattered, 1 to 3 in. long, linear, not much broader than the glabrous petiole, very glandular-pubescent. *Racemes* 2 to 6 in. long, leaf-opposed; flower-pedicels ·35 to ·75 in. long, rusty-pubescent. *Sepals* lanceolate, minutely glandulose or sub-glabrous. *Styles* 3, bifid to the base. *Seeds* obovoid, much reticulate not scrobiculate. DC. Prod., I, 319; Roxb. Fl. Ind., II, 113; Wall. Cat., 1244; Wight Ill. t., 20; W. & A. Prod. Fl. Penins. Ind., 34: Planch. in Ann. Sc. Nat. Ser., III, Vol. IX, 209; Miq. Fl. Ind. Bat., Vol. I, Pt. 2, 120; Hf. & Th. in Journ. Linn. Soc. II, 82; Dalz. & Gibs. Fl. Bomb., 12; Kurz in Journ. As. Soc Beng., 1876, Pt. II, 310; Trimen Fl. Ceyl., Pt. II, 146; Clarke in Hook. fil. Fl. Br. Ind., II, 424. *D. Finlaysoniana*, Wall. Cat., 3752. *D. serpens*, Planch. l.c., 204.—Rheede, Hort. Malab., X, t. 20.

Malacca: Province Wellesley, and probably in the other provinces.—Distrib. British India, Ceylon, Malayan Archipelago, tropical Australia, and Africa.

Order LI. PASSIFLOREÆ.

Twining herbs or shrubs, rarely erect. *Leaves* alternate, stipulate, entire or lobed, penni- or palmi-nerved, frequently glandular beneath. *Petiole* usually bearing glands. *Stipules* foliaceous or minute, *Tendrils* axillary or 0. *Inflorescence* axillary, cymose, sometimes with one or more branches cirrhose, rarely flowers solitary. *Bracteoles* 3, minute and scattered, or foliaceous and forming an epicalyx, rarely 0. *Flowers* regular, unisexual, or bisexual. *Calyx* tubular at the base, fleshy, sub-coriaceous or membranous; segments imbricate, 5. *Petals* 0 or as many as the calyx-lobes, springing from the tube of the calyx, membranous or fleshy, imbricate, marcescent. *Corona* of one or more rows, filamentous or membranous or both, arising from various portions of the calyx-tube, rarely 0; basilar corona urceolate or cup-shaped, surrounding the base of the andrœcium, sometimes represented by five separate glands of the disc; rarely 0. *Stamens* 5, in a tube or free to the base, perigynous; anthers oblong, 2-celled, basi- or dorsi-fixed, dehiscing laterally or introsely. *Ovary* superior, on a gynophore or subsessile, 1-celled with 3 parietal placentas, rudimentary or absent in the male flowers. *Styles* 1 or 3; stigmas reniform, capitate or flattened. *Ovules* numerous, pendulous, anatropus; funicle expanded into a cup-shaped arillus. *Fruit* baccate or capsular. *Seeds* numerous, ovoid or flattened, often pitted, covered with a fleshy arillus; albumen fleshy, rarely scanty; embryo straight, cotyledons flat leafy, radicle short terete.—DISTRIB.: Chiefly tropical; most numerous in South America. Genera about 18; species about 320.

Erect shrubs, without tendrils ... ... 1 PAROPSIA.
Scandent, with tendrils:—
    Fruit pulpy, indehiscent; flowers large ... ... 2 PASSIFLORA.
    Fruit dehiscent; flowers small ... ... 3 ADENIA.

1. PAROPSIA, Noronh.

Shrubs. *Leaves* simple. *Flowers* in dense axillary cymes. *Calyx-tube* short; limb 5-parted. *Petals* 5, springing from the base of the calyx-tube. *Corona* of fine threads springing from the tube of the calyx and more or less divided into five phalanges. *Gynophore* short; filaments flat; anthers oblong. *Ovary* subglobose. *Style* short, dividing into three branches; stigmas reniform-capitate. *Fruit* capsular.—DISTRIB. Species 4 or 5, natives of tropical Africa and Malaya.

P. VARECIFORMIS, Mast. in Trans. Linn. Soc., XXVII, 639. A shrub or small tree. *Leaves* subcoriaceous, oblong or oblong-lanceolate, acute or shortly acuminate, the base cuneate, the edges entire or (rarely) minutely serrate; both surfaces glabrous except the glandular puberulous midrib and nerves; the lower with numerous minute adpressed scales; main 6 or 7 pairs spreading, curved; length 2·5 to 5·25 in., breadth 1 to 1·75 in., petiole ·1 to ·2in. *Flowers* about ·5 in. in diam., on short, rusty-tomentose pedicels ·15 in. long. *Calyx* campanulate, leathery, adpressed-villose outside like the pedicels, the lobes much longer than the tube, unequal, oblong, subacute. *Petals* oblanceolate, smaller than the calyx-lobes. *Corona* single, very short, lanate, in 5 phalanges. *Stamens* 5. *Gynophore* shorter than the corona; ovary villose. *Fruit* ovoid or sub-globose, ·5 to ·7 in. across. Masters in Fl. Br. Ind., II, 600. *P. malayana*, Planch. ex Masters l.c. *Trichodia vareciformis*, Griff. Notul., IV, 571.

MALACCA: Griffith, Manigay, and others. PERAK: Scortechini, King's Collector; a common plant.

I can find no constant characters to separate the two species into which this plant has been divided in the Flora of British India and therefore unite them under the oldest specific name.

2. PASSIFLORA, Linn.

Twining shrubs. *Leaves* simple or palmilobed, usually with glands on the under surface and on the petiole; stipules thread-like or leafy. *Flowers* pedunculate; often involucrate; peduncles simple or cymose. *Bracteoles* 3, small, scattered. *Calyx-tube* fleshy, limb 5-lobed. *Petals* 5, springing from the throat of the calyx. *Corona* of one or more rows of fine threads springing from the throat of the calyx-tube and of one or more membranous folds arising lower down. *Gynophore* surrounded at the base by a shallow membranous cup or basilar corona; filaments 5, flat; anthers oblong, 2-celled, dorsifixed; pollen-grains reticulate on the surface. *Ovary* 1-celled; styles 3, stigmas reniform-capitate. *Fruit* baccate. *Seeds* arillate.—DISTRIB. A genus of about 250 species which are most numerous in tropical and sub-tropical America.

PASSIFLORA HORSFIELDI, Blume, Rumphia, I, 170, t. 52. A slender climber; young branches slightly quadrangular, slender, striate, almost glabrous. *Leaves* membranous, oval or oblong-ovate, subacute sometimes retuse, the base rounded and minutely emarginate; upper surface pale-brown when dry, shining, glabrous, minutely reticulate; lower surface when young sometimes with sparse deciduous hairs, but more usually glabrous from the first, always dull and whitish and with a few flat dark-coloured glands, the transverse veins and reticulations very distinct; main-nerves about 5 pairs, ascending, faint; length 4 to 6 in.; breadth 2·5 to 3·25 in.; petiole ·6 to ·9 in., with two oval flat glands near its middle. *Inflorescence* shorter than the leaves, axillary, about 5-flowered, the flowers 1·25 to 1·5 in. in diam., on slender long pedicels, white tinged with green; corona double, the outer with long erect filamentous segments; the inner about one-fourth as long, its segments few, lanceolate, incurved. *Stamens* 5; the filaments spreading, clavate; anthers dorsifixed, oblong. *Ovary* ovoid, hirsute, the gynophore nearly as long as the outer corona; styles long, recurved. *Fruit* subglobular, ·75 in. in diam. *Disemma Horsfieldii*, Miq., Fl. Ind. Bat., I, Pt. 1, 700.

PERAK; *Scortechini* 655, 2,192; *King's Collector* 3,078, 4,104, 5,936, DISTRIB.—Java and Madura.

This is apparently the only species really indigenous in the Malayan Peninsula. There are, however, four American species which have escaped from cultivation. These are:—

P. suberosa, L. A small species with diversely shaped leaves, flowers little more than half-an-inch in diameter and ovoid fruits about the same in length.

P. foetida, L. A species with variable leaves, emarginate at the base, often 3-lobed; recognisable at once by its foetid flowers and 3-leaved fimbriate involucre.

P. edulis, Sims. With deeply 3-lobed serrate leaves, flowers more than an inch across; and globular edible fruit. This is often cultivated under the name of *Granadilla*.

P. quadrangularis, L. A large species with boldly 4-angled stems; handsome fragrant, purple flowers banded with white, 3 to 5 in. across; broadly ovate leaves and large oblique ovate-oblong stipules.

P. laurifolia, L. A more slender species than the last and with smaller flowers of similar colour, with a large 3-leaved or 3-partite involucre of broad segments, and of long filiform stipules; the leaves broadly oblong, entire and shortly apiculate.

3. ADENIA, Försk.

Scandent. *Leaves* entire or palmilobed, usually with two or more flat circular glands on the under surface and with similar glands at the apex of the petiole. *Cymes* axillary, few or many-flowered, on long peduncles, one or more of which is sterile and tendril-like. MALE FLOWER: *Calyx* tubular or bell-shaped; limb 5-lobed, lobes leathery, imbricate. *Petals* 5, free, membranous, 1-nerved, springing from the calyx-tube. *Corona* a ring of threads arising from near the base of the calyx-tube, or wanting. *Glands of the disc* 5, opposite the sepals, strap-shaped or capitate. *Andrœcium* cup-shaped, membranous beneath; filaments 5, linear-subulate; anthers linear-oblong, 2-celled. *Ovary* rudimentary or 0. FEMALE FLOWER: *Calyx* and *corolla* as in the male. *Corona* a membranous fold, springing from near the base of the calyx-tube, or none. *Glands of the disc* 5, strap-shaped, capitate, opposite the sepals. *Staminodes* 5, forming a membranous cup surrounding the base of the ovary, above dividing into barren filaments. *Ovary* globose or elliptic, sessile or stalked; style cylindrical or none; stigmas 3, capitate or flat and dilated. *Fruit* capsular, 3-valved. *Seeds* numerous, attached by long funicles to parietal placentas.—DISTRIB. About 40 species, natives of the tropics of the Old World.

NOTE.—The name used for this genus in Hooker's Flora of British India is *Modecca*, Lamk. which dates from 1797. Following Engler, I have here used Förskal's name *Adenia*, which dates from 1775.

Leaves always deeply 3-lobed ... ... 1 *A. trilobata.*
Leaves entire :—
  Leaves minutely peltate at the base; lobes of calyx long, narrow and reflexed ... ... 2 *A. nicobarica.*
  Leaves cordate at the base :—
    Base broadly and deeply cordate, main-nerves radiating from the base: flowering peduncles up to 6 in. long ... ... 3 *A. cardiophylla.*
    Base slightly cordate: main-nerves pinnate: flowering peduncles less than 2 in. long ... 4 *A. populifolia* var. *pentamera.*
  Leaves not cordate at the base or only occasionally very slightly so: main-nerves usually 2 sometimes 3 pairs :—
    Nerves and reticulations of leaves distinct ... 5 *A. acuminata.*
    Nerves and reticulations of leaves invisible, the lower surface of the leaves whitish ... ... 6 *A. singaporeana.*

1. ADENIA TRILOBATA, Engl. Jahrb., XIV, 375. Many feet in length, glabrous, the bark on the old shoots cinereous, on the young smooth green. *Leaves* remote, membranous, broadly cordate at the base, deeply 3-lobed; the lobes lanceolate, the two outer often auriculate at the base, the sinuses wide, rounded, and each bearing a small gland; main-nerves 5, palmate; the lateral nerves and the reticulations few; length 6 to 9 in.; width 4·5 to 6·5 in.; *petioles* from half as long to nearly as long as the leaf-blades, terete, smooth, not enlarged at the base, the apex with two conical recurved glands. *Peduncles* slender, smooth, terete, axillary, longer than the petioles, umbellulately cymose; flowers few, ·3 to ·5 in. long, the females somewhat longer than the males. *Calyx* tubular, the lobes short, oblong, subacute. *Petals* narrowly oblong, inserted near the base of the calyx-tube. *Filaments* united into a tube springing from the fundus of the calyx; *anthers* linear-oblong, abruptly acute, the connective produced into a minute point. *Glands* narrowly oblong, blunt, incurved. *Staminodes* in female flower united into a membranous cup. *Rudimentary* ovary in male flower trifid. *Fruit* oblong, scarlet, from 2 to 2·5 in. long when ripe, and 1·5 in. in diam. *Seeds* compressed, sub-obcordate or sub-rotund, scrobiculate, the arillus thin, clear. *Modecca trilobata*, Roxb. Hort. Beng., 49; Roxb. Corom. Plant. III, t. 297; Fl Ind., III, 133; Wall. Cat., 1234; Kurz, in Journ. As. Soc., Beng., 1877, II, 95; Masters in Hook. fil. Fl. Br. Ind., II, 602.

ANDAMAN ISLANDS; common.—DISTRIB. Northern parts of British India and Burma.

2. ADENIA NICOBARICA, King. Slender and slightly branched, glabrous *Stems* minutely sulcate, thin, wiry. *Leaves* membranous,

entire, narrowly elliptic-oblong or lanceolate; the base rounded and minutely bi-glandular, slightly peltate; the apex acuminate, rarely abruptly acute; both surfaces shining; main-nerves only about 4 pairs, interarching broadly and far from the edge; intermediate nerves horizontal; reticulations wide; length 2·5 to 4·5 in.; width ·6 to 1·8 in.; petiole ·4 to ·8 in., compressed, not enlarged at the base. *Peduncles* longer than the petioles but much shorter than the leaves, bearing a filiform tendril and only one or two flowers. *Flowers* rather less than ·5 in. long, green. FEMALE FLOWER unknown. MALE FLOWER ·4 to ·5 in. long *Calyx* campanulate, deeply divided into 5 linear-oblong, subacute, much reflexed lobes. *Petals* shorter than the calyx and inserted into it below the middle, membranous, reticulate, oblanceolate, their apices truncate and broad. *Glands* short, oblong, truncate. *Anthers* about equal to the petals, oblong, obtuse, cordate at the base; the filaments united into a wide tube. *Fruit* elliptic-oblong, tapered to each end, from 1·5 to 2·3 in. long, and ·75 in. in diam., reddish when dry, smooth. *Seeds* much compressed, sub-orbicular, with a few shallow pits in the centre, and a row of short depressed radiating grooves round the edge, the aril very thin. *Modecca nicobarica*, Kurz in Trimen's Journ. Bot. for 1875, p. 327; Mast. in Hook. fil. Fl. Br. Ind. II, 603.

ANDAMAN and NICOBAR ISLANDS; not uncommon. MALACCA; *Maingay* (Kew Distrib.) 670. PERAK; *Wray* 651, 2781; *King's Collector* 2439; *Scortechini* 633; *Ridley* 10280. PENANG; *Curtis* 1521.

A species distinguished by its entire oblong leaves minutely peltate at the base, by its long narrow reflexed calyx-lobes, and by its rotund seeds with *shallow* pits in the centre and radiating grooves at the edges.

3. ADENIA CARDIOPHYLLA, Engl. in Jahrb. XIV, 376. Rather stout, glabrous. *Stems* almost terete. *Leaves* membranous, remote, broadly ovate, rotund-ovate, sometimes almost sub-reniform, the base deeply cordate, the auricles rounded; the apex with a short triangular point; both surfaces smooth; the lower with numerous distinct reticulations; main-nerves about 9, radiating from the base; the secondary nerves sub-horizontal, numerous; length 5 to 9 in.; breadth 3·5 to 7·5 in.; petiole 2 to 4·5 in. long, not thickened at the base but with 2 sessile glands at the apex. *Peduncles* 4 to 6 in. long, longer than the petioles, with several widely-spreading cymose branches and usually one tendril. MALE FLOWER narrowly ovoid, ·2 in. long. *Calyx* leathery, spotted inside, the mouth with blunt short teeth. *Petals* thin, broadly oblong-lanceolate, sub-acute, spotted, their apices level with those of the teeth of the calyx, their bases inserted about the middle of the calyx-tube. *Glands* short, oblong-cuneiform. *Anthers* linear-ovate, acute, the filaments united into a tube inserted into the fundus of the calyx. FEMALE FLOWER twice as

long as the male, tubular. *Calyx* as in the male, the teeth recurved. *Petals* as in the male, their apices entire or minutely serrulate. *Ovary* ovoid, on a short gynophore, the stigma peltate 3-lobed. *Fruit* broadly fusiform, 2 to 2·5 in. long and 1 in. in diam. at the middle, dirty-yellowish when dry. *Seeds* compressed, sub-rotund, keeled, with prominent sharply edged deep pits in the centre and a row of elongate pits round the edges. *Modecca cardiophylla*, Mast. in Hook. fil. Fl. Br. Ind. II, 602. *Modecca cordifolia*, Kurz (not of Blume) in Journ. As. Soc. Beng., 1876, II, 132: Masters in Hook. fil. Fl. Br. Ind. II, 602. *M. heterophylla*, Kurz, (not of Blume) Andam. Report Append. A., 39.

Andaman Islands; very common. Nicobar and Great Coco Islands; *Prain.*—Distrib. Cambodia, Khasia Hills and Eastern Bengal, tropical Eastern Himalaya.

A species well marked by its deeply cordate leaves much reticulate on the lower surface, widely-spreading cymes and sub-rotund cancellate pitted seeds. Some confusion in nomenclature has arisen from the fact that Kurz, without having seen authentic specimens of Blume's two species *Modecca cordifolia* and *M. heterophylla* referred this plant to both of them. Dr. Masters perpetuated part of Kurz's mistake by accepting his view as to the identity of this Andaman and Nicobar plant with *M. cordifolia*, Blume, whereas the whole of the Andaman material (greatly increased in bulk since he wrote) really belongs to his own species *M. cardiophylla*. This view was first expressed by Dr. D. Prain, Superintendent of the Calcutta Garden in a note on one of the specimens in the Herbarium there.

4. Adenia populifolia, Engl. in Jahrb. XIV, 376, var. pentamera King. A slender and often very extensive climber (often 150 feet) *Stems* slender, smooth, terete. *Leaves* thinly coriaceous, oblong-ovate, gradually narrowed to the acute or sub-acute apex, the base slightly cordate; both surfaces smooth, the nerves and reticulations little prominent when dry: main-nerves 5 to 7 pairs, curved, spreading, rather faint; length 3 to 5 in.; breadth 1·75 to 2·5 in.; petiole ·75 to 1·25 in., its apex bearing 2 large cup-shaped glands conjoined by their backs. *Peduncles* shorter than the leaves with 2 slender spreading branches and a single rather stout tendril. *Flowers* not numerous, on slender unequal pedicels, some of them ·75 in. long. Male flower ·2 in. long, narrowly fusiform; the calyx with 5 short oblong blunt lobes. *Petals* springing from the calyx-tube just below its lobes, and like them but narrower. *Anthers* 5, broadly linear, the connective slightly produced beyond the apex, shortly sagittate at the base; filaments joined into a tube and inserted into the fundus of the calyx: rudimentay ovary linear. Female flower shorter than the male (only ·15 in. long) and not so slender but with similar calyx-lobes and petals. *Ovary* oblong, crowned by three erect oblong rather large stigmas. *Fruit* double fusiform, deep red when ripe, 2·5 to 3 in. long and from ·75 to 1 in. in

diam. *Seeds* broadly oblong, compressed, foveolate with a row of short radiating grooves round the edges. *Modecca populifolia*, Blume Rumphia, 168 t. 50. *M. populifolia*, Bl.: Masters in Hook. fil. Fl. Br. Ind. II, 603 (*amongst imperfectly known species*).

MALACCA; *Maingay* (K.D.) 668. PERAK; *Scortechini* 1609; *King's Collector*, many Nos.

Blume describes and figures his *Modecca populifolia* plant as tetramerous and as this exactly agrees both with his text and figure, except in being pentamerous, I regard it as a variety. There are in Herb. Calcutta specimens from Perak without flower or fruit, of what appears to be a 3-lobed form of this.

5. ADENIA ACUMINATA, King. *Stems* slender, striate. *Leaves* subcoriaceous, ovate-oblong or rotund-ovate, the base usually narrowed but sometimes sub-cordate always bi-glandular; the apex shortly and abruptly acuminate; the secondary nerves and reticulations distinct on both surfaces when dry but especially on the lower; main-nerves 2 or sometimes 3 pairs, originating from the midrib near its base, all prominent: length 4 to 6 in.; breadth 2 to 4 in.; petiole ·75 to 1·35 in. long. *Peduncles* usually nearly as long as the leaves but sometimes much shorter, bearing a few short many-flowered spreading branches at the apex and often a short tendril. MALE FLOWER narrowly ovoid, ·25 to ·3 in. long. *Calyx* leathery with 5 short ovate-lanceolate lobes. *Petals* thick, oblong, acute, springing from the calyx-tube above the middle. *Glands* small, lanceolate. *Anthers* linear, sub-acute, erect, the filaments short. FEMALE FLOWER larger than the males (·4 in. long), tubular, swollen in the lower third. *Calyx-lobes* very short, broad, blunt, incurved. *Petals* narrowly oblong, sub-acute, incurved. *Ovary* fusiform. *Fruit* fusiform, dull, reddish when dry, about 2 in. long and ·75 in. in diam. at the middle. *Seeds* compressed, subrotund, boldly pitted in the centre and with a marginal row of radiating grooves on each side, slightly oblique and pointed at the base. *Modecca acuminata*, Blume Bijdr. 940; Miq. Fl. Ind. Bat. I, Pt. 1,702. *M. singaporeana*, Mast. in Hook. fil. Fl. Br. Ind. II, 601 (*in part*).

PERAK; *Scortechini* 254, 459, 629; *Wray* 498, 1745; *Ridley* 9462, 9632; *King's Collector*, many numbers. SELANGOR; *Ridley* 7288. MALACCA; *Goodrich* 1340.—DISTRIB.; Java, Sumatra, (*Beccari* P.S. 743).

6. ADENIA SINGAPOREANA, Engl. in Jahrb. XIV, 376. *Stems* slender, striate. *Leaves* subcoriaceous, oblong to ovate-oblong, cuneate and bi-glandular at the base, the apex sub-acute or shortly and bluntly acuminate; both surfaces smooth, opaque, the lower very pale, the secondary nerves and reticulations very indistinct on both; main-nerves 3 pairs, the lower two pairs bold and ascending, the upper pair less bold and spreading; length 3·5 to 4·5 in.; breadth 1·75 to 2·25 in.; petiole

·5 to 1·5 in. long. *Peduncles* about as long as the petiole, few-flowered. *Male flowers* (*fide* Masters) "·25 in. long, elongate, fusiform. *Calyx* leathery, shortly 5-lobed; lobes ovate, connivent (? always). *Petals* thick, leathery, oblong-acute, springing from the calyx-tube just beneath the throat. *Corona* none (?). *Glands* of the disc 5, small, oblong, at the base of the calyx-tube, opposite to its lobes. *Stamens* 5; anthers sub-sessile, erect, linear; connective long, thread-like. *Rudimentary ovary* fusiform. *Fruit* 2 in. long, glabrous, fusiform." *Seeds* compressed, sub-ovoid, obliquely contracted to a short podosperm, the centre boldly tubercled, the edges with a row of broad grooves the tubercles between which on the extreme margin are bold and some of them black. *Passiflora singaporeana*, Wall. Cat. 1232. *Modecca singaporeana*, Masters in Hook. fil. Fl. Br. Ind. II, 601.

SINGAPORE; *Wallich*. JOHORE; *King*. MALACCA; *Maingay* (K.D.) 667.—DISTRIB. Java.

A species badly represented in collections and misunderstood. It is based on the plant collected by Wallich at Singapore and issued by him under his Cat. No. 1232 and named *Passiflora singaporeana*. With this agree absolutely a plant collected by Mr. Hullett and myself at Jaffaria (in Johore) also some specimens collected by Mr. H. O. Forbes in the Preanger in Java (*Herb. Forbes* 565). Maingay collected at Malacca six specimens of a *Modecca* all of which in Herb. Kew. are named *M. singaporeana*. In my opinion five of these belong to *M. acuminata*, Bl. I have seen no flowers of *M. singapo eana* and the account of them given above is copied verbatim from Masters. The leaves are very opaque and of a dull pale colour beneath, and the nerves are very faint. The fruit is slightly shorter than that of *M. acuminata*, Bl. of which species this is I fear little more than a form.

Order LII. BEGONIACEÆ.

Succulent herbs or undershrubs; stem often rhizomatous or tuberous. *Leaves* alternate (sometimes falsely whorled), more or less unequal-sided, entire, toothed or lobed; stipules 2, free, frequently deciduous. *Peduncles* axillary, dichotomously cymose, the branches and bracts at their divisions generally opposite. *Flowers* white rose or yellow, showy, sometimes small, monœcious. MALE: perianth (of the only Indian genus) of 2 outer valvate opposite sepaloid segments, and 2-0 inner smaller segments; stamens indefinite often very many, free or monadelphous, anthers narrowly obovoid. FEMALE: perianth (of the only Indian genus) of 5-2 segments. *Ovary* inferior (in *Hildebrandia* half-superior), 2-3-4-celled; placentas vertical, axile (at the time of æstivation), divided or simple; styles 2-4, free or combined at the base, stigmas branched or tortuous; ovules very many. *Fruit* capsular, more rarely succulent, often winged, variously dehiscing or irregularly breaking up. *Seeds* very many, minute, globose or narrow-cylindric, testa reticulated: albumen very scanty or 0.—DISTRIB. Species 400 (of which 398 belong to the genus *Begonia*), in all tropical moist countries; not yet met with in Australia.

1. BEGONIA, Linn.

Characters of the Order.

GROUP I. Capsule 3-celled, with 3 nearly equal narrow vertically oblong wings, dehiscing by 2 oblong valves on each face between the wings :—

Small acaulescent herbs, only a few inches in height: leaves rotund-ovate slightly oblique ... ... 1. *B. Forbesii.*

Herbs with stems 2 or 3 feet high; leaves obliquely ovate-oblong or ovate-lanceolate, the base cordate and very unequal-sided :—

Male flowers ·2 to ·3 in. across ... ... 2. *B. isoptera.*

Male flowers 1·5 in. across ... ... 3. *B. isopteroidea.*

GROUP II. Capsule 2-celled, triquetrous, with 3 short unequal wings, dehiscing irregularly by the breaking up of the fragile faces between the wings; anthers obovoid, often emarginate at the apex :—

Caulescent; rootstock tuberous :—

Upper surfaces of leaves with numerous adpressed white stellate hairs; bracts of inflorescence ·05 to ·1 in. long, densely adpressed-pubescent; male flowers ·2 to ·25 in. in diam.; capsules about 3 in. broad ... 4. *B. sinuata.*

Upper surfaces of leaves scantily adpressed hairy; bracts ·35 to ·5 in. long, glabrous; male flowers ·5 in. and capsules ·6 in. across ... ... 5. *B. andamensis.*

Leaves glabrous ... ... 6. *B. debilis.*

Acaulescent; rhizome creeping :—

Leaves rather thick (when dry), rotund-reniform, deeply cordate the basal lobes overlapping, the nerves beneath and the petioles rusty-tomentose ... 7. *B. thaipingensis.*

Leaves very thin (when dry), obliquely ovate-reniform, quite glabrous except for a few sparse hairs on the under surface of the nerves; petioles glabrous ... 8. *B. guttata.*

GROUP III. Capsule 2-celled, triquetrous with 3 wings one of which is much elongated transversely so as greatly to exceed the other two, dehiscing by the rupture of the stout membranous faces between the wings :—

Anthers cuneiform-oblong; leaves peltate ... ... 9. *B. Hasskarlii.*

Anthers linear-oblong or linear; leaves not peltate :—

Leaves not at all or very little oblique even at the base, not cordate; petioles very long :—

Leaves with coarse hairs on both surfaces :—

Leaves narrowly lanceolate ... ... 10. *B. Scortechinii.*

Leaves ovate-lanceolate ... ... 11. *B. Kunstleriana.*

Leaves glabrous :—
Leaves broadly elliptic-ovate, equal-sided at the base ... 12. *B. Herveyana.*
Leaves ovate-lanceolate, unequal-sided especially at the base ... ... 13. *B. perakensis.*
Leaves very oblique, ovate to reniform, obliquely cordate at the base :—
Leaves glabrous even on the nerves :—
Male flowers less than 1 in. across ... ... 14. *B. paupercula.*
Male flowers about 1·5 in. across ... ... 15. *B. venusta.*
Leaves glabrous, but the nerves hairy; male flower 2 in. across ... ... 16. *B. megapteroidea.*
Leaves with a few coarse compressed rusty-pubescent hairs on both surfaces; nerves beneath, petioles and also peduncles rusty-pubescent; male flowers ·8 in. across ... ... 17. *B. Maxwelliana.*
Upper surfaces of leaves papillose and bearing coarse hairs :—
Acaulescent; petiole much longer than the lamina 18. *B. praeclara.*
Stems 3 feet high; petiole shorter than the blade 19. *B. Lowiana.*

1. Begonia Forbesii, King n. sp. A small plant a few inches high with densely rusty-villose rhizome. *Leaves* rotund-ovate shortly apiculate, sometimes blunt, the base slightly cordate, the edges subentire or remotely denticulate; upper surface glabrous: the lower with numerous white scales and a few coarse hairs on the nerves near their bases: main-nerves 9, radiating from the base, inconspicuous; length 1·25 to 2·25 in.; breadth 1 to 2 in.; petiole 1·5 to 3 in.; stipules lanceolate, villous externally, ·3 in. long. *Peduncles* as long as or longer than the leaves, slender, glabrous, bearing a solitary flower at the apex, or 2-branched and bearing 2 to 5 flowers; bracts absent on the lower part of the peduncle, in pairs in its upper part, small, obovate-oblong. *Flowers* pink, their pedicels red. Male; *sepals* 2, oblong, blunt, ·15 in. long; *petals* 2, similar but smaller; *stamens* numerous; *anthers* obovate, with emarginate apices, filaments short. Females; *perianth* of 4 unequal pieces, the outermost rotund-ovate: the inner oblong. *Styles* 3, thick, the stigmas large, flattened, rotund. *Capsule* 3-celled, opening on each face; the wings subequal, spreading, triangular, blunt.

Perak; *Wray* 2476.—Distrib. Sumatra, *Forbes* 2666.

2. Begonia isoptera, Dry. in Smith's Ic. 43. Caulescent: three feet high, nearly glabrous; stem and branches slender. *Leaves* obliquely ovate-oblong or ovate-lanceolate, shortly acuminate, the base cordate, the sides very unequal; edges remotely and usually coarsely dentate; upper surface of leaves quite glabrous, the lower minutely scaly; main-nerves mostly radiating from the base, branched, prominent; length 3·5 to 6 in.; breadth 1·5 to 3 in.; petioles slender, varying from ·5 to

2·25 in. in length: *stipules* lanceolate or oblong, ·75 in. long. *Inflorescence* leaf-opposed, shorter than the leaves, slender; the female flowers near its base, the male on short branches on its upper half. MALES ·2 to ·3 in. across; *sepals* 2, rotund; petals 0; *stamens* numerous, broadly oblong or obovate, minutely apiculate; filaments short. FEMALE *perianth*-segments 5. *Styles* three, bifid, the arms twisted. *Capsule* 3-celled, about ·8 in. long and equally broad, dehiscing by two slits on each face, the three wings equal, narrow, oblong, ·25 in. wide. Dry. in Trans. Linn. Soc. I, 160. *B. repanda*, Bl. Enum. Pl. Jav. I, 97. *Diploclinium repandum*, Klo. Begon. 72. *Begonia Wrayi,* Hems. in Journ. Bot. for 1887, 203.

PERAK; *Scortechini* and *King's Collector*, many numbers. MALACCA; *Hervey*. SELANGOR; *Ridley* 8589. PAHANG; *Ridley* 2246. NEGRI SEMBALAN; *Ridley* 10028. PENANG; *Curtis* 7094.—DISTRIB. Sumatra, Java.

B. bombycina, Bl. (Enum. Pl. Jav. 97) is possibly identical with this; it has been reduced here by De Candolle and part of it is no doubt so reducible. Under *B. bombycina* however have been distributed specimens of an allied species with larger flowers in short spreading cymes. Which of the two plants Blume intended as his *B. bombycina*, it is impossible from his short description and in the absence of authentic specimens to determine.

3. BEGONIA ISOPTEROIDEA, King n. sp. Caulescent, 3 feet high, glabrous. *Leaves* thin, very obliquely ovate-lanceolate acuminate; the base acute on one side of the petiole but with a broad round auricle on the other, the edges remotely lobulate-dentate; lower surface with very minute white scales; main-nerves 7, radiating from the base, rather prominent beneath; length 3·5 to 4·5 in.; breadth 1·2 to 1·5 in.; petioles unequal, 2 to 3·5 in long. *Stipules* broadly lanceolate, acute, ·5 to ·75 in. long. *Peduncles* slender, axillary, about an inch long and bearing about two flowers on long slender pedicels and one sub-sessile. *Flowers* pink, large. MALES; *sepals* 2, rotund-oblong, blunt, ·75 in. long; *petals* 2 similar but only ·5 in. long; *stamens* inserted on an elongate anthophore, the anthers quadrate, 2-groved, truncate, only about half as long as the slender filaments. FEMALES nearly as large as the males; *style* short, thick, divided into 3 slender, bifid spiral spreading branches. *Capsules* about ·75 in. in length and breadth, 3-celled, its wings narrow oblong, thin, membranous, the posterior narrower than the lateral.

PERAK; on Gunong Brumban, elevation 5,000 feet; *Wray* 1548.

A species in leaves capsules and habit resembling *B. isoptera*, but with much larger flowers.

4. BEGONIA SINUATA, Wall. Cat. 3680. Shortly caulescent (from 2·5 to 12 inches high) the rootstock tuberous. *Leaves* either broadly

reniform and blunt, or sometimes with a short broad abrupt apiculus, the basal sinus deep and the edges wavy and minutely denticulate or crenate; or reniform-cordate, gradually tapered to the sub-acute apex, the margins slightly lobulate-dentate, the lobes denticulate, the basal sinus small: length of the reniform over 4 to 6 in.; breadth 5 to 8 in., of the ovate-reniform 1·5 to 3 in.; breadth 1 to 3 in.; petioles of the radical leaves 1 to 3 in.; of the cauline ·5 to 2·5 in.; both surfaces with numerous adpressed white stellate hairs, the lower with small oblong white scales also; main-nerves 7 to 11, radiating from the base, prominent on the lower surface; petioles unequal, ·5 to 3 in. long, pubescent. *Stipules* small, oblong-lanceolate, slightly oblique, blunt, glabrous. *Inflorescence* 3 to 8 inches long, sparsely stellate-puberulous; the peduncle very slender; branches few, short, filiform, few-flowered; bracts minute (·05 to ·1 in. long) bluntly lanceolate, rather densely adpressed-pubescent externally, the upper in whorls of three. *Flowers* small, pink, glabrous. MALES about ·2 to ·25 in. in diam.: *sepals* 2, roundish; *petals* 2, narrower, obovate; *stamens* about 20, monadelphous; anthers obovoid, connective not produced. FEMALE *perianth*-segments 5, the inner gradually smaller. *Styles* 2, combined for half their length, *stigmas* lunate. *Capsule* about ·3 in. broad and slightly longer, the posterior wing the largest. *Seeds* ovoid, shining, brown, deeply pitted. A. DC. Prod. XV, Pt. I, 354; Kurz in Journ. As. Soc. Beng., 1877, Pt. II, 108; Clarke in Hook. fil. Fl. Br. Ind. II, 650. *Diploclinium biloculare*, Wight Ic. 1814. *Begonia guttata*, *elongata* et *subrotunda*, Wall. Cat. 3671 B (*not* A), 6291, 6293.

PENANG; *Wallich*; *Phillips*; *King's Collector* 2269, 4860; *Curtis* 390, 481, 3098; *Ridley* 9229. MALACCA; *Maingay* (K.D.) 674. PERAK; *King's Collector* 4971.—DISTRIB. BURMA; *Griffith*, *Parish*.

5. BEGONIA ANDAMENSIS, Parish ex Clarke in Hook. fil. Fl. Br. Ind. II, 650. Like the reniform-leaved form of *B. sinuata*, but the hairs on the surfaces of the leaves scanty: the inflorescence usually longer and its peduncle and branches much stouter; the bracts glabrous, longer (·35 to ·5 in.) and blunter and the male flowers (·5 in. across) and capsules (·6 in. across) longer and more numerous than those of *B. sinuata*.

ANDAMAN ISLANDS; *Parish*; *King's Collector*.—DISTRIB. Burma.

This ought probably to be regarded as a variety of *B. sinuata*. Actual specimens of the two look more different than written descriptions lead one to suppose; I therefore retain this as a species.

6. BEGONIA DEBILIS, King n. sp. A slender weak herb, about 6 to 8 inches high, caulescent. *Leaves* thin, narrowly reniform, blunt or sub-acute; the base unequal, rounded at both sides but one auriculate and

much longer; edges sub-entire or slightly remotely and obscurely crenate; breadth 1·5 to 3 in.; length (from base of largest lobe to apex) 3·5 to 7 in.; upper surface glabrous, the lower minutely scaly; main-nerves 7, radiating from the base, some of them branching, rather prominent below; petioles 1 to 3 in. long. *Inflorescence* axillary or terminal, slender, longer than the leaves, with a few lax filiform dichotomous spreading few-flowered branches, bracts in pairs, ovate-lanceolate, ·1 to ·15 in. long. *Flowers* pure white, the stamens yellow. Male ·35 in. across; *sepals* 2, oblong-ovate, blunt: *petals* 2, similar but smaller; *stamens* in a globular mass; anthers obovate, short with broad emarginate inappendiculate apices. Female *perianth* of 5 unequal obliquely oblong pieces; *styles* united into a short column, above divided into numerous crowded awns. *Capsule* ·75 in. broad (to the end of the wings), and ·4 in. from base to apex, glabrous, 2-celled: the 2 lateral wings triangular, acute, the posterior wing oblong, tapering a little to the blunt apex, more than twice as long as the lateral.

Perak; *King's Collector* 8289.

A species allied to *B. varians*, A. DC., but with more entire leaves.

7. Begonia thaipingensis, King n. sp. *Rhizome* long, creeping, rooting at intervals, wire-like, rusty-villous. *Leaves* rotund-reniform, the edges minutely and rather remotely dentate, the basal sinus mostly obliterated by the overlapping of the auricles; both surfaces scaly the lower more distinctly so and rusty tomentose on the 6 or 7 radiating sub-prominent nerves; length 1·25 to 2 in.; breadth 1·5 to 2·25 in.; petioles unequal, 1 to 4 in. long, densely rusty-tomentose. *Peduncles* 4 to 9 in. long, slender, sparsely rusty-villous, bearing one or two remote pairs of small lanceolate bracts and near the apex 3 to 5 slenderly pedicellate pink flowers on slender branches. Male flowers; *sepals* 2, sub-rotund, ·15 in. long; *petals* 2, smaller, oblong; *stamens* numerous; *anthers* obovate, the apex blunt and emarginate, the filaments short. Female *perianth* of 5 unequal pieces, the largest most external: *style* short, thick, with 2 stout arms and short thick twisted stigmas. *Capsule* 2-celled, ·5 in. broad (to the ends of the wings); all the wings triangular, sub-equal.

Perak; *Scortechini* 1479; *Wray* 1774; *King's Collector* 2523, 8511.

A species allied to *B. sinuata*, Wall., but differing by the creeping rhizome, non-apiculate leaves, rusty-tomentose petioles and peduncles.

8. Begonia guttata, Wall. Cat. 3671 A. *Stem* succulent, short. weak, bearing about two thin obliquely ovate-reniform glabrous nearly entire *leaves* with oblique cordate bases, and subacute apices; the nerves about 5, radiating from the base, prominent, sparsely hairy;

4 to 7 in. long and 2 to 4·5 in. broad; petioles 1·5 to 4 in. *Peduncles* varying in length from 1 to 2 in., slender, glabrous, bearing a few flowers near the apex. MALE flower; *sepals* 2, rotund; petals 2, narrowly oblong; *stamens* about 50, monadelphous; *anthers* obovoid. FEMALE; *perianth*-segments 5, gradually smaller inwards: *styles* 2, with two twisted branches. *Capsule* ·4 in. long and ·75 in. broad to the ends of the wings, the smaller wings very narrow; the posterior one broad, descending. A. DC., Prod. XV, Pt. I, 352; Clarke in Hook. fil. Fl. Br. Ind. II, 648.

PERAK; *Scortechini* 571. MALACCA; *Maingay* (Kew Distrib.) 675. PENANG; *Wallich.* SELANGOR; *Ridley* 7289.

9. BEGONIA HASSKARLII, Zoll. et Mor. Syst. Verz. Zoll. 31 (*not of Miq.*) All parts glabrous. *Stem* a creeping rhizome. *Leaves* rotund-ovate, shortly and abruptly caudate-acuminate, peltate, the edges wavy but entire; both surfaces glabrous, the upper pitted when dry, the lower with sub-rotund scales; main-nerves about ten, radiating from the insertion of the petiole, not very prominent; length 3·5 to 5·5 in.; breadth 2·25 to 3·75 in.; petiole attached to the leaf about ·75 to 1·25 in. from its lower edge; *stipules* short, lanecolate. *Peduncle* usually longer than the leaves (often twice as long), about as thick as the petioles, bearing a few slender branches near the apex, ebracteate. *Flowers* small, white tipped with red. MALE ·2 in. broad; *sepals* 2, reniform, the margins thick. *Stamens* numerous, cuneiform-oblong, their apices emarginate; filaments very short, free. FEMALE, *sepals* 2, with vertical veins, reniform; *style* short, thick, with 4 short branches; *stigmas* 4, much lobulate. *Capsule* 4-celled, ·6 in. long, the lateral wings very narrow; the posterior broad slightly narrowed to the blunt apex, ·5 in. long: *seeds* minute, ovoid, tapering to one end, brown, shining, pitted. *B. peltata*, Hassk. in Hoev. et De Vriese, Tijdschr. X (1843) 133. *Metscherlicia coriacea*, Klotzsch in Abh. Akad. Berl. (1855) 74; Miq. Fl. Ind. Bat. I, Pt. I, 696. *B. coriacea*, Hassk. Pl. Jav. Rar. 209; *B. hernandiaefolia*, Hook. (not of others) Bot. Mag. t. 4676.

PERAK; *Scortechini* 1607; *King's Collector* 4427, 8245; *Ridley* 9689. PAHANG; *Ridley* 2442.—DISTRIB. Java, *Zollinger* 1613.

This is one of three species to which the specific name *peltata* has been given. That name must however be reserved for the Brazilian species to which it was first applied by Otto & Dietr. (Allg. Gartenz. IX (1841) 58). The MSS. name *B. Hasskarliana* was given by Miquel to a species near *B. coespitosa* which he confused with Zollinger's No. 1613 (the type of the species above described), and this inaccuracy was perpetuated by Miquel on p. 1091 of his Fl. Ind. Bat. I, Pt. I, where he describes *Diploclinium Hasskarlianum.*

10. BEGONIA SCORTECHINII, King, n. sp. *Rhizome* creeping, short, scaly.

Leaves on very long glabrous petioles, narrowly lanceolate, attenuate to the acuminate apex, and to the rounded or acute nearly equal-sided base; the edges dentate-ciliate; both surfaces with numerous scattered coarse subulate spreading hairs compressed at their bases, the lower also minutely scaly; main-nerves pinnate, 3 or 4 pairs, then ascending; length 2·75 to 4 in.; breadth ·5 to 1 in.; petioles 5 to 7 in. *Peduncles* axillary, somewhat shorter than the leaves, glabrous, bearing at the apex 2 few-flowered branches and a few rather long bracts. *Flowers* white, tinged with pink and green. MALE: *sepals* ovate, obtuse, ·75 in. long; *petals* narrower but nearly as long. *Stamens* numerous, in a short column; anthers linear-oblong, the apical appendage obtuse; filaments short. *Female* with perianth-segments similar to the male (*fide* Scortechini) but 5. *Ovary* glabrous, 2-celled; *styles* free, 2 to 4-fid. *Capsule* ·75 in. broad (including the wings) the lateral wings narrow, oblong, the posterior much larger (*fide* Scortechini).

PERAK; *Scortechini* 1845; *King's Collector* 7227.

I have seen no ripe capsules, and the above description of them is taken from Scortechini's field-note. The species is readily distinguishable by its very narrow equal-sided coarsely hairy leaves. A drawing of this, sent to Herb. Kew from Penang by Mr. C. Curtis, represents the leaf-petioles as not more than one inch long.

11. BEGONIA KUNSTLERIANA, King n. sp. *Rhizome* creeping, very scaly. *Leaves* ovate-lanceolate to lanceolate, often but not always unequal-sided, much acuminate; the base cuneate usually oblique; edges ciliate-serrate, the teeth slightly unequal; both surfaces with coarse spreading hairs with dilated flattened bases; the lower with minute white scales also; main-nerves about 3 pairs, pinnate, densely rufescent villous like the petioles; length 5 to 7·5 in.; breadth 1·75 to 2·5 in.; petiole from half as long to nearly as long as the blade. *Peduncles* longer than the petioles and more slender, glabrous, 2- to 4-flowered at the apex. *Flowers* large, white, tinged with red. MALE; *sepals* 2, elliptic, obtuse, 1 in. long and ·5 in. broad, vertically veined; *petals* similar but not half so large. *Stamens* numerous, linear-oblong, bluntly apiculate. FEMALE *perianth* of 5 oblong blunt segments; *styles* 2, each with two short twisted branches. *Capsule* (to the end of the posterior wing) 1 in. broad: the lateral wings short, narrow; the posterior elongate not tapered to the apex, 2-celled. *Seeds* ellipsoid, shining, brown, pitted.

PERAK; *King's Collector* 7194; *Scortechini*; *Ridley* 9651.

This resembles *B. Scortechinii*, but has larger leaves and shorter petioles which are densely villous.

12. BEGONIA HERVEYANA, King n. sp. Glabrous except for a few

hairs on the nerves on the lower surface of the leaves: *rhizome* creeping, thin. *Leaves* broadly elliptic-ovate, shortly acuminate, slightly narrowed to the rounded almost equal-sided base; the edges slightly undulate, very indistinctly serrate; upper surface glabrous, lower very minutely scaly; nerves pinnate, about 6 pairs, ascending, branching; length 5 to 9 in.; breadth 3 to 4·5 in.; petioles much longer than the leaves, glabrous; *stipules* lanceolate, inconspicuous. *Peduncles* 5 to 10 in. long, slender, bearing near the apex 2 or 3 branches with few shortly pedicellate flowers. MALE *flowers; sepals* 2, ovate-subrotund; *petals* 2, much smaller, oblong, blunt; *stamens* numerous, arranged in a cone, linear, with a blunt apical appendage, the filaments short. FEMALE *perianth* of 5 subrotund pieces. *Capsule* 1 in. broad and about half as much from base to apex, imperfectly 4-celled: lateral wings narrow oblong; the posterior wing ovate, blunt, about ·65 in. long.

MALACCA; *Hervey*; *Derry.*

This is a very distinct species resembling in the shape of its leaves no Asiatic *Begonia* that I have seen, except on unnamed species from Tonkin (No. 3763 of Herb. Balansa).

13. BEGONIA PERAKENSIS, King n. sp. *Rhizome* slender, creeping. *Leaves* ovate-lanceolate, slightly unequal-sided, acuminate; the base broad, rounded or very slightly emarginate or oblique, the edges obscurely and remotely dentate, or sub-entire; both surfaces glabrous, the lower minutely scaly; main-nerves pinnate, 4 or 5 pairs, ascending; length 3·5 to 5·5 in.; breadth 1·5 to 2·25 in.; petiole 2·5 to 5 in.; slender, glabrous. *Peduncles* usually longer than the leaves (at least when in fruit), 4-angled, glabrous, few-flowered. *Flowers* whitish tinged with pink, or pink. MALE; *sepals* rotund-ovate, ·4 in. long. *Petals* 2, oblong and much smaller. *Stamens* numerous, linear with short blunt apical appendages and short filaments. FEMALE *perianth* of 5 (?) segments. *Capsule* (ripe) 1·2 in. broad (to end of posterior wing), and ·5 in. from base to apex, 2-celled; the lateral wings oblong, narrow; the posterior oblong, blunt, slightly oblique, ·35 in. broad; *seeds* small, ellipsoid, pitted, shining.

PERAK; *King's Collector* 10338, 10506, 10951.

Specimens of a species closely resembling this, but insufficient for accurate determination, have been collected in Selangor by Mr. Ridley (Herb. Ridley 8590).

14. BEGONIA PAUPERCULA, King n. sp. *Rhizome* creeping, acaulescent, everywhere glabrous. *Leaves* ovate, very unequal-sided and very oblique at the base, or ovate-lanceolate, slightly unequal-sided and little oblique at the base; the apex always acuminate, the edges slightly sinuate-lobed, obscurely dentate; both surfaces glabrous: main-nerves 5 to 7, radiating from the base, prominent below, midrib with a few

lateral nerves, length 3·5 to 5 in.; breadth 1·25 to 3·5 in.; petioles varying in length from 2·5 to 7 in., slender, 2-to 3-flowered. *Flowers* white, tinged with red. MALES; *sepals* 2, elliptic-oblong, ·4 in. long; *petals* 0. *Stamens* linear-oblong, shortly and bluntly apiculate: filaments short. FEMALE; the *perianth* of 5 very unequal lobes, the outermost larger than the sepals of the male. *Capsules* ·6 in. long and 1 in. broad, 2-celled; the 2 lateral wings sub-elliptic, oblique, ·3 in. broad; the posterior wing oblong, blunt, ·6 to ·7 in long and ·35 in. broad.

PERAK; *King's Collector* 5952.

This has leaves resembling those of *B. borneensis*, but the flowers are fewer and larger. Beccari's Sumatra specimens (P.S. 857), in fruit only, appear to belong to this species.

15. BEGONIA VENUSTA, King n. sp. *Rhizome* slender, creeping; whole plant glabrous. *Leaves* reniformly ovate, shortly acuminate, the basal sinus deep; the edges sub-entire or remotely and minutely denticulate; both surfaces smooth, shining: main-nerves 7, radiating from the base, slender; length 3 to 5·5 in.; breadth 2 to 3·5 in.; petioles unequal, slender, from 6 to 12 in. in length. *Peduncles* 3·5 to 6 in. long, bearing about 3 pedunculate pinkish-white flowers near the apex. MALE; *sepals* 2, ovate-rotund, blunt, ·75 in. long. *Petals* 2, somewhat larger. *Stamens* narrowly oblong, with a large apiculus; filaments unequal, the inner ones long, the outer short. FEMALES smaller than the male, the *perianth* of 5 unequal broad blunt segments; *styles* very short, with numerous broad depressed lobules. *Capsule* ·3 in. long and 1·15 in. broad (to the ends of the wings); lateral wings more than half as long as the posterior, broadly triangular, blunt; posterior wing oblong, blunt, ·7 in. long.

PERAK; at an elevation of about 6,000 ft., *Wray* 1598.

The leaves are not unlike those of *B. paupercula* and *B. borneensis* but the flowers are large and handsome.

16. BEGONIA MEGAPTEROIDEA, King n. sp. *Rhizome* as thick as a swan-quill, creeping on rocks. *Leaves* broadly and very obliquely ovate, acuminate; both sides of the base rounded but very unequal, the sinus between them wide, the edges remotely and minutely dentate, upper surface glabrous; the lower also glabrous except the rusty-pubescent nerves which are also scaly near the base: main-nerves about 8, radiating from the base, the larger branched and all rather prominent; length (from apex of petiole to apex of blade) 4 to 5 in.; breadth 4 to 5 in.; petiole 12 to 16 in. long, glabrous. *Peduncles* from half as long to nearly as long as the leaves, glabrous, ebracteate below the flowers. MALE flowers: *sepals* rotund-ovate, very obtuse, 1 in. long and ·6 to ·7 in. broad; *petals* much smaller, elliptic: *stamens* numerous, in a conical

mass on a short thick anthophore; *anthers* oblong, bluntly apiculate, filaments varying in length (the inner the longest). FEMALE *perianth* of 5 unequal pieces: *styles* 2, rather long, combined at the base. *Capsule* not seen.

PERAK; collected at an elevation of 5,000 ft., *Wray* 1450, 1573.

Specimens of this plant are rather scanty. They resemble *B. megaptera*, but are not caulescent like that species. In the Calcutta Herbarium there is, nnder the name *Diploclinium tuberosum*, Miq., a specimen collected by Kurz in Western Java which apparently belongs to this species. There are also two plants from Sumatra collected by Forbes (Herb. Forbes 2333*a* and 2255) which appear to belong to this. The genus *Diploclinium* is inseparable from *Begonia* and the specific name *tuberosa* is pre-occupied in the latter by a species described by Lamack from the Moluccas which has a rounded tnberous root.

17. BEGONIA MAXWELLIANA, King n. sp. *Rhizome* as thick as a swan-quill, bearing many broadly lanceolate scales. *Leaves* broadly and obliquely ovate to ovate-rotund, more or less acuminate, the edges minutely ciliate-denticulate, the base very oblique, one side of it rounded the other rounded-auriculate, the sinus wide; both surfaces with a few coarse compressed rusty hairs, most numerous on the nerves near the base; the lower surface with minute white scales; main-nerves 7 to 9, radiating from the base, prominent; length 5 to 6 in.; breadth 4 to 7 in.; petioles 4 to 10 in. long, compresed (when dry) like the peduncles and like them rusty-pubescent. *Peduncles* unequal, those bearing only male flowers often shorter than the petioles; those bearing female and male, or females only often longer than the petioles; all ebracteate below the inflorescence, dichotomously branched and few-flowered at the apex; the bracts short, broad. MALE flowers densely clustered; *sepals* 2, oblong-ovate, blunt, ·4 in. long, puberulous outside; *petals* 2, similar, but much smaller. *Stamens* numerous, without anthophore; anthers linear, bluntly apiculate, slightly shorter than the filaments. FEMALE *perianth* of 5 unequal pieces diminishing in size inwards; *styles* 2, short, much lobulate. *Capsule* 2-celled, 1·4 in. broad (to the ends of the wings) and ·6 in from base to apex; the 2 lateral wings sub-quadrate, obtuse; the posterior oblong, blunt, more than three times as long as the lateral.

PERAK; Maxwell's Hill, at elevation of 3,000 feet, *Wray* 119, 2199; *Scortechini* 1607, 1798; *King's Collector* 2038.—DISTRIB. Sumatra, *Forbes* 3119*a*.

The flowers of this are white tinged with pink and the leaves green, the nerves beneath being red. This resembles B. *megapteroidea*,* King, but the flowers are smaller, and the leaves and inflorescence are not glabrous as in that species.

18. BEGONIA PRÆCLARA, King n. sp. *Rhizome* creeping, very scaly. *Leaves* obliquely ovate, acuminate, the base rounded on one side of the

petiole and on the other expanding into a broad rounded auricle, the edges minutely dentate, rarely with small lobes besides: upper surface with numerous conical papillæ each bearing a coarse curved hair flattened at the base; under surface with a few scattered flattened hairs especially on the nerves; main-nerves 7, radiating from the base, prominent beneath; length 3·5 to 5·5 in.; breadth 2·5 to 3·5 in.; petioles unequal 3 to 6 in. long, with a few flexuose hairs near the apex. *Peduncles* longer than the petioles, slender, glabrous, 1- to 3-flowered. *Flowers* on rather long slender pedicels, pink. MALES; *sepals* 2, narrowly oblong-ovate, obtuse, ·8 in. long; *petals* 2, narrowly oblong, blunt, ·5 in. long; *stamens* linear-oblong, apiculate, the filaments unequal the central the largest. FEMALE perianth unknown; *styles* 2, short, 2-branched, branches divided into many flat twisted lobes. *Capsule* ·5 in. long and about 1·5 in. broad (to the ends of the wings); the lateral wings quadrate-ovate, obtuse, about ·4 in. long; the posterior oblong, blunt, 1 in. long and ·4 in. broad.

PERAK; at elevations of from 3,000 to 6,700 feet, *Wray* 318, 349, 427; *King's Collector* 8077.

The upper surface of the leaves is dark green, the nerves being coloured; the under surface is red of various tints and the flower-stalks are pale crimson.

19. BEGONIA LOWIANA, King n. sp. Caulescent; 3 feet high; stems and branches covered with coarse flexuose glandular hairs. *Leaves* mostly very obliquely reniform; but some of the cauline ovate and nearly equal-sided acute, the basal sinus deep, the edges with a few very shallow lobes closely and rather minutely dentate-serrate and shortly ciliate; both surfaces coarsely rusty-pubescent, the hairs flexuose compressed and with dilated bases, the lower also with small white scales; main-nerves about 9, radiating from the base, prominent and densely villous; length 3 to 4·5 in.; breadth 4 to 7 in.; petioles unequal, stout, villous like the under surface of the ribs and midrib, from ·4 in. long in the upper leaves, to 4 in. long in the lower. *Cymes* few-flowered, leaf-opposed and terminal, shorter than the leaves when in flower, much larger when in fruit; bracts ovate-lanceolate, opposite, ciliate. *Flowers* pink or white, pedicellate. MALE about ·75 in. across; *sepals* 2, ovate-oblong, sub-acute, ·5 in. long; *petals* 2, oblong, much smaller. *Stamens* numerous, oblong, blunt, without apical appendages; filaments short. FEMALE, the *perianth* of 5 pieces decreasing in size inwards; *styles* 2, deeply bifid and spiral. *Capsules* ·65 in. long and twice as broad to the end of the wings; lateral wings very narrow (about ·15 in. broad), the posterior oblique, broadly ovate, blunt, ·9 in. long and ·8 in. broad.

PERAK; at an elevation of 7,000 feet on Gunong Brumber Pahang, *Wray* 1567; also on Gunong Batu Puleh, *Wray* 316.

This resembles the Indian species *B. Thomsonii*, DC., but differs in being caulescent, in having shorter hairs on leaves and petioles, and in the posterior wing of the capsule being much larger. I have named the species after Sir Hugh Low, late British resident at Malacca, to commemorate his many services towards the botanical exploration of the Province of Perak.

Order LIV. FICOIDEÆ.

Herbs. *Leaves* simple, often fleshy, usually opposite or whorled; stipules 0 or scarious. *Flowers* usually in cymes or clusters, rarely solitary, regular, hermaphrodite rarely polygamous. *Calyx* of 4-5 segments, united into a tube or nearly distinct, free from the ovary in the Indian genera, often persistent. *Petals* usually wanting, when present small. *Stamens* perigynous or hypogynous, definite or indefinite; staminodes sometimes present. *Ovary* free (except in *Mesembryanthemum*), 2-5-celled, syncarpous (except in *Gisekia*); styles as many as the carpels: ovules numerous in each carpel and axile or solitary and basal. *Fruit* usually capsular, splitting dorsally or circumsciss, more rarely the carpels separate into cocci. *Seeds* many or 1 in each carpel, usually reniform, compressed; embryo curved or annular, surrounding the farinaceous albumen, radicle next the hilum.—DISTRIB. Species 450, chiefly African, a few are scattered through most tropical and subtropical regions.

Capsule with circumscissile dehiscence ... ... 1. SESUVIUM.
Capsule with dorsal dehiscence ... ... 2. MOLLUGO.

1. SESUVIUM, Linn.

Succulent branching herbs. *Leaves* opposite, fleshy; stipules 0. *Flowers* axillary, sessile or peduncled, solitary, rarely in cymes. *Calyx-tube* short; lobes 5, triangular-lanceolate, persistent, often coloured. *Petals* 0. *Stamens* many or 5, inserted round the summit of the calyx-tube. *Ovary* free, 3-5-celled; styles 3-5; ovules many, axile. *Capsule* ovate-oblong, membranous, 3-5-celled, circumsciss. *Seeds* many in each cell, reniform; embryo annular.—DISTRIB. Species 4, littoral in warm climates.

SESUVIUM PORTULACASTRUM, Linn. Syst. ed. 10, 1058. Creeping and rooting in the sand, glabrous. *Leaves* linear-spathulate almost cylindric, sometimes sub-obovate: gradually narrowed into a short petiole with dilated scariously margined base. *Flowers* solitary, axillary, their pedicels ·25 in. long. *Calyx* rose-coloured inside. *Stamens* 15 to 40, free or almost free. *Styles* 3 to 5. *Capsule* ·2 in. across. *Seeds* black, shining, smooth, not numerous. Roxb. Fl. Ind. II, 509; Dalz. & Gibs. Bomb.

Fl. 15; Kurz in Journn. As. Soc. Beng. 1877, Pt. II, 110: Clarke in Hook. fil. Fl. Br. Ind. II, 659. *S. repens*, Willd. Enum. p. 511; DC. Prod. III, 453: W. & A. Prod. Fl. Pen. Ind. 361; Wight in Hook. Comp. Bot. Mag. II, 71, t. 23; Miq. Fl. Ind. Bat. I, Pt. I, 1060. *Psammanthe marina*, Hance in Walp. Ann. II, 660. *Crithmum indicum*, Rumph. Herb. Amb. VI, t. 72, fig. 1.

On the sea shores in the Andamans and the other Provinces.—Distrib. B. India, Malayan Archipelago.

2. Mollugo, Linn.

Herbs, branched, often dichotomous. *Leaves* often falsely whorled, or alternate, or all radical, from linear to obovate, entire; stipules fugacious. *Flowers* axillary, sessile or pedicelled, clustered or in panicles or racemes, small, greenish; bracts inconspicuous. *Sepals* 5, persistent. *Petals* 0; staminodes 0 or small in the same species. *Stamens* 5-3, rarely many. *Ovary* free, globose or ellipsoid, 3-5-celled; styles 3-5, linear or very small; ovules many, axile. *Capsule* membranous, sheathed by the sepals, 3-5-celled, dehiscing dorsally. *Seeds* several in each cell, rarely 1, reniform, appendaged or not at the hilum; embryo annular.—Distrib. Species 12, tropical and subtropical.

Mollugo pentaphylla, Linn. Spec. Plantar. ed. 1 (1753), 89. A few inches high, glabrous; stems much-branched, leafy, varying from oblong-lanceolate, lanceolate-acute to obovate-obtuse, contracted at the base, subsessile or sessile, from less than ·5 in. to more than 2 in. in length. *Panicles* compound, terminal, many times longer than the leaves. *Sepals* elliptic or rotund, blunt. *Stamens* 3 to 5, short; filaments rather broad, compressed. *Capsule* globose, as long as the sepals, thin-walled, many seeded. *Seeds* dark-brown, tubercled; embryo curved. W. & A. Prodr. 44; Dalz. & Gibs. Bomb. Fl. 16; Kurz in Journ. As. Soc. 1877, Part II, 111. *M. triphylla*, Lour. Fl. Cochinc. 79; DC. Prodr. I, 392; Roxb. Hort. Beng. 9, Fl. Ind. I, 360; Wall. Cat. 651; W. & A. Prodr. 44. *M. Linkii*, Seringe in DC. l.c. *M. stricta*, Linn. Sp. Pl. ed. II, 131; DC. Prodr. I, 391; Roxb. l.c.; Wall. Cat. 650; W. & A. Prodr. 44; Dalz. & Gibs. l.c.; Clarke in Hook. fil. Fl. Br. Ind. II, 663: *Pharnaceum strictum*, *triphyllum* and *pentaphyllum*, Spreng. Syst. I, 949.—Rheede Hort. Mal. x. t. 26.

In all the Provinces, near cultivated places.—Distrib. General throughout S. E. Asia.

Order LV. UMBELLIFERÆ.

Herbs (rarely in non-Indian species shrubs or trees). *Leaves* alternate, usually divided or dissected, sometimes simple, petiole generally sheathing at the base; stipules 0. *Flowers* hermaphrodite or polygamous, in compound umbels (simple in *Hydrocotyle* and *Bupleurum*), exterior of the umbel sometimes radiant; umbels with involucriform bracts at the base of the general one and bracteoles at the base of the partial ones (umbellules). *Calyx-tube* adnate to the ovary, limb 0 or 5-toothed. *Petals* 5, epigynous, often unequal, and with a median fold on the face, plane or emarginate or 2-lobed with the apex inflexed; imbricated in bud, in *Hydrocotyle* sometimes valvate. *Stamens* 5, epigynous. *Ovary* inferior, 2-celled, disc 2-lobed; styles 2, stigmas capitellate; ovules 1 in each cell, pendulous. *Fruit* of 2 indehiscent dorsally or laterally compressed carpels, separated by a commissure; carpels each attached to and often pendulous from a slender often forked axis (carpophore), with 5 primary ridges (1 dorsal, 2 marginal and 2 intermediate) and often 4 secondary ones intercalated between these; pericarp often traversed by oil-canals (vittæ). *Seed* 1 in each carpel, pendulous, albumen cartilaginous; embryo small, next the hilum, radicle superior.—Distrib. Species about 1,500, mainly in Europe, North Africa, West Central and North Asia; a few are North American, tropical, and natives of the Southern Hemisphere.

Creeping unarmed herbs ... ... 1. Hydrocotyle.
Erect spinous herbs ... ... 2. Eryngium.

1. Hydrocotyle, Linn.

Prostrate herbs, rooting at the nodes. *Leaves* (in the Indian species) cordate or hastate, not peltate, round or 5–9-gonal, subentire or palmately lobed, palmate-nerved, long-petioled; stipules small, scarious. *Umbels* (in the Indian species) simple, small; bracts small or 0; flowers white, sometimes unisexual. *Calyx-teeth* 0 or minute. *Petals* entire, valvate or imbricate. *Fruit* laterally compressed, commissure narrow; carpels laterally compressed or sub-pentagonal; lateral primary ridges concealed within the commissure, or distant therefrom and prominent; vittæ 0, or most slender, obscure; carpophore 0. *Seed* laterally compressed.—Distrib. Species 70; in wet places in tropical and temperate regions, more numerous in the Southern Hemisphere.

Petals acute, valvate; fruit with no secondary ridges; pericarp thin ... ... 1. *H. javanica.*
Petals obtuse, imbricate; fruit with prominent secondary ridges, the pericarp thickened ... ... 2. *H. asiatica.*

1. Hydrocotyle javanica, Thunb. Dissert. Hydrocot. n. 17, t. 2: ed. Pers. II, 415, t. 2. *Leaves* reniform, 5–6-lobed, the lobes irregularly crenate, sometimes sub-entire, 1 to 3 in. broad. *Peduncles* long, slender, often clustered. *Petals* acute, valvate. *Fruit* much compressed, the

secondary ridges absent; pericarp thin, blackish. DC. Prodr. IV. 67; Miq. Fl. Ind. Bat. I. Pt. I, 734; Kurz in Journ. As. Soc. 1877, Pt. II. 113; Clarke in Hook fil. Fl. Br. Ind. II, 667. *H. hispida*, Don Prodr. 183. *H. nepalensis*, Hook. Exot. Fl. t. 30; Wall. Cat. 561; DC. l.c. 65; Miq. l.c. 735. *H. zeylanica*, DC. l.c. 67; W. & A. Prodr. 366; Miq. l.c. 734. *H. hirsuta*, Blume Bijd. 884. *H. polycephala*, W. & A. Prodr. 366; Wight. Ic. t. 1003. *H. hirta*, R. Br. var. *acutiloba*, F. Muell.; Benth. Fl. Austral. III. 340. *H. Heyneana*, Wall. Cat. 563. *H. strigosa*, Ham. in Wall. Cat. 7219.

PERAK; and probably in all the other provinces except the Andaman and Nicobar Islands.—DISTRIB. The Malay Archipelago, Australia, Philippines.

2. HYDROCOTYLE ASIATICA, Linn. Sp. Pl. 234. *Leaves* rotund-reniform, the margins not lobed but uniformly crenate or dentate, sometimes sub-entire, ·5 to 2 in. broad. *Peduncles* short, often 2 or 3 together. *Petals* obtuse, imbricate. *Fruit* compressed, secondary ridges prominent, pericarp thickened. Roxb. Hort. Beng. 31: Fl. Ind. II, 88; Wall. Cat. 560; DC. Prodr. IV, 62; W. & A. Prodr. 366; Wight Ic. t. 565; Dalz. & Gibs. Bomb. Fl. 105; Kurz in Journ. As. Soc. 1877, Pt. II, 113; Clarke in Hook. fil. Fl. Br. Ind. II, 669. *H. Wightiana*, Wall. Cat. 7220. *H. lurida*, Hance in Walp. Ann. II, 690.—Rheede Hort. Mal. X. t. 46.

ANDAMAN ISLANDS; PERAK.—DISTRIB. Tropical and sub-tropical regions.

2. ERYNGIUM, Linn.

Spinescent, glabrous, erect, perennial *herbs* (the Indian species). *Leaves* spinous-toothed, entire lobed or dissected. *Flowers* in simple heads, each bracteolate; bracts whorled, spinulose (in Indian species). *Calyx-tube* covered with ascending hyaline scales; teeth rigid, acute. *Petals* whitish, narrow, erect, emarginate, scarcely imbricate. *Fruit* ellipsoid, nearly cylindric: carpels dorsally subcompressed, subconcave on the inner face; primary ridges obtuse not prominent, secondary 0; vittæ in the primary ridges inconspicuous or 0, with some very slender scattered in the endocarp: carpophore 0. *Seed* semi-terete, dorsally subcompressed, subconcave on the inner face.—DISTRIB. Species 100, temperate and tropical; plentiful in Western Asia.

ERYNGIUM FŒTIDUM, Linn. Sp. Pl. 232, (*in part.*) Erect, unbranched below, dichotomously branched above. *Leaves* radical, oblong-oblanceolate, coarsely serrate, glabrous, 4 to 9 in. long and not more than 1 in. broad. *Bracts* of inflorescence all spinous-toothed; the lower deeply lobed; the upper smaller (about 1 in. long), lanceolate, not lobed, whorled. *Flowers* in dense cylindric spikes, less than 1 in. long DC. Prodr. IV, 94.

SINGAPORE: *King's Collector* 333.

Order LVII. CORNACEÆ.

Shrubs or trees. *Leaves* opposite or alternate, more or less coriaceous, usually petiolate, entire, rarely serrate or lobed, often unequal at the base, exstipulate. *Flowers* usually small, regular, hermaphrodite or unisexual, in axillary or terminal cymes, panicles or capitules. *Calyx-tube* adherent to the ovary; the limb truncate or 4–5-toothed or lobed, valvate or imbricate, persistent at the apex of the fruit. *Petals* 4-5, sometimes as many as 20, or none, valvate or imbricate. *Stamens* inserted with the petals and equal to them in number, rarely 2 or 3 times as many. *Ovary* inferior, 1–4-celled, crowned by a large fleshy or rarely small disc. *Style* single, long or short; stigma truncate, capitate or pyramidal, sometimes lobed. *Ovules* solitary in each cell (rarely 2), pendulous from the apex. *Fruit* baccate, (the pulp often scanty), usually 1-celled, sometimes as many as 4-celled. *Seed* oblong, pendulous, with copious fleshy albumen; embryo axile minute or often large with flat leafy cotyledons.—DISTRIB. Species about 90, widely scattered but most abundant in the temperate regions of the Northern Hemisphere.

Flowers hermaphrodite:—
  Petals not larger than the lobes of the calyx; anthers short, ovate and cordate; style short ... ... 1. MASTIXIA.
  Petals much longer than the lobes of the calyx; anthers long, linear; style elongate ... ... 2. ALANGIUM.
Flowers unisexual ... ... 3. NYSSA.

1. MASTIXIA, Blume.

Trees, young parts more or less pubescent. *Leaves* alternate or opposite, petioled, entire. *Flowers* hermaphrodite, often 2-bracteolate, small, in terminal many-flowered cymose panicles; bracts small or lengthened, pedicels short or 0, jointed under the flower. *Calyx-tube* campanulate, pubescent or silky; limb 5–4-toothed. *Petals* 5–4, ovate, leathery, valvate, pubescent, silky. *Stamens* 5–4; anthers cordate-oblong. *Ovary* 1-celled; disc fleshy; style cylindric, simple; ovule 1, pendulous from one side of the cell very near its summit. *Drupe* ellipsoid or ovoid, crowned by the calyx-teeth or a scar; putamen grooved down one face; endocarp protruded inwards down one side. *Seed* ellipsoid; albumen fleshy; embryo small, radicle elongate, cotyledons thin, elliptic.—DISTRIB. Species 18; S. India and Malaya.

Leaves alternate; bracts of the inflorescence dimorphous 1. *M. bracteata.*
Leaves alternate or opposite:—
Bracts of the inflorescence all small, triangular, concave, puberulous, not in whorls ... ... 2. *M. Scortechinii.*
Bracts of inflorescence in whorls at the base of the flower-pedicels, broad ... ... 3. *M. gracilis.*
Leaves opposite:—
Flowers 5–merous ... ... 4. *M. Maingayi.*
Flowers 4–merous ... ... 5. *M. Clarkeana.*

1. MASTIXIA BRACTEATA, Clarke in Hook. fil. Fl. Br. Ind. II, 746. A tree 40 or 50 feet high: young branches slender, glabrous. *Leaves* alternate, thinly coriaceous, olivaceous-green when dry, abruptly bluntly and shortly acuminate, the base cuneate; both surfaces glabrous, the lower faintly reticulate; main-nerves 5 or 6 pairs, ascending, curved, impressed on the upper but prominent on the lower surface: length 1·75 to 3 in.; breadth ·75 to 1·35 in.; petiole ·25 to ·5 in. *Cymes* terminal, ·75 to 1·5 in. long, branching, many-flowered, bracteate; the bracts of two sorts; those at the bases of the branches linear-oblong, blunt, 1-nerved, glabrous, longer than the flowers; those at the bases of the flowers much smaller, lanceolate, puberulous. *Flowers* a little over ·1 in. long. *Calyx* funnel-shaped, the tube adpressed-silky outside; the mouth expanded, glabrous, wavy but scarcely distinctly toothed, *Corolla* hemispheric in bud: *petals* adnate by their edges, broadly ovate, silky externally. *Anthers* 5, broadly ovate, cordate at the base; filaments short. *Disc* large, fleshy, 5-toothed, each tooth with an oblong depression in the middle. *Style* short, grooved. *Fruit* unknown.

MALACCA: *Maingay* (K.D.) 710. PERAK: *Kunstler* 6830.

2. MASTIXIA SCORTECHINII, King n. sp. A small tree; young branches slender, angled, glabrous. *Leaves* coriaceous, elliptic-oblong or oblanceolate, much attenuate to the base, the apex shortly and bluntly acuminate; both surfaces glabrous, pale olivaceous when dry, the lower the palest; main-nerves 4 or 5 pairs, ascending, slender; length 1·75 to 2·5 in.; breadth ·85 to 1·25 in.; petiole ·25 to ·5 in. *Cymes* corymbose, terminal, several together, 1·25 to 1·75 in. long, puberulous; the branches short, angled; bracts at the bases of the branches and of the flowers similar, small, triangular, concave, puberulous. *Flowers* sessile; *calyx-tube* narrowly campanulate, the mouth with 5 distinct triangular teeth. *Corolla* depressed-globose in bud. *Petals* 5, puberulous outside, ovate, acute. *Stamens* 5: *anthers* broadly ovate, cordate at the base: filaments short. *Disc* fleshy, cushion-like, with 5 short lobes. *Ovary* 1-celled; *style* short, grooved, stigma peltate. *Fruit* unknown. *M. bracteata* Scortechini MSS. (not of Clarke).

PERAK: *Scortechini* 1971.

This much resembles a leaf specimen issued by Koorders and Valeton (No. 914) from Herb. Buitenzorg as *M. trichotoma*, Bl. I have not seen Blume's type of this species. But in his Bijdragen he describes its flowers as tetramerous. A Sumatra specimen collected by Beccari (P.S. 956) which has ripe fruit but no flowers probably belong to this. These fruits are narrowly oblong, tapering to each end, smooth, slightly over an inch in length and about ·35 in. in diam. (when dry). *M. Scortechinii* much resembles *M. bracteata*, Clarke; but differs in having bold acute calyx-teeth, and only one kind of bracts on the inflorescence.

3. Mastixia gracilis, King n. sp. A small tree; young branches slender, angled, smooth, yellowish. *Leaves* thinly coriaceous, lanceolate, tapering much to the base and still more to the much acuminate apex; both surfaces pale olivaceous-green when dry, glabrous; the upper shining, the lower somewhat dull; main-nerves 8 to 14 pairs, ascending, very little curved, faint on both surfaces; length 2·25 to 4·5 in.; breadth ·8 to 1·5 in.; petioles varying from ·2 to ·25 in. *Cymes* in threes, terminal, about a third or a fourth the length of the leaves, on short angled peduncles, the branches short and crowded at their apices, many-flowered, with a whorl of minute broad bracts at the base of flower pedicels. *Flowers* about ·1 in. long, their pedicels about as long, ovoid. *Calyx* campanulate; the tube puberulous, slightly furrowed; the mouth wavy, indistinctly 5-toothed. *Petals* 5, oblong-ovate, adherent by their edges, concave, leathery. *Stamens* 5; *anthers* oblong, bifid: filaments short. *Disc* small. *Style* short, conical: stigma concave. *Fruit* unknown.

Perak: at an elevation of about 5,000 feet; *Wray* 1528.

4. Mastixia Maingayi, Clarke in Hook. fil. Fl. Br. Ind. II, 746. A tall tree; young branches, petioles, under surfaces of leaves, branches and bracts of the inflorescence and the outer surfaces of the calyx and petals densely and softly rusty-tomentose. *Leaves* opposite, coriaceous, elliptic or elliptic-ovate, the apex shortly and abruptly acuminate, the base cuneate; upper surface glabrous, greenish when dry, the midrib and nerves impressed; the tomentum on the lower surface pale brown; main-nerves 6 to 8 pairs, ascending, curved, very prominent on the lower surface and connecting nerves transverse; length 4 to 6 in.; breadth 1·5 to 3 in.; petioles unequal, ·75 to 1 in. *Cymes* branched, on peduncles 1·5 to 2 in. long, terminal, longer than the leaves; the bracts at the bases of the branches small, oblong. *Flowers* numerous, ·15 in. long. *Calyx* campanulate, deeply 4-lobed; the lobes broadly ovate, obtuse. *Petals* 4, similar in shape to the sepals but smaller, concave, adnate by their edges. *Stamens* 4, inserted on a thick fleshy cushion-like circular disc by short filaments; *anthers* short, broadly ovate, cordate, introrse. *Ovary* one-celled, crowned by the fleshy disc. *Fruit* ellipsaid, not compressed, attenuate towards the apex, smooth, 1·2 in. long and ·6 in. in diam.

Malacca: *Maingay* (K.D.) 711. Singapore: *T. Anderson*, *Kurz.*

Var. *sub-tomentosa*, King. The tomentum minute, the *panicles* somewhat shorter, otherwise as in the typical form. *M. Junghuhniana*, Clarke not of Miq. in Hook. fil. Fl. Br. Ind. II, 746.

Singapore: *Ridley* 6293, 6310. Penang: *Curtis* 1564. Malacca: *Maingay* (K.D.) 709.

5. Mastixia Clarkeana, King n. sp. A tree 40 to 60 feet high; young branches slender, striate, glabrous. *Leaves* opposite, thinly coriaceous, oblong or oblong-lanceolate, narrowed to the rounded or sub-acute base; the apex rather abruptly and somewhat bluntly acuminate; both surfaces glabrous, the upper pale olivaceous-green, the lower dull, pale brownish when dry; main-nerves 5 to 6 or 7 pairs, ascending, slightly curved, impressed on the upper surface, prominent on the lower; length 3 to 4 in.; breadth 1 to 1·35 in.; petiole ·3 to ·35 in. *Cymes* terminal, nearly as long as (or sometimes longer than) the leaves, pedunculate, with rather numerous many-flowered angular puberulous branches: bracteoles minute, opposite in pairs, lanceolate or ovate, concave. *Flowers* ·1 in. long, sessile. *Calyx* funnel-shaped, pubescent outside, the mouth with 4 deep broadly ovate teeth. *Corolla* depressed-globular in bud. *Petals* 4, nearly as long as the calyx-teeth, ovate-rotund, concave. *Stamens* 4: anthers short, ovate-rotund, filaments short. *Disc* fleshy, 4-lobed. *Style* short, compressed. *Stigma* concave. *Fruit* unknown.

Perak: *Scortechini* 98, 625, 869; *King's Collector* 10861.

Var. *macrophylla*, King. *Leaves* ovate-elliptic, shortly acuminate; main nerves 7 pairs: flowers as in the typical form.

Perak: *Scortechini* 10575.

There are in Herb. Cal. specimens belonging to four distinct species of *Mastixa* which are too imperfect to be named, and which I have been unable to match with any already described species. These are as follows:—

(*a*). Two gatherings (*Wray* 1234 and *King's Collector* 2907) of a plant collected a tan elevation of from 3000 to 3400 feet in Perak which is evidently a *Mastixia*. In their leaves these resemble *M. Maingayi*, Clarke, var. *sub-tomentosa*, King; but the under snrfaces are more glabrous and the main-nerves are rather more oblique than in that plant; the young branches are moreover of a dark colour and almost glabrous, while those of *M. Maingayi* are pale and rufescently tomentose. These specimens are in fruit, and none of them has a single flower. The fruit is narrowly ellipsoid, attenuate gradually to the apex, smooth, 1·2 in. long, and ·4 in. in diam. While the leaves suggest a relationship to *M. Maingayi*, the remains of the calyx-lobes at the apex of the fruit, which are 4-lobed, suggest perhaps a still closer affinity to the tetramerous species *M. Clarkeana*, King.

(*b*). A specimen from Penang (Herb. *Curtis* 919) which is in fruit only.

(*c*). Specimens of a tetramerous species (in fruit only) from the Andamans with leaves otherwise like those of *M. pentandra*, Bl., but obscurely serrate.

(*d*). Two specimens collected by Mr. Wray at an elevation of 6,700 feet in Perak. These are in fruit; their leaves resemble those of *M. gracilis*, King, but have the main-nerves fewer but bolder.

2. ALANGIUM, Lamk.

Shrubs or trees. *Leaves* alternate, petiolate, entire, persistent. *Flowers* in axillary fascicles or short cymes, hermaphrodite, hairy, jointed on their pedicels; bracts small or 0. *Calyx-tube* adnate to the ovary, the limb toothed or truncate. *Petals* 5 or 6 (rarely more), linear-oblong, valvate, sometimes becoming reflexed. *Stamens* equal in number to or twice as many as the petals or more; the anthers, long, linear; the filaments short compressed, often hairy. *Ovary* inferior, 1- to 3-celled, or 1-celled at the apex and 2- to 3-celled at the base, surmounted by a fleshy disc: *style* very long often clavate; *stigma* large, capitate or pyramidal; *ovule* pendulous. *Fruit* a berry, often with very scanty pulp, crowned by the slightly enlarged calyx. *Seed* oblong, compressed; albumen fleshy, sometimes ruminate; cotyledons leafy, flat or crumpled: radicle long or short.—DISTRIB. About 16 species, in tropical and sub-tropical Asia and Africa, Australia, Polynesia.

Stamens (in Malayan specimens) more than 6 (usually 15 to 20): fruit only slightly compressed ... ... 1. *A. Lamarckii.*
Stamens 5 or 6; fruit much compressed :—
Leaves oblique, membranous :—
Cymes on comparatively long peduncles, much-branched, many-flowered ... ... 2. *A. uniloculare.*
Leaves not oblique, coriaceous : —
Cymes on short peduncles; flowers 6 to 12, shortly pedicelled and ·1 in. in diam.; leaves glabrous above and minutely scaly underneath ... .. 3. *A. ebenaceum.*
Cymes sessile, 3- to 5-flowered; flowers ·25 in. in diam.; leaves glabrous on both surfaces ... 4. *A. Ridleyi.*
Cymes on very short peduncles, 4- to 8-flowered: flowers ·1 in. in diam.; leaves tomentose or pubescent on lower surface ... ... 5. *A. nobile.*

1. ALANGIUM LAMARCKII, Thwaites Enum. Pl. Ceyl. 133. A shrub or small tree. *Leaves* variable in form and size, those of the Malayan specimens oblong-elliptic, elliptic to elliptic-ovate or ovate-rotund, the base rounded or slightly cordate, the apex with a short blunt apiculus; upper surface glabrous or nearly so, the lower with a few scattered hairs; main-nerves 4 or 5 pairs, reticulations distinct; length 3 to 6 in.; breadth 2 to 3·5 in.; petiole ·2 to ·3 in. *Flowers* in short dense fascicles of 4 to 8, about ·75 in. long; peduncles, pedicels and outside of calyx rusty-tomentose. *Calyx* cupular, slightly 6-toothed. *Petals* lanceolate,

sub-acute, externally hairy, inside glabrous but with a hairy mesial line. *Stamens* about 18, two opposite each petal and one opposite each sepal, free; filaments slender pilose; *anthers* linear reaching almost to the apices of the petals. *Disc* annular, wavy. *Style* as long as the stamens, 6-grooved; stigma 3-lobed. *Fruit* ellipsoid, slightly compressed, contracted below the disc-bearing mouth, densely and minutely tomentose, ·75 to 1 in. long and ·65 in. in diam. Dalz. & Gibs. Fl. Bombay 109; Brandis For. Fl. N.-W. India 250; Clarke in Hook. fil. Fl. Br. Ind. II, 741; Trimen Fl. Ceylon I, 285. *A. decapetalum*, Lamk. Dict. I, t. 174; DC. Prodr. III, 203; Wall. Cat. 6884; W. & A. Prodr. 325; Wight Ic. t. 194 Miq. Fl. Ind. Bat. I, Pt. I, 774; Kurz For. Fl. I, 543. *A. hexapetalum*, Lamk. and DC. ll. c.; Roxb. Hort. Beng. 38, Fl. Ind. II, 502; Wall. Cat. 6883; W. & A. Prodr. 326; Wight Ill. t. 96. *A. sundanum*, Miq. Fl. Ind. Bat. I, Pt. I, 774; Kurz. l.c. *A. tomentosum*, Lamk. and DC. ll. c.; Wall. Cat. 6885. *A. latifolium*, Miq. in Pl. Hohenack. No. 719.—Rheede Hort. Mal. IV, tt. 17, 26.

Perak: *Scortechini; King's Collector* 5590. Singapore; *Ridley* 6020.—Distrib. Brit. India, Malayan Archipelago, S. China, Philippines, East Africa.

Var. *glandulosa*, Clarke in Hook. fil. Fl. Br. Ind. II, 742. A large climber. *A. glandulosa*, Thw. Enum. Pl. Ceyl. 133; Trimen Fl. Ceyl. II, 286.

Andaman and Nicobar Islands. Distrib. Ceylon.

2. Alangium uniloculare, King. A tree 30 to 60 feet high; young branches minutely rusty-pubescent, slender. *Leaves* membranous, obliquely ovate-lanceolate or oblong-lanceolate, acuminate, the base unequal, one side rounded the other acute, the edges somewhat wavy; upper surface glabrous except the tomentose midrib and pubescent main-nerves; the lower sparsely sub-adpressed pubescent and minutely glandular; main-nerves 4 to 6 pairs, ascending, the lower on one side much branched, all slightly prominent on both surfaces; the main-veins sub-parallel; length 3·5 to 5·5 in.; breadth 1·75 to 2·25 in.; petiole ·25 to ·3 in., villous. *Cymes* axillary, about one-third of the length of the leaves, pedunculate; the branches spreading, rusty pubescent, many-flowered. *Flowers* about ·4 in. long, with subulate bracteoles and short pedicels. *Calyx-tube* funnel-shaped, not grooved, the mouth minutely toothed. *Petals* 5, linear; *anthers* linear; filaments short, broad, woolly at the apex. *Style* cylindric, pubescent; stigma subglobose. *Fruit* ovate in outline, much tapered to the apex, compressed, faintly ridged when dry, ·6 in. long and ·35 in. broad when dry. *Marlea unilocularis*, Griff. Notul. IV, 679. *M. Griffithii*, Clarke in Hook. fil. Fl. Br. Ind. II, 742.

MALACCA: *Griffith* (K.D.) 3387; *Maingay* 708. PERAK: *Wray* 2927, 3486; *Scortechini* 1914; *King's Collector*—many numbers.

3. ALANGUIM EBENACEUM, Griffith MSS. A tree 30 to 70 feet high; young branches rather slender, smooth, dark-coloured when dry. *Leaves* coriaceous, oblong, slightly acuminate, the base cuneate or rounded; upper surface glabrous, the lower with numerous minute pale scales; main-nerves 13 to 16 pairs, spreading, very slightly curved, prominent on the lower surface; length 6 to 10 in.; breadth 2·5 to 4 in.; petiole ·35 to ·8 in. long. *Cymes* from as long to twice as long as the petioles, on short peduncles, axillary, branched, 6- to 12-flowered. *Flowers* sessile, ·65 in. long, and only ·1 in. in diam. *Calyx* cupular slightly grooved; the mouth truncate, slightly toothed. *Petals* 6 (sometimes only 5), linear, minutely pubescent externally. *Stamens* 6 (or 5); *anthers* about as long as the petals, linear; filaments short, compressed, woolly in front. *Style* cylindric-clavate, shortly hairy; stigma pyramidal. *Fruit* ovate in outline, compressed, faintly ridged, about 1 in. long and ·6 in. wide. *Marlea ebenacea*, Clarke in Hook. fil. Fl. Br. Ind. I, 742.

MALACCA: *Griffith* (K.D.) 3384. *Maingay* (K.D.) 706. PERAK: *Wray* 3302; *Scortechini* 1963; *King's Collector* 3252, 5363, 6562, 6626.

4. ALANGIUM RIDLEYI, King. A tree; young branches covered with minute deciduous scales and hairs, rather slender. *Leaves* coriaceous, elliptic, sometimes slightly obovate, shortly and bluntly acuminate, the base cuneate; both surfaces glabrous; main-nerves 10 pairs spreading, slightly curved upwards, bold and prominent on the lower surface; connecting veins parallel, faint; length 6 to 8 in.; breadth 2·5 to 3·5 in.; petioles ·9 to 1·3 in. *Cymes* as long as or rather shorter than the petioles, sessile, 3- to 5-flowered. *Flowers* nearly 1 in. long, ·25 in. in diam. their pedicels ·2 to ·25 in. long, minutely velvety-tomentose like the outside of the calyx and petals. *Calyx* campanulate, slightly furrowed, the mouth wide truncate. *Petals* 6, thick, grooved and minutely hairy inside, oblong-lanceolate, sub-acute. *Stamens* somewhat shorter than the petals; *anthers* narrowly linear, with a tuft of hairs at the base; filaments short flat almost glabrous. *Style* slender clavate; stigma deeply furrowed, disc 6-angled cushion-like, glabrous. *Fruit* unknown.

SINGAPORE, in the Botanic Garden Jungle, *Ridley* 4941.

Ridley's specimens are without fruit. Mr. Wray has sent from Perak some specimens (Herb. *Wray* 3632) of a plant in fruit which in spite of its considerably larger leaves (nearly a foot long), may be conspecific with this. These fruits are narrowly ellipsoid, much compressed and deeply furrowed, narrowly to the base, ess so to the truncate apex. *A. costata*, Boerl. MSS. is the nearest ally of both.

5. Alangium nobile, Harms. A tree 60 to 100 feet high: young branches and petioles velvety rusty-tomentose. *Leaves* coriaceous, elliptic to ovate-elliptic, rarely slightly obovate, entire, the base slightly cordate rarely sub-acute, the apex blunt or very shortly and bluntly acuminate; upper surface almost glabrous, the midrib and nerves minutely tomentose: lower surface densely and minutely tomentose or pubescent; main-nerves 8 to 10 pairs, spreading, slightly curved, very bold on the lower surface when dry, the secondary nerves transverse and bold; length 4·5 to 12 in.; breadth 3 to 6·5 in.; petiole ·8 to 1·75 in. *Cymes* on very short peduncles, 4- to 8-flowered, shorter or slightly longer than the petioles. *Flowers* ·5 or ·6 in. long and ·1 in. in diam.; their pedicels very short and thick. *Calyx* narrowly campanulate; deeply 6-grooved; the mouth with 6 deep lanceolate spreading teeth. *Petals* thick, narrowly oblong, sub-acute, tomentose, especially outside, sub-glabrous inside. *Stamens* 6, shorter than the petals, filaments short villous inside; *anthers* linear. *Style* cylindric, adpressed villous; stigmas linear. *Disc* glabrous, deeply 6-lobed. *Fruit* compressed, ridged, ellipsoid in outline, slightly contracted at both ends, tomentose, about 1 in. long and ·65 in. broad. *Marlea nobilis*, Clarke in Hook. fil. Fl. Br. Ind. II, 743.

Malacca: *Griffith* (K.D.) 3384, 3385. *Maingay* (K.D.); 705, 707. Perak: *King's Collector* 6047, 6116, 10892. Singapore: *Maingay*; *Ridley* 5077.

Beccari collected in Borneo specimens (Herb. Becc. P.B. 3611) of a species closely allied to this, the flowers of which are however longer (·85 in.) with the calyx-tube much less prominently grooved.

3. Nyssa, Linn.

Trees (or shrubs), innovations silky. *Leaves* alternate, petioled, entire. *Flowers* capitate, on axillary peduncles, polygamo-diœcious, 1 or few females and many males in a head, each 3–4-bracteolate, or the males irregularly coalescing. Male: calyx short, cup-shaped, 5-7-toothed; petals 5-7, imbricate, hairy; stamens usually 10 (in the Indian species) around a large circular disc; rudiment of the ovary 0 or small. Female: calyx-tube campanulate; limb 5-toothed; petals 0 or minute; rudimentary stamens none; ovary 1-celled; style cylindric, simple or shortly 2-fid; ovule solitary, pendulous. *Berry* oblong or ovoid. *Albumen* copious; cotyledons flat, leafy, nearly as broad as the seeds.—Distrib. Species 5-6, in N. America, and from Sikkim to Java.

Nyssa sessiliflora, Hook. fil. in Gen. Plantar. I, 952. A tree. *Leaves* sub-coriaceous, oblanceolate or elliptic-lanceolate tapering to each end, length 4 to 8 in.; breadth 1·5 to 2·5 in.; petiole ·6 to ·8 in.; both surfaces minutely punctate; main-nerves 6 to 8 pairs, spreading.

Peduncles puberulous, ·5 to 1 in. long. *Ripe fruit* oblong-ovoid, smooth, crowned by the small circular calyx, ·6 to ·75 in. long when dry. Clarke in Hook. fil. Fl. Br. Ind. II, 747. *Daphniphyllopsis capitata*, Kurz For. Fl. I, 240; and in Journ. As. Soc. 1875, Pt. II, 201, with fig. *Ilex daphniphylloides*, Kurz in Journ. As. Soc 1870, Pt. II, 72. *Agathisanthes javanica*, Blume Bijd. 645; Miq. Fl. Ind. Bat. I. Pt. I. 839. *Ceratostachya arborea*, Blume Bijd. 644; Miq. l.c.

Perak: at elevat. of 3,400 feet, *Wray*.—Distrib. Sumatra, *Forbes* 2880: *Beccari* (P.S.) 17, 335; Java; Trop. Eastern Himalaya; Khasia Hills.

IV.—Noviciæ Indicæ XIX. *A new Indian* Dendrobium.—*By* D. Prain.

[Received February 26th; Read March 6th, 1902.]

Among the Orchids that flowered in the Royal Botanic Garden, Calcutta, during 1901, one of the most beautiful was a *Dendrobium* that differs from any of the Indian species hitherto described. To be assured that the plant is in reality a previously unknown species a drawing from life has been compared with the material and drawings preserved in the great national collection at Kew. The following description of the plant is now therefore offered.

Dendrobium regium Prain; *caulibus* erectis parum compressis; *foliis* oblongo-lanceolatis versus apicem oblique retusum vel incisum angustatis; *floribus* 2-3 pedunculo brevi subracemosis, pedunculis e caulis aphylli nodis orientibus; *sepalis* lineari-oblongis obtusis roseo-purpureis lineis rubro-purpureis notatis; *petalis* ellipticis roseo-purpureis lineis rubro-purpureis reticulatis; *mento* brevi lato; *labio* lituiformi aliquantum angustato, limbo roseo-purpureo lineis rubro-purpureis reticulato, glabro; tubo pallide flavo.

Hab. In provinciis Hindustaniæ inferioribus.

Stems 8-12 cm. long, 1·3 cm. thick; nodes 3 cm. apart. *Leaves* 8-40 cm. long, 1·5 cm. wide, tips distinctly obliquely notched. *Peduncles* 2 cm. and pedicels 4 cm. long; bracteoles adpressed, lanceolate, under 1 cm. long. *Flowers* 8 cm. across, magenta with darker lines and transverse markings; *mentum* 1·25 cm. long; *sepals* 1 cm. and *petals* 2·75 cm. wide; *lip* 4 cm. long.

This species is very nearly related to *D. nobile* Lindl. but is quite distinct from any of the known varieties of that somewhat variable species. In the nearly uniform coloration of the sepals and petals (though not in the colour itself) it approaches most closely the form of *D. nobile* distinguished and figured by Lindley, *Sertum* t. 18, as *D. coerulescens*. That plant, however, has a lip with purple throat and yellow margin; the present species has a cream-coloured tube and throat with a magenta limb coloured and marked like the petals and sepals. The lip of *D. regium* s, more over, narrower than in any form of *D. nobile* and is not pubescent.

V.—*On some cases of Abrupt Variation in Indian Birds.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

[Received February 26th ; Read March 5th, 1902.]

I. Albinistic variation in *Dissemurus paradiseus*, *Æthiopsar fuscus*, *Acridotheres tristis*, and *Pavoncella pugnax*.

The albinistic and other varieties which so frequently occur everywhere among birds are too frequently passed over by ornithologists as mere "freaks" unworthy of careful consideration; yet every now and then occurs an instance of sudden and abrupt variation, of a type which when found constantly is unhesitatingly allowed the rank of a species.

It is true that the majority of albinistic specimens belong to a form which appears no more capable of maintaining itself in nature than is the perfect pink-eyed albino; at any rate, just as no pink-eyed species of bird exists in the wild state, so we also find that no *species* is splashed, pied, or mottled in the irregular manner characteristic of many domestic birds and of the usual pied variety which occurs in wild ones.

Such a specimen is the pied Bhimraj (*Dissemurus paradiseus*) figured on Plate I., in contrast with the type of the species named by me (J.A.S.B. LXVIII, Pt. II. p. 119) *Dissemurus alcocki*; I have been induced to refigure the latter in order to show that it is no mere albinism. The pied bird had the base of the bill partly whitish, and even some of the rictal bristles white; it is the only pied specimen of this species I have ever seen, and I have examined many, both alive and dead.

A more interesting and much rarer type of variety, however, is that in which the markings are similar to those occurring in a natural species. Such an one is the specimen of the Jungle Mynah (*Æthiopsar fuscus*) figured on plate II; and catalogued by Anderson (Cat. Birds, Mus. As. Soc. interleaved Museum copy) as "577, one, albino, Moulmein, Major Tickell."* In this bird the general plumage is white, with the quills, both primary and secondary, and the tail feathers normally coloured. The greater coverts are partly white and partly normal, and thus I am inclined to suspect that this is a similar case to one which I have recently observed in the Common Mynah (*Acridotheres tristis*). In this bird the plumage was originally all white, with the eyes, bill and feet normal. Mr. Rutledge kept it for some time, and it began to change

* This colouration of white body and dark quills and tail is normal in the Javan *Graculipica melanoptera*, a bird which I was able to study in life in the London Zoological Gardens in 1901. Since writing this paper I have seen another grizzled specimen of *Dissemurus paradiseus*.

into the normal plumage, remaining for some time white with normal wings and tail, like the present bird. It is now in a very peculiar condition, being only scantily covered with feathers, some white and some normal. It has for a companion a normally-coloured bird, which, as I can personally testify, was once white, though not so completely so.

Another case of albinism of unusual interest is furnished by the white-headed form of the Ruff (*Pavoncella pugnax*), which is apparently not uncommon, at all events in Eastern specimens of this bird. Though the male is so well known to be exceedingly variable when in summer plumage, it is as constant in colour during the winter as other birds. Yet every now and then there appears a specimen in winter plumage with the head and neck more or less white, varying from complete whiteness of these parts to merely a white nape and unusually white fore-neck. All of the birds thus characterized are adults, as is shown by their orange or flesh-coloured feet (these being olive in the young); and the females or Reeves are thus affected as well as the Ruffs, but far more rarely and to a less extent.

In the stuffed pair figured in Plate III., which are part of the Asiatic Society's collection, and were procured by Blyth during the years 1842–1846, the whole head and neck are white with the exception of the crown, which is mostly normal, and of some scattered brown feathers on the neck. They are numbered 1601B (the female) and 1601K (the male).

In a skin (2340 in the Museum Register) procured on in the Calcutta Bazaar, February 19th, 1875 evidently a male from the dimensions, the whole head, neck and upper breast are white, there are a few white feathers on the upper back, and the coverts along the fore-arm and carpus are partly white. This is figured in the plate, together with another male (Reg. No. 24005) obtained this winter (January 30th, 1902), which is even whiter, having more white feathers on the back and fore-arm, and one tertiary white. In this the feet and base of bill were flesh-coloured; the eyes normal.

Six more specimens of the variation have been obtained by me in the Calcutta Bazaar during the present winter, all being adult males. One (Reg. No. 24006) is whiter than either of those figured, having the upper back largely white, as well as all the head and breast, but no abnormal amount on the wings.

The second whitest specimen, (Reg. No. 24007) procured on February 2nd, has a white head and neck, with normally coloured feathers round the face; it had the feet and base of bill orange.

Of the others, one, procured on February 16th (Reg. No. 24018) closely resembles Blyth's male figured; another, procured on February

3rd (Reg. No. 24024) is also similar, but has the back of the neck normal; one, procured on February 22nd (Reg. No. 24019) has the head normal and the neck white all round; and a rather small specimen, obtained on February 11th (Reg. No. 24008) has the neck all white in front and the head and back of the neck merely mottled with white.

This nearly approaches the normal form, in which the fore-neck shows a varying amount of white; but any white on the crown or nape may fairly be called an abrupt variation.

I have not this year been able to procure any specimens of this variety in good enough condition to keep alive, but early last year I was more fortunate, and got two pairs, most of which are still living in the Alipore Zoological Garden. Both males much resemble the mounted male figured, but one has some tertiaries white in both wings at the present time, though when obtained it only showed white in one wing. The one female which remains alive merely has the neck white all round.

During last winter I remember seeing one male largely white-necked, which was dead, and I therefore did not buy it, not then attaching so much importance to the variety, as I had seen so few.

It is only during the last two winters that I have taken special notice of this species, but I could not very well have overlooked the conspicuous white-headed form had it occurred commonly before; and it is to be noted that these last two winters have been noteworthy for unusually numerous occurrences of the Bronze-capped Teal (*Eunetta falcata*) in the Bazaar, a bird usually decidedly rare in India. It is possible, therefore, that these white-headed Ruffs are an Eastern strain, which, like the duck above-mentioned, only occasionally migrate in a westerly direction. It will be noticed also that during the years 1842-46 that Blyth procured his specimens, he also got the Clucking Teal (*Nettium formosum*) and Eastern White-eyed Pochard (*Nyroca baeri*), also eastern irregular visitants to our empire.

As out of so many specimens of this variety seen by me only three were females, we may conclude that the variation is largely limited to the male, Reeves here at all events being much more numerous than Ruffs. I have above shown that it only occurs in old birds, and thus I am inclined to look on it as a species of senile albinism analogous to what occurs in black varieties of the domestic fowl and duck. I have also seen an ageing green Canary turn largely yellow about the head.

At the same time, these white-marked individuals are not at all wanting in vigour; the two white-headed males at the Calcutta Zoological Gardens have survived while all the normally coloured Ruffs procured that winter (1900-01) have died, though kept under similar conditions; and one now, although crippled to a great extent in one wing, is master of most if not all the normally coloured Ruffs again placed with him in another aviary. Yet a Reeve, which was at first his sole companion of the species, seems to have deserted him for a normally coloured bird.

The only-slightly-mottled specimen alluded to above also, though undersized and slightly lame, often attacked and beat a larger, though younger, normally-coloured male confined with it, which was sound.

In conclusion, it seems to me, that whether the unusual number of this variety which have appeared of late is due to an abnormal westerly migration or not, it seems to be a well-marked and definable form, liable to recur again and again, and very probably hereditary; thus it would be likely to increase, unless checked by natural or sexual selection.

The Ruff could probably afford to run a greater risk than most birds, as it is evidently a vigorous species, more hardy of constitution, courageous, and indiscriminate in its diet than most *Limicolæ*; this is shown by its readiness to eat vegetable as well as animal food, its habit of constantly fighting, in which both sexes indulge as well in winter as in summer, and its power of recovering from injuries and enduring so unnatural a climate as that of Bengal.

As it is desirable to distinguish a well-marked and recurrent aberration like this by a subspecific name, I venture to suggest that it be known as *Pavoncella pugnax leucoprora*.*

II. Note on the *Gallus pseudhermaphroditus* of Blyth.

With the attention that is now being paid to the variation of animals under domestication, it may not be *mal à propos* to recall to the memory of naturalists the curious variety of the fowl described many years ago, though doubtfully, by Blyth, under the name of *Gallus pseudhermaphroditus*. The specimen is alluded to in his catalogue of the birds in the collection of the Asiatic Society under No. 1463 as "P. Singular individual (?) variety, from Mergui, described as *G. pseudhermaphroditus*, J.A.S.X, 925. Rev. J. Barbe (1841)."

The specimen still exists, and, unlike too many of Blyth's birds, has suffered little deterioration, and hence I have thought it advisable to give a figure of it here (Plate II), as I have never seen or heard of a similar variation myself. I also reproduce below the original description from page 925 of the tenth volume of our Society's Journal, since this is not very readily accessible now-a-days :—

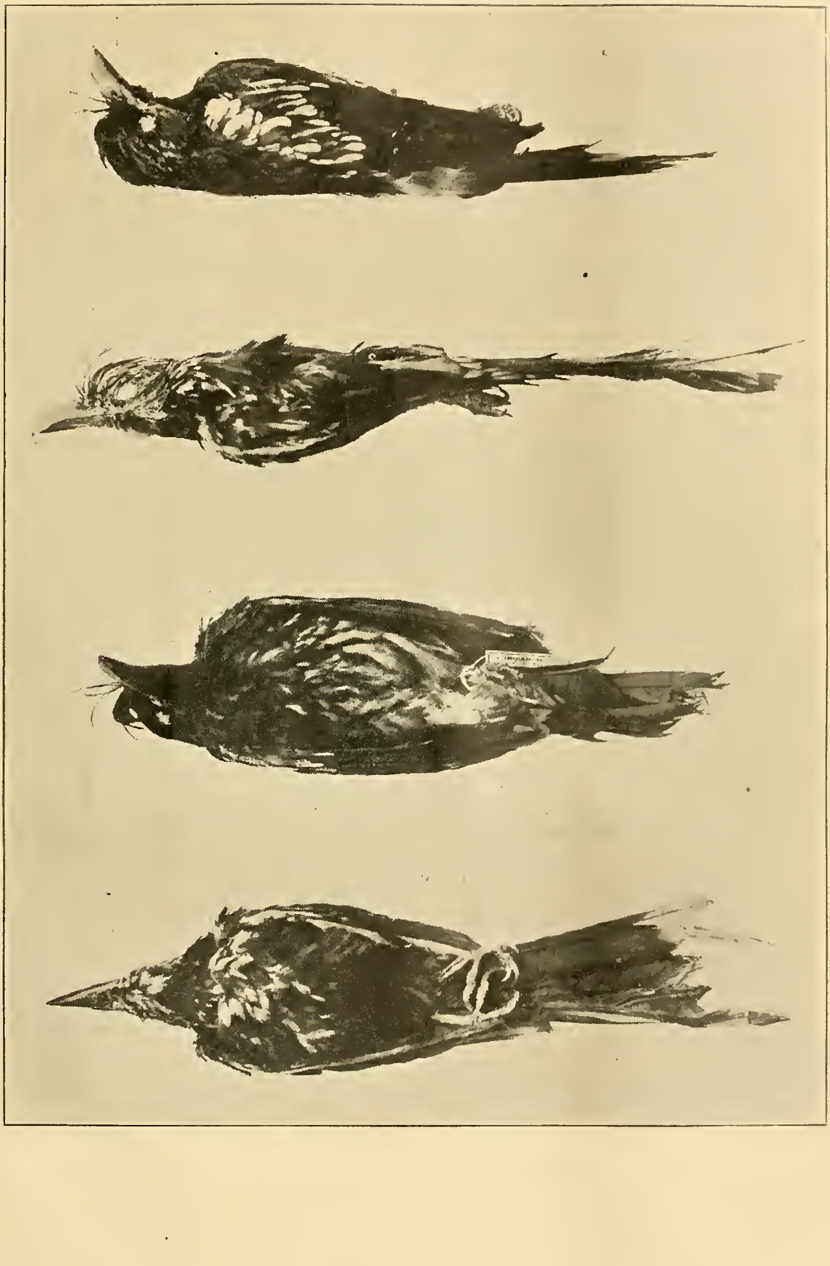
* *Diagnosis*—Exemplis hibernis *P. pugnacis* similis, sed capite et nuchâ aut omnino albis aut albo variegatis distinguenda.

" *Gallus pseudhermaphroditus*, Nobis, N.S. ? ——— A very singular bird, which, if I was not positively assured, was a male in normal plumage, I should have suspected to be either an individual of mingled sex, or possibly an aged male ; for that it is not a female in partially masculine attire is evident from the size of its comb and wattles, and especially of its spurs. Size of an English game cock, or larger than the male *G. Bankivus*, having much stouter legs, the spurs of which are $1\frac{1}{2}$ inches long ; comb and wattles as in the *G. Bankivus*, but the former more entire towards the front (possibly a mere individual diversity) : the tail is that of a cock bird of this genus, but scarcely more developed than in the *Euplocomi* (as *Eu. albocristatus*) ; in other respects the plumage is altogether that of an ordinary brown hen, having a redder cast than in the female *G. Bankivus*, especially on the wings ; tail coloured as in an ordinary male. Length about 2 feet, of which the middle tail feathers occupy 10 inches, wing from bend 9 inches, and tarse behind, to back toe, $2\frac{3}{4}$ inches. I am informed that this species is never clad in the usual bright plumage of other male birds of its genus."

The specimen now only shows one long central tail-feather or "sickle," the other having apparently been broken, since there is a large broken feather on the opposite side of the tail. From the look of the comb and the coarse legs with abnormally enlarged anterior scales, there can be little doubt that the bird was really a domestic one ; and if its peculiarities were as a matter of fact racial, it would seem that there has existed in the east, a breed of which the cocks bore more or less feminine plumage, comparable to the "Henny" game still existing in England ; which, however, are *altogether* hen-feathered.

I have never seen any hen-feathered cocks among the very variable domestic poultry which occupy the coops in the Calcutta Bazaar ; and I should like here to draw attention to the fact that the operation of caponizing, so frequently performed in India, results in more finely-developed male plumage in the cockerels operated on, although their combs and wattles do not develop fully, but remain like those of hens.

PLATE I.



DISSEMURUS PARADISEUS, VAR.

DISSEMURUS ALCOCKI.

DISSEMURUS PARADISEUS, VAR.

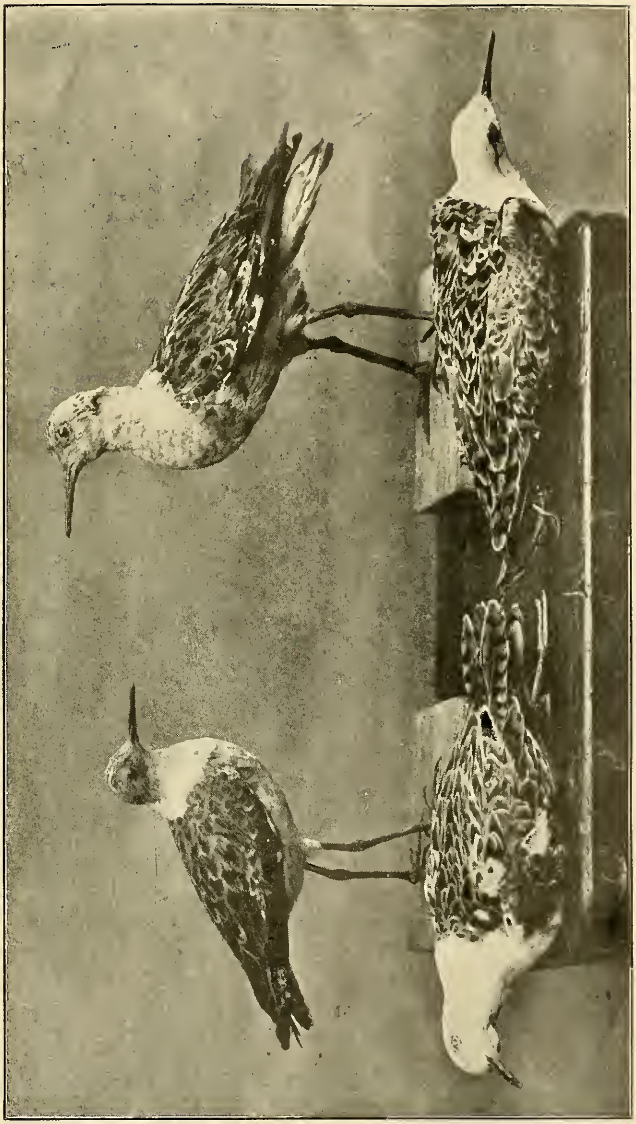
DISSEMURUS ALCOCKI.

PLATE II.

GALLUS PSEUDHERMAPHRODITUS

ÆTHIOPSAR FUSCUS, *Var.*

PLATE III.



Female (1842–46).
Male (Jan. 30th, 1902).

PAVONCELLA PUGNAX LEUCOPRORA.

Male (1842–46).
Male (Feb. 19th, 1875).

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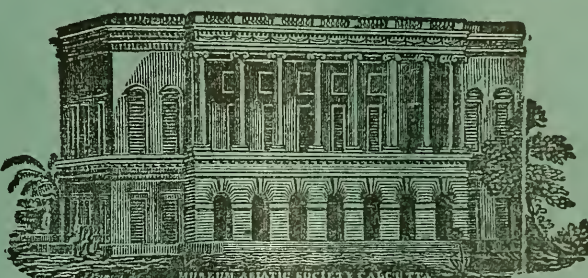
EDITED BY

The Natural History Secretary.



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

⁂ *Communications should be sent under cover to the Secretaries, Asiat. Soc., to whom all orders for the work are to be addressed in India; or care of Messrs. Luzac & Co., 46, Great Russell Street, London, W. C., or Mr. Otto Harrassowitz, Leipzig, Germany.*

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CONTENTS.

ERRATA.

page 92 head line and line 8 from top for K. read R.
,, 106 line 6 from bottom for " overleaf " read " opposite."
,, 118 line 14 for " page 106 " read " page 107."
,, 119 line 1 for 102 read 103.

JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL,

Vol. LXXI. Part II.—NATURAL SCIENCE.

No. II.—1902.

VI.—*On specimens of two Mauritian Birds in the collection of the Asiatic Society.—By* F. Finn, B.A. F.Z.S., *Deputy Superintendent of the Indian Museum.*

[Received March 26th ; Read April 2nd, 1902.]

I. On a specimen of the Moorhen from Mauritius.

In Blyth's catalogue of the Birds in the Museum of the Asiatic Society, p. 286, one of the specimens of *Gallinula chloropus* is noted as follows:—G. Var. ? From the Mauritius. Presented by Willis Earle, Esq.

This specimen is still in existence, but as it is in poor condition, having lost many feathers, and the remainder being loose in places, I have deemed it well to have it figured, as it presents certain points of interest which make its appearance worthy of record. (*See* Plate IV).

Being a stuffed specimen it is not easy to measure exactly with regard to length, but with a tape I make it out to be 1 ft. $\frac{3}{4}$ inches from tip of bill to end of tail, a fair average length judging from the measurements given by Dr. Sharpe in the British Museum Catalogue of Birds. The wing, however, is only about 6·1 inches, and although its feathers are much abraded, it could never have been more than about $6\frac{1}{2}$ inches long, whereas Dr. Sharpe gives 7·3 inches as the length of wing for a bird measuring only a foot and half an inch in length, *i.e.*, about the size of this one. The tail of the Mauritius birds is 2·5 inches in length, whereas the British Museum specimen alluded to has the tail 2·9.

The most remarkable point about the present bird however is its powerful bill and feet. The beak, with frontal shield, measures 1·65 inches; in thickness, at the proximal end of the nostril, it is ·45 of an inch, whereas the biggest-billed Old World bird in the Indian Museum

Collection, a Kashmir specimen, has a bill and frontal shield of 1·6 inches, with the depth of bill measured in the same place, of ·4 only. The wing of this bird measures 6·3.

The left shank of the Mauritius bird, measured from the upper end of the tarso-metatarse to the setting-on of the front-toes, is 2·2 inches, as against the 1·8 of the Kashmir bird; but the thickness of the shank across the front, midway down its length, is ·2 in the former as against ·15 in the latter. I have not measured the shanks from front to back, so as to avoid any error from the insertion of wires into the legs of the Asiatic Society's specimen. The middle toe and claw of the Mauritius bird only exceed those of the Kashmir specimen by about ·1 of an inch, so that in the insular specimen the toes have decreased in relative length. Another remarkable point about the Mauritius bird is that it has the frontal shield, which is very large, truncate behind even more markedly than in the American *Gallinula galeata;* that is to say, judging from our two specimens of the latter, which show so much variation in this character as to suggest that those authors who only allow the New World birds the rank of a subspecies are correct. The differences in the frontal shields will be easily be apparent from the full-sized figures given in Plate V. It will be seen that the Mauritius bird has as long a bill as the Lake St. Clair example of *G. galeata*, whose wing measures 7·4 inches.

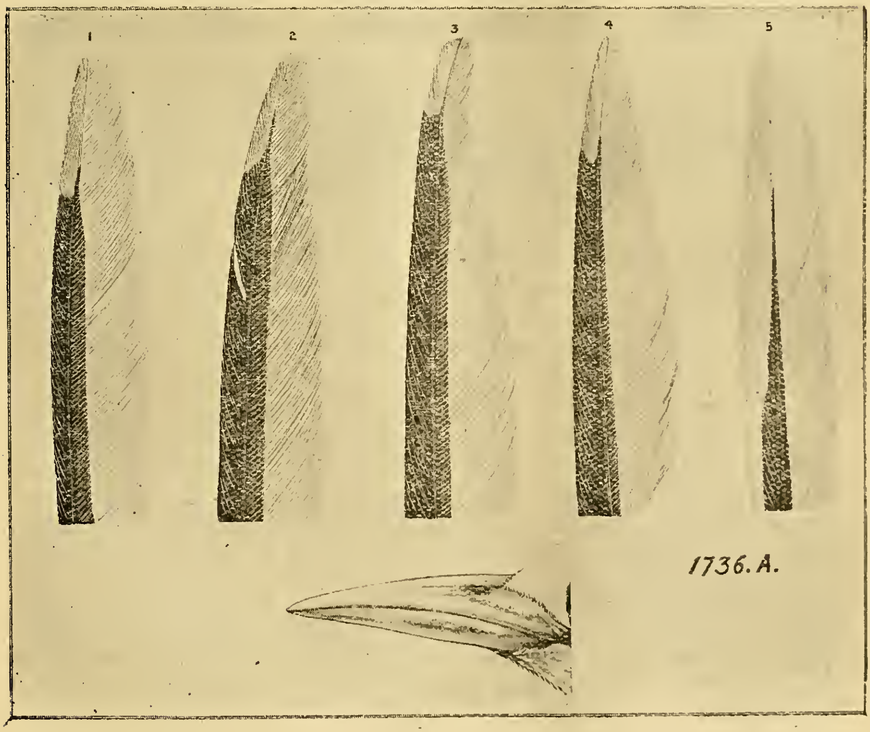
To sum up, the present specimen of *G. chloropus* from Mauritius, when compared with normal specimens, exhibits an increase of the size of the bill and feet, and a shortening of the wings, tail, and toes, which show that it has progressed some way in the direction of the flightless forms of *Gallinula* separated in the British Museum Catalogue as *Porphyriornis*. In colouration it does not differ from *G. chloropus;* it is true that the under-tail coverts are cream-colour instead of white, but this is probably due to the age of the specimen. Professor A. Newton's *G. pyrrhorhoa*, described from Mauritius, has these ochreous under-tail-coverts; but the tinge has been shown by Dr. R. B. Sharpe (Cat. Birds, B.M., Vol. XIII, p. 173), to exist in English specimens, and one in the Indian Museum collected by Colonel C. T. Bingham in the Shan States also exhibits it. Another character given by Professor Newton is the yellowness of the legs of *G. pyrrhorhoa;* but from an old specimen like the present one it is quite impossible now to say of what colour the legs originally were.

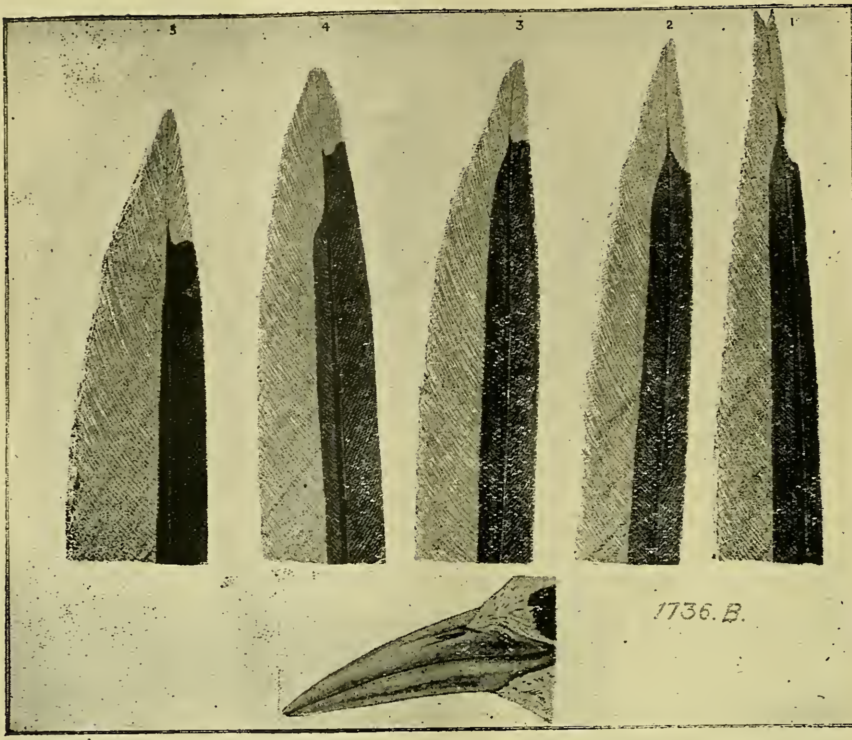
It seems to me, therefore, that the Moorhens of Mauritius need re-examination; if they normally present the stoutness of build and brevity of wing and tail characteristic of the present specimen, they certainly constitute a recognizable race, which might well bear the name bestowed by Professor Newton, since that ornithologist expressly mentions a large frontal shield as one of the characteristics of *G. pyrrhorhoa.*

II. On two specimens of a Tropic-bird from Mauritius.

In Blyth's Catalogue, under the number 1736, we find the entry, "A.B., Adults, from the Mauritius. Willis Earle, Esq.," in reference to two specimens of a Tropic-bird which he there designates *Ph. candidus.* This is the *P. lepturus* of the British Museum Catalogue, Vol. XXVI, p. 454.

I find, however, that while specimen A of Blyth's Catalogue agrees with the British Museum Catalogue description in most particulars, specimen B is distinct, and resembles *Phaëthon americanus* in having shorter white tips to the first four primaries, and in having the outer web of the fifth entirely black to within a short distance of the extremity. Both birds also have evidently had the bill almost entirely yellow, unlike that of *P. lepturus* as described. (*See figures below*).





Except for this bill and for the slightly shorter white tips to the quills, 1736A is true *P. lepturus*, which, from the British Museum Catalogue list of specimens, occurs at Mauritius, and it may therefore, I think, be referred to that species, although not entirely agreeing therewith.

The other specimen, B, however, is not so nearly in agreement with *P. americanus*, for while it has a nearly completely yellow bill, the white tips of the first four primaries are never so little as half an inch long, and the third quill is not nearly all black, but marked like the rest, although the fifth has a good deal of black along the outer web as in *P. americanus*.

Thus these two specimens do not agree with the description of any species of *Phaëthon;* and yet they differ far too much from each other to be referred to a separate form. I am therefore disposed to think that they are both *Phaëthon lepturus;* and this must be a variable species, since it can produce, in the Old World, one individual showing a considerable approximation to the American *P. americanus*, in the colouration of the bill and quills; and another which approaches the American form in the colouration of the bill only. It is, of course, just conceivable that a specimen of *P. americanus* strayed at one time to Mauritius and interbred with the local birds; but the distribution of the form renders this unlikely, and I should be rather inclined to put down the peculiarities of these birds to simple variation.

VII.—*On hybrids between the Guinea-fowl and Common fowl.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

[Received March 26th; Read April 2nd, 1902.]

A good account of this cross, which is not by any means common, has been given by Dr. Juan Vilaro, in the Bulletin of the American Museum of Natural History, Vol. IX. (1897), p. 225.

The hybrid, as represented in the plates accompanying Dr. Vilaro's papers has a very characteristic appearance, its general form and carriage being intermediate between the Fowl and Guinea-fowl, and its head devoid of the comb and gular wattles of the one and rictal wattles and casque of the other. I was thus easily enabled to recognize as Guinea-fowl hybrids three curious fowls received by the Calcutta Zoological Garden from Mr. A. T. Blewitt, of Kalka, early in 1899.

They had been caught in a wild state, but this is not surprising as the tame-bred hybrid between the domestic Muscovy Duck and Common Duck is known to become feral at times.

These birds all resembled Common fowls in colour, the largest being splashed with white and red-brown, and the other two (one of which is figured on Plate VI) being red-brown with black necks and fine black pencilling on many of the feathers. The characteristic spotting of the Guinea-fowl was altogether absent. All had bare flesh-coloured faces, and a pendulous dewlap, most marked in the large white-spotted specimen. There was no comb, although a bare median area at the base of the bill above seemed to indicate a rudiment; and the rictal wattles of the Guinea-fowl were just indicated at the gape; of the horn of the Guinea-fowl and gular wattles of the fowl there was no trace at all. The specimen figured was a male, the testes being about the size of haricot beans; of the others, which have also died and been transferred to the Museum, the brown specimen has been preserved entire in spirits, and the other made into a skeleton. The taxidermist who prepared it states that it was a female, which I should certainly not have suspected from seeing the three birds alive. All were larger than a Guinea-fowl or ordinary Indian fowl, and had particularly strong bills and legs, the latter of a black colour. Their behaviour was quiet; but they were never placed with other birds, so I do not know how they would have treated these. Like Dr. Vilaro's specimens, they seemed to be very sensible to heat, panting more than other birds, and their only cry was a piping, chirping sound, very different from the harsh note of the birds which came under Dr. Vilaro's observation.

VIII.—*Notes on Animals kept in the Alipore Zoological Garden. No. I.*—. *By* Rai K. B. Sanyal Bahadur, *Superintendent of the Garden.*

[Received March 26th; Read April 2nd, 1902.]

Observations on the habits of Orang Outang in captivity.

Orang Outang thinks and acts with a view to accomplishing an object. An Orang Outang and a Proboscis Monkey (*Semnopithecus* [*Nasalis*] *larvatus*), lived in two contiguous cages separated by iron gratings. Although of different temperaments—the Orang Outang lively, vivacious and prone to mischief, and the monkey phlegmatic and indolent—they were best of friends; and enjoyed each other's company as much as the intervening partition would allow. The Orang's friendship for the monkey was, however, not altogether disinterested. They were usually fed about the same time upon the same kind of food, and as the Orang Outang was blessed with a keen appetite, he had no scruple to help himself, to as much of his friend's share as chance brought within his reach. One morning he was found making desperate attempts to annex the remnants of the monkey's breakfast by repeatedly thrusting his arms through the gratings. But all his tricks and trouble availed him not, as the light tin vessel containing the tempting morsel lay beyond the reach of his long arms. Having failed in his attempt to get at the food, he sat still for a few seconds as if to collect his thoughts, and to devise means for the accomplishment of his object, and presently made a rush into his sleeping apartment, fetched a quantity of straw, and twisted it into a sort of rough rope, and with it began striking the tin vessel containing the food, and ultimately succeeded in bringing it within the reach of his arms.

Orang Outang imitating human action. It is well known that in their wild state Orang Outangs indulge in the habit of building platforms of twigs and branches on large trees. Given opportunities they would do the same in captivity also.

The Orang Outang whose habits are here chronicled, was a remarkably docile animal, and was, therefore, allowed to enjoy as much freedom as it was deemed safe. The first use that he made of his liberty was to build himself a platform on one of the trees that stood close to his habitation. One cloudy August morning, while seated on his arboreal perch, he noticed some early visitors open out their umbrellas to protect themselves from a passing shower of rain, and straightway he broke off a leafy branch and held it umbrella-fashion over his own head in immitation of the human folks!

It was amusing to see him following visitors who happened to have anything tied in their cloth, or who carried a bundle on their head. Quick to observe, he had noticed some of them untying a bundle to give him a feed, and by a simple process of ratiocination he came to connect all bundles with food and feeding!

Physiological economy of animals affected by accidents.

A Large White Egret (*Herodias alba*) having lived happily in the Garden for many years managed to break one of its legs by sustaining a fracture of its left tarsus. The fracture was set up and the wound healed nicely, but the shock of the accident must have materially affected the physiological economy of the bird's system; as during the next two years it did not assume the full breeding plumage, or the bright green of the facial skin which it usually did in summer and which was such a characteristic feature of the bird Although in about three years after the accident it began putting on the summer dress again, there was a marked deterioration in the character of the plumes and the colour of the facial skin. This might have been due to old age also.

IX.—*On the Variation of the Flower of* Ranunculus arvensis.—*By* I. H. Burkill, M.A.

There is a regular sequence of organs in the Phanerogamic flower,—sepals, petals, stamens, carpels,—which is never departed from, and which may be said to be due to the passing of moods over the axis,—a mood for the formation of sepals, a mood for the formation of petals, a mood for the formation of stamens, and a mood for the formation of carpels. Each mood is preclusive in its time of the others and definite; and the flower axis runs through them as a matter of course.

In the flower, mood follows mood very closely; yet the tendency so widely manifest, for the floral organs to be formed in whorls is a separating of the moods each from its neighbours by concentrating on itself.

The symmetry of the flower depends firstly on this regular sequence and separation of the moods; it depends secondly on the way in which successive rings of organs,—sepals, petals, etc.—are commonly isomerous.

I have been driven to a conviction that the separation of these moods has not yet obtained the attention it deserves. We need to know much about them; chiefly as to the conditions which lead to their separation: for the whole Phanerogamic subkingdom shows us that the more specialised a flower is the more distinctly are its moods separated; and the isolation of the moods is undeniably of far-reaching importance in the growth of perfect floral symmetry.

It may be said that there are questions of four kinds to be asked regarding the moods, (i) why the moods exist, (ii) as to the reason of their sequence, (iii) as to the requirements which have made them as distinct as they are, and (iv) as to the causes leading to a determination of the number of lateral organs which belong to each of them severally.

They are questions in organography, as Goebel terms the causative morphology of the new school, in order to distinguish it from the descriptive morphology which is subservient to the systematist. The foundation of organography is in the Darwinian theory of evolution.

The present paper concerns questions of the fourth kind; but in preface I wish to make some brief remarks regarding the second and the third kind of question. Regarding the second: the sepals are formed outermost to protect; the petals are formed second to attract; and we have these reasons for the position of both; but why the mood for the formation of stamens should invariably precede that for the formation of carpels is a question which must remain a subject for speculation almost as long as the origin of the Phanerogams is unsolved. This only can be said, that somehow the formation of female organs puts a period to the forward growth of the axis, whereas the forming stamens have divided with the axis the available nutrition passing beyond the growing sepals and petals. This perhaps means some advantage in the matter of food to one or the other. I do not say which: but it is to be confessed that there are strong reasons for assuming that, in nature generally, conditions of good nourishment tend more to the formation of female than of male organs: for experiments on the lower plants—Algæ, Fungi and Vascular Cryptogams—have shown that there is a tendency for female reproductive organs to be formed when the plants are well nourished, male organs when they are starved: and extensive observations on animals indicate the same thing. A condition so widely true may well be true also of the Phanerogams; but at the present time can we produce any convincing evidence that the developing bud gets better nourished as it progresses from the formation of sterile protective or showy organs, through male organs to female organs, or that the female organs appropriate two shares of nutriment because there is by them that which might belong to an elongating axis?

Regarding the third kind of question, let it be remarked that intermediate organs are apt to be useless organs and that therefore we see one reason for the distinctness of the moods; secondly, it is to be stated that if we let ourselves believe that sepals, petals, stamens and carpels are formed under conditions of nutrition which change as the axis gives rise to them, we still cannot easily assume that the conditions of nourishment change as abruptly as do the moods.

Lastly, with regard to the fourth kind of question we are bound to suppose that a certain relationship between the number of the stamens and carpels exists which is at least not prejudicial to the maintenance of the race; *i.e.*, that enough stamens must be produced to enable a sufficiency of seed to be set by the carpels; and it is reasonable to believe that the petals and the sepals are required by their biological functions to bear a more or less definite proportion to the organs they protect or make conspicuous: but it will be acknowledged that this supposition implies a force too loose in its action to produce isomerism as we see it, too loose to regulate the not uncommon orderly change of a normally tetramerous flower to pentamerism, or of a normally pentamerous flower to hexamerism, and impossible to accept as the sole factor when we glance at the general absence of intermediate conditions between isostemony and diplostemony. The view to which Schwendener's and Karl Schumann's work leads, can carry us a step beyond this supposition; for, as they have shown, we have strong reasons for believing that the symmetry of a flower is largely influenced by the mutual pressure in the bud of part on part, and that this pressure to a considerable degree compels new organs to appear in the niches between those recently formed. Thus do the sepals—the outermost members of the flower—as it were set the step and, *e.g.*, if they are in rings of five (I use the word ring because I require a term less definite than whorl) the petals and stamens frequently follow in fives.

The carpels too may follow the step, but their position is unique in that the axis is no longer growing forward when they form and new conditions of pressure, as perhaps of nutrition, are possibly existing.

The individual and the race are always in slight antagonism: the race asks for reproduction, and some writers such as Axell have thought that they could see in the flower the most perfect adaptation or subservience to reproduction. But our flower, above conceived, asserts the individual distinctly if we allow the possible formation of sexual organs by order according to nutrition available, and the fixing of the number by the need of packing. I shall show later, at least in *Ranunculus arvensis*, another assertion of the individual—a setting aside of the claims of the race by allowing a kind of right of primogeniture to the moods in the flower. This right of primogeniture is the more interesting when we consider it in connection with the view that sepals and petals are sterilised stamens; for it gives preference to the mood which by origin is then supposed secondary.

The above remarks are to be taken as embodying some notion of the foundations of the Phanerogamic flower. Working upon them we may make a study of a particular species of plant in order to seek how far the fixed and definite relationships of the organs in number to one another, which we can observe in most Phanerogams, may be due to the compelling influence of pressure in the bud acting inwards from the outermost organs (sepals), or to the way in which nutrition becomes available in the developing axis, or to nutrition and the influence of pressure combined, or to the attempt of the plant to produce an effective and economical assemblage of reproductive members. I have proposed to approach the question by comparing the variation in adjacent sets of floral organs, and seeing how far in different types of flower any one set is free to deviate from pattern.

There are flowers where the jointing of set on set may be considered to be loose, where adjacent rings of organs are not isomerous and such flowers seemed best for my purpose. One such is *Parnassia palustris* where a 4-merous ovary tops an otherwise 5-merous flower; another is the garden Gloxinia where 2 carpels top a similarly 5-merous (potentially in stamens) flower. It is to be asked if, as a rule, variation from normal is more easily accomplished on the upper side of the badly fitting joint than elsewhere. If so, then the inference is obvious that pressure is playing a large part in keeping to type the moods of that flower which are well jointed.

This I found to be the case with *Parnassia palustris*. In 1894 and 1895 I examined over 5,000 flowers and I recorded my observations in the Journal of Botany, 1896, pp. 12–15.

I had approximately 5,152 flowers normal in the number of sepals and in only two of them did the petals, stamens and staminodes fail to keep true to symmetry; but the carpels diverged from the normal four in 450 cases. I had 36 flowers abnormal in the number of sepals, 15 with only four, 21 with six, and in all but three of those flowers petals, stamens and staminodes followed the lead and varied with the sepals; but in them eleven flowers had three carpels, nine had the usual four, fourteen had five and two had six. So much for the free variation above the badly fitting line in Parnassia. In the garden Gloxinia on which I have made, when at Kew, some unpublished observations, it is the same. Gardeners have selected and raised beautiful races with more than the normal number of petals ; the selection was never for the sepals or stamens, but these two sets of organs have varied hand in hand with the petals while the ovary which normally has two carpels hesitates in the improved race between two and three.

A table which I gave in my note on Parnassia shewed that when the sepals were 4, the carpels were generally 3 ; and when the sepals were 6, the carpels were generally 5. Herein we see a correlative increase or decrease in both. Now it is easier by $\frac{1}{30}$ of the unit to squeeze five than to expand three into the space of four and it happened in Parnassia, as I showed in a table on page 13 of the Journal, that five carpels were more common in 6-merous than three in the 4-merous flowers,—an observation in accord with ideas of pressure but of a ring on a confined area ; and not of organs compelling others to fall into the niches between them. Towards satisfying myself in this matter, I devised a little machine for measuring divergences and succeeded in demonstrating (see *Annals of Botany*, XV, 1901, pp. 187-192) that, at least when near fruit-ripening, the carpels in Parnassia have no very exact relationship in position to the sepals.

After examining Parnassia I sought for a flower with worse fitting joints or better with no joints at all and took *Ranunculus arvensis* for my purpose.

Ranunculus arvensis is a little cornfield weed of Europe and Temperate Asia, an annual and easily grown. It is very variable in the flower and in all parts of it ; it has not got that concentration of the moods for the formation of the various floral organs which occurs in all regularly whorled flowers, its moods for the formation of petals and stamens being particularly ill-defined. These irregularities seemed to me qualifications suiting it particularly to my purpose. The sepals are commonly 5 with a divergence of $\frac{2}{5}$, the petals are 5 or fewer alternating with the sepals and repeating their divergence; but the stamens and carpels have a completely different arrangement ; the former are very variable in number and the latter generally 4–7.

I grew my plants in 1895 in the University Botanic Garden, Cambridge, from seed which had ripened in the Botanic Gardens of Bonn and Hiedelberg, Paris, Stockholm and Bordeaux, and in 1898 in a window box at Kew from seed which had ripened in the years 1896 and 1897 in the Royal Botanic Gardens, Kew. I made a point of examining every flower produced, counting and recording the number of its sepals, petals, stamens and carpels, and noting any obvious abnormalities in it. For the purpose the flowers were picked when just open, and this picking, done daily, caused the plants to continue long in blossom.

In this way I examined in 1895, 1,383 flowers from Heidelberg seed and 1,203 from Bonn seed; in 1898, 2,298 from Kew 1896 seed (157 plants) and 1,589 from Kew 1897 seed (73 plants); and also in 1895 lesser numbers of flowers from Paris, Stockholm, and Bordeaux seed—numbers too small to be of real service. I give the results of the examination of the Paris, Stockholm and Bordeaux plants here before proceeding. I shall not mention them again.

	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens.	Average No. of Carpels.
Stockholm	135	4·94	4·49	8·27	5·87
Paris	382	4·91	3·50	5·50	5·25
Bordeaux	167	4·95	4·10	6·74	5·37

As to the more profitable experiments I found the different sowings to vary as follows:

Table I.—Variation in Sepals.

No. of Sepals.	0	1	2	3	4	5	6	7	8	9
Heidelberg	...	...	...	1	85	1,287	8	1	0	1
Bonn	...	1	0	9	69	1,121	2	0	1	...
Kew, Old	...	...	2	13	63	2,217	3	...	...	...
Kew, New	1	3	4	18	46	1,516	1	...	...	...

Table II.—Variation in Petals.

No. of Petals.	0	1	2	3	4	5	6	7	8
Heidelberg	...	5	126	486	417	345	3	1	...
Bonn	...	4	82	349	438	327	1	1	1
Kew, Old	2	2	26	237	430	1592	9	...	...
Kew, New	3	2	19	182	289	1091	3	...	...

Table III.—Variation in Stamens.

No. of Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Heidelberg ...	...	1	12	21	65	136	238	308	282	170	98	32	8	4	3	3	1	1	...
Bonn	.	1	4	9	21	81	154	247	294	211	123	36	8	5	6	0	2	1	...
Kew, Old	...	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	...	...
Kew, New ...	...	3	6	30	143	292	265	203	190	140	95	74	60	46	25	1	4	1	1

Table IV.—Variation in Carpels.

No. of Carpels.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Heidelberg ...	3	3	13	95	266	511	314	136	31	8	0	0	1	0	0	1	1
Bonn ...	5	10	4	35	155	426	379	153	28	6	2	...	...	...	...	...	...
Kew, Old ...	...	3	24	175	362	634	584	403	107	6	...	...	...	...	...	...	...
Kew, New ...	1	2	16	68	198	353	391	364	158	37	1	...	...	...	...	...	...

There is an obvious difference between the two German races and the Kew race and some difference between the Kew plants from 1896 seed and those from 1897 seed although they belonged to the same stock. The variation curves which may be plotted from these figures are irregular, and those for no one set of organs exactly correspond with those for neighbouring sets: the curves of the sepals are half-Galton curves: and the curves of the petals in the Kew race are also half-Galton curves, but not quite as those for the sepals; while the curves of the petals in the German races are intermediate between half-Galton and symmetric Quetelet binomial curves: the curves for the stamens are equally asymmetric, but in a different way; while the curves for the carpels are the most nearly bi-symmetric of all but are not quite so. It is evident from a comparison of them that the flower does not vary as an unit as for instance a Tulip flower may, every ring of organs changing from 3-merism to 4-merism; but each mood varies in its own manner. We shall learn more of this independence of the moods in variation by studying their association. I cannot give tables of the combinations observed in the different races for all the four sets of organs taken two together, without occupying a great amount of space; I therefore give tables for the "Kew Old" plants alone. They will serve as an illustration for all, as the tables which could be given for the German races and "Kew New" are not unlike them.

Table V.—Kew, Old—Correlation of Sepals and Petals.

Sepals.	0	1	2	3	4	5	6	Total No. of flowers.	Average No. of Sepals.
0 Petals	...	...	...	...	...	2	...	2	...
1	...	...	...	...	...	2	...	2	...
2	...	...	1	...	2	23	...	26	4·81
3	...	...	...	7	24	205	1	237	4·85
4	...	...	1	6	26	396	1	430	4·89
5	...	...	...	...	10	1,582	...	1,592	4·99
6	...	...	...	...	1	7	1	9	5·00
Total No. of flowers ...	...	...	2	13	63	2,217	3	2,298	...
Average No. of petals...	...	...	...	3·46	3·71	4·60	...	...	...

Table VI.—Kew, Old—Correlation of Sepals and Stamens.

Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
Sepals ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...
2 ...	...	..	...	...	...	2	...	..	...	...	...	...	...	...	...		...	2	...
3 ...	...	...	...	4	4	2	2	1	...	...	...	...	...	.	...	...	..	13	4·39
4 ...	...	...	...	10	17	18	5	4	3	3	1	0	2	...	...	...	...	63	5·25
5 ...	...	1	5	48	208	410	419	299	267	131	139	97	71	69	27	17	9	2,217	7·01
6 ...	...	...	...	...	...	1	2	...	...	...	...	...	..	...	...	...	...	3	...
Total	..	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average	...	...	...	4·71	4·89	4·94	4·98	4·98	4·99	4·98	4·99	5·00	4·97	5	5	5	...	...	...

Table VII.—Kew, Old—Correlation of Sepals and Carpels.

Carpels.	0	1	2	3	4	5	6	7	8	9	10	Total.	Average.
Sepals ...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 ...	...	...	...	...	2	...	...	...	...	...	...	2	...
3 ...	...	...	2	3	4	3	0	1	...	...	...	13	3·92
4 ...	...	1	2	21	20	10	6	3	...	...	...	63	4·05
5 ...	...	2	20	150	335	621	577	399	107	6	...	2,217	5·46
6 ...	...	...	...	1	1	0	1	...	...	...	...	3	...
Total ...	...	3	24	175	362	634	584	403	107	6	...	2,298	...
Average ...	...	...	4·75	4·84	4·93	4·97	4·99	4·99	5·00	...	...	...	...

Table VIII.—Kew, Old—Correlation of Petals and Stamens.

Stamens.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
Petals ...		...	...	...	...	...	...	...	...	...	...	...	...	...	..	..	...	...
0 ...	1	0	0	1	...	...	...	...	...	...	...	...	...	...	..		2	...
1 ...	...	...	1	0	0	0	1	...	...	...	...	...	...	...	..		2	...
2 ...	...	...	6	10	7	1	1	1	...	...	...	...	...	...	...		26	4·38
3 ...	...	3	24	88	48	35	32	4	3	...	...	...	.	...	..		237	4·91
4 ...		1	17	70	137	95	56	19	15	12	6	0	1	1	...	...	430	5·77
5 ...	...	1	14	59	237	295	212	246	116	128	91	73	68	26	17	9	1,592	7·91
6 ...	...		...	1	4	2	2	...	...	...	...	...	...	...	...		9	...
Total	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average	..	...	3·60	3·77	4·42	4·61	4·59	4·89	4·84	4·86	4·94	5·00	4·98	4·98	5	...	...	...

Table IX.—Kew, Old—Correlation of Petals and Carpels.

Petals.	1	2	3	4	5	6	7	8	9	Total.	Average.
Carpels	...	...	..	...	...	...	...	...	...	...	...
0	...	...	...	...	1	0	1	...	...	2	...
1	...	...	2	...	...	...	...	...	...	2	...
2	...	1	9	14	2	...	...	...	...	26	3·65
3	2	13	70	88	52	12	...	...	...	237	3·89
4	1	10	64	126	141	66	18	4	...	430	4·69
5	...	...	30	134	435	502	382	103	6	1,592	5·88
6	...	...	...	...	3	4	2	...	...	9	...
Total ...	3	24	175	362	634	584	403	107	6	2,298	...
Average	...	3·38	3·65	4·06	4·60	4·85	4·95	4·96	...	...	...

Table X.—Kew, Old—Correlation of Stamens and Carpels.

Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Aver-age.
0 Carpels ...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
1 ...	...	...	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	3	...
2 ...	...	...	...	4	10	6	3	1	...	...	...	...	...	...	...	...	...	24	4·46
3 ...	...	...	3	26	54	60	19	11	2	...	...	...	...	...	...	...	...	175	4·61
4 ...	...	...	2	18	87	99	83	50	19	3	1	...	...	...	...	...	...	362	5·35
5 ...	...	1	...	7	55	175	67	104	80	24	15	5	1	...	...	...	...	634	6·18
6 ...	...	...	...	3	17	73	17	95	106	56	47	26	23	17	4	...	...	584	7·66
7 ...	...	...	...	1	6	17	116	39	55	48	58	52	35	36	12	5	3	403	9·44
8 ...	...	...	...	1	...	2	33	4	8	3	19	13	14	16	10	11	3	107	11·05
9 ...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	3	6	...
Total ...	...	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average ...	...	...	...	3·68	4·14	4·68	5·16	5·36	5·80	6·18	6·56	6·78	6·93	7·02	7·30	7·76	...	...	...

If we take three absolutely symmetrical dice and toss them the probable scores obtained in 240 throws mathematically calculated are as follows:—

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	3	6	10	15	21	28	36	36	28	21	15	10	6	3	1

If we take another three dice of distinguishing colour absolutely symmetrical, and throwing them with the others record the association of numbers, the resulting table will be as symmetric as the binomial curve just given, but in two dimensions, and out of 14,400 throws there is one chance of $3+3$ being the score of the two sets of dice and one of $18+18$, one of $3+18$ and one of $18+3$; there are three chances of the score being $4+3$, and three of its being $17+3$, *i.e.*, equal chances as far as the extremes are concerned of there being a close similarity between the figures and a wide dissimilarity. A glance at the tables just given will satisfy that this is not the case in them and that the tendency to similarity is evident; that in the mutual relationship of mood to mood the adjustment is not a question of chance but, as is indicated by the averages in the last column and lowest line of each table, is due to some loosely coercing force which will be discussed.

As I have foregone the publishing of tables to give for the Kew New plants and the Bonn and Heidelberg races my exact observations on adjustment of moods, I place below the averages found omitting those derived from fewer flowers than ten.

I will briefly call attention to the chief points in the averages. Table XI shows that fewer sepals mean fewer of all other organs and it is to be noted that the reduction is greatest in the organs furthest away from the sepals. Table XII shows for the Kew race a considerable reduction of both stamens and carpels when the petals are reduced; it shows for the German races a much slighter reduction of carpels and an insignificant reduction of stamens. It shows further that reduction in the number of petals does not act as a reflex on the number of sepals in anything like the way in which reduction of sepals may be said to promote reduction of petals. Table XIII shows that with a reduction or increase of stamens the reduction or increase of the carpels is much greater than the reduction or increase of the organs which preceeded them. Table XIV shows that reduction or increase of carpels is accompanied by a more nearly corresponding reduction or increase in the organs closest to them. Consequently, admitting that there is an exception in the relation of petals to stamens in the German races, we may broadly state that the influence producing correlative increase or decrease chiefly acts forwards from the preceding mood to the moods which follow and that correlative increase and decrease is closest in neighbouring moods.

Table XI.—Average No. of other organs in association with three, four and five Sepals.

Number of Sepals.		3	4	5
Average No. of Petals ...	Kew, Old	3·46	3·71	4·60
	Kew, New	3·56	3·57	4·58
	Bonn	2·78	3·54	3·87
	Heidelberg	...	3·47	3·72
Average No. of Stamens...	Kew, Old	4·39	5·25	7·01
	Kew, New	4·73	5·37	7·42
	Bonn	3·78	7·31	7·83
	Heidelberg	...	6 28	7·27
Average No. of Carpels ...	Kew, Old	3·92	4 05	5·46
	Kew, New	3·67	4·09	5·94
	Bonn	2·11	4·79	5·48
	Heidelberg	...	4·31	5·19

Table XII.—Average No. of other organs in association with two, three, four, five and six Petals.

Number of Petals.		2	3	4	5	6
Average No. of Sepals ...	Kew, Old .	4·81	4·85	4·89	4·99	5·00
	Kew, New ..	4·58	4·76	4·87	4·98	..
	Bonn ...	4·83	4·91	4·92	4·98	...
	Heidelberg ...	4·93	4·95	4·89	4·99	...
Average No. of Stamens	Kew, Old ...	4·38	4·91	5·77	7·81	8·55
	Kew, New ...	4·47	4·97	6·00	8·12	...
	Bonn ...	7·84	7·68	7·68	7·98	...
	Heidelberg ...	7·17	7·20	7·18	7·35	...
Average No. of Carpels ...	Kew, Old ...	3·65	3·89	4·69		5·45
	Kew, New ..	3·37	4·21	5·12	6·36	...
	Bonn ...	4·94	5·18	5·45	5·82	...
	Heidelberg ...	4·74	4·82	5·25	5·63	...

Table XIII.—Average number of other organs in association with 2–16 Stamens.

Stamens.		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Average No. of Sepals...	Kew, Old ...	...	4·71	4·89	4·94	4·98	4·98	4·99	4·98	4·99	5·00	4·97	5·00	5·00	5·00	5·00
	Kew, New ...	...	4·77	4·67	4·92	4·95	4·97	4·98	4·98	4·99	5·00	5·00	5·02	5·00	5·00	...
	Bonn ...	...	4·33	4·86	4·87	4·91	4·93	4·97	4·93	4·95	5·03	5·00	...	...	...	...
	Heidelberg ...	4·83	4·86	4·81	4·88	4·94	4·95	4·98	4·92	4·97	4·97	5·00	...	...	...	...
Average No. of Petals ...	Kew, Old ...	...	3·60	3·77	4·42	4·61	4·59	4·89	4·84	4·86	4·94	5·00	4·98	4·98	5·00	5·00
	Kew, New ...	...	3·40	3·81	4·18	4·49	4·68	4·83	4·87	4·97	5·00	4·98	4·96	5·00	4·73	...
	Bonn ...	...	3·44	3·71	3·81	4·00	3·81	3·55	3·79	3·75	4·03	3·62	...	...	...	...
	Heidelberg ...	3·67	3·76	3·38	3·80	3·87	3·59	3·63	3·68	3·70	4·06	4·12	...	...	...	...
Average No. of Carpels	Kew, Old ...	...	3·68	4·14	4·68	5·16	5·36	5·80	6·18	6·56	6·78	6·93	7·02	7·30	7·76	7·00
	Kew, New ...	...	3·80	4·65	4·91	5·39	5·79	6·28	6·79	6·85	7·31	7·39	7·40	7·96	7·36	...
	Bonn ...	...	2·89	4·14	4·58	4·81	5·13	5·54	5·91	6·10	6·53	6·75	...	...	...	...
	Heidelberg ...	4·92	4·19	4·20	4·41	4·79	5·02	5·43	5·71	6·11	6·34	7·50	...	...	...	...

Table XIV.—Average number of other organs in association with 1–9 Carpels.

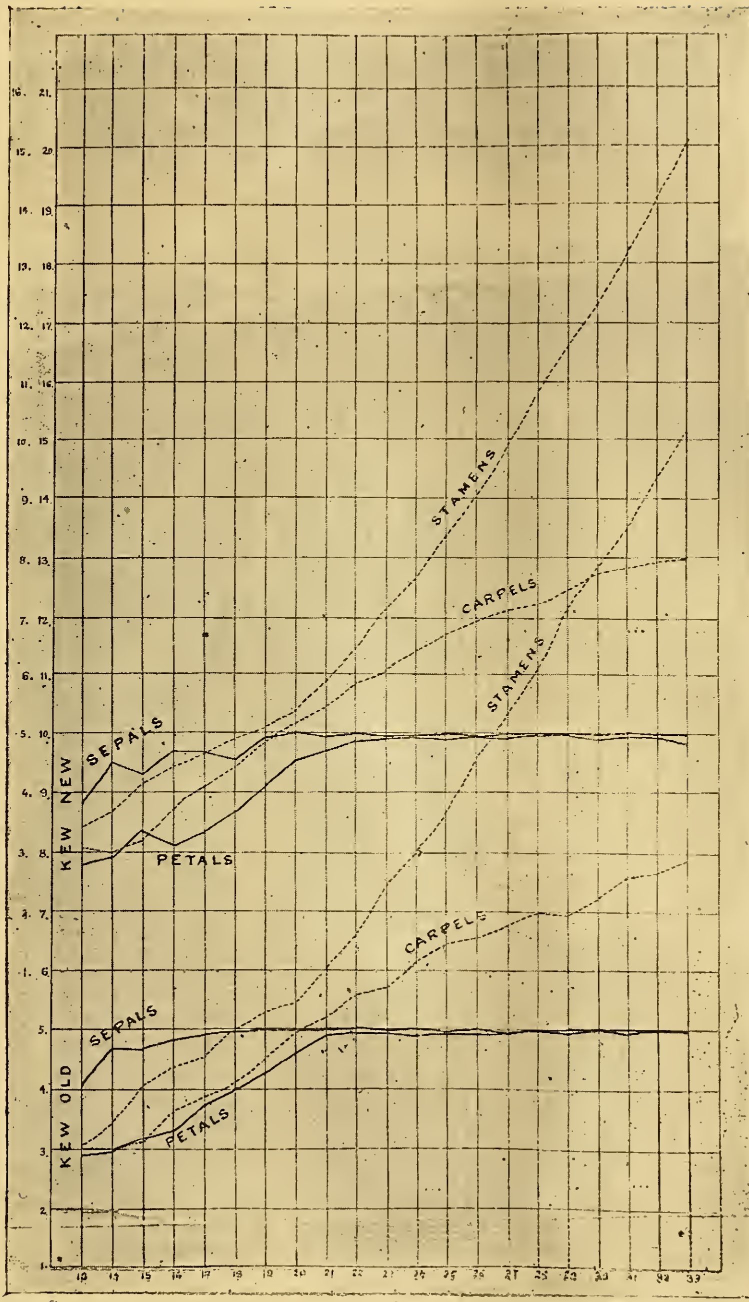
Carpels.		1	2	3	4	5	6	7	8	9
Average No. of Sepals ...	Kew, Old ...	...	4·75	4·84	4·93	4·97	4·99	4·99	5·00	...
	Kew, New ...	...	4·69	4·41	4·78	4·96	4·98	5·00	4·98	5·00
	Bonn ...	4·20	...	4·74	4·87	4·94	4·97	4·97	5·00	...
	Heidelberg ...	...	4·62	4·79	4·90	4·96	4·97	5·04	5·06	5·00
Average No. of Petals ...	Kew, Old ...	...	3·38	3·65	4·06	4·60	4·85	4·95	4·96	...
	Kew, New ...	...	3·31	3·18	3·77	4·51	4·73	4·88	4·91	4·95
	Bonn ...	3·66	...	3·60	3·52	3·74	3·94	4·11	4·36	...
	Heidelberg ...	...	3·44	3·18	3·43	3·58	4·03	4·19	4·09	4·12
Average No. of Stamens ...	Kew, Old ...	...	4·46	4·61	5·35	6·18	7·66	9·44	11·05	...
	Kew, New ...	...	3·94	4·63	5·22	5·98	7·16	8·87	10·27	10·68
	Bonn ...	4·90	...	6·03	6·72	7·28	8·26	9·18	9·57	...
	Heidelberg ...	...	5·50	5·84	6·37	7·11	7·84	8·50	8·90	8·50

I must now point out some differences between the races.

When one sepal less than the complete five is present in the Kew race there is approximately one petal less, two stamens less and $\frac{1}{2}$ carpel less: when two sepals are wanting then we lose further $\frac{1}{8}$ petal, $\frac{2}{3}$ stamen and $\frac{1}{4}$ carpel.

In the German races one sepal less than the complete five means roughly $\frac{1}{3}$ petal less, $\frac{3}{4}$ stamen and $\frac{2}{3}$ carpel: when two sepals are wanting we lose a further $\frac{3}{4}$ petal, $3\frac{1}{2}$ stamens, $2\frac{1}{2}$ carpels; *i.e.*, in the German races 4 sepaled flowers are more nearly otherwise normal than in the Kew race: and what is true for the sepals is true for the petals, *i.e.*, that the first reduction in them from normal is much more closely accompanied by a reduction in other organs than is the case in the two German races.

Apportionment of organs in the Kew race.—The least flower of the Kew race had 8 organs in all, the largest 36. The largest flowers were richest in stamens, the least richest in sepals. I give in table XV the average number of sepals, petals, stamens and carpels in flowers with varying numbers of total organs, and over leaf are curves expressing the result graphically. The result may be briefly stated thus:—if there is power to produce more than 15 organs the sepals claim their full compliment; if there is power to produce more than 20 organs, the petals also claim their full compliment; if there is power to produce more than 28 organs the carpels begin to show signs of



Graphic representation of the apportionment of sepals, petals, stamens and carpels in flowers of *Ranunculus arvensis* (Kew race) with the number of organs varying from 13 to 33.

satiety; extra power beyond this goes chiefly to the stamens. At 20 the flower is not far from having the formula K5 C5 A5 G5, *i.e.*, from being regularly 5-merous. The staminal curve shows slight irregularities at 15 and 18 the curves for petals and carpels practically touch at 15. The correspondence in the two sets of curves is most interesting.

Table XV.—Apportionment in flowers of the Kew race with the number of total organs varying from to 8 *to* 36.

No. of organs.	Kew, Old.					Kew, New.				
	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens	Average No. of Carpels.	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens.	Average No. of Carpels.
8 ...	...	...		...	...	1	0	3·00	1·00	4 00
9 ..	...	...	...	...	...	0	...	...	...	...
10 ...	...	...	...	...	...	1	2·00	3·00	4·00	1·00
11 ..	4	4·25	1·75	2·50	2·50	0	...	...	...	...
12 ...	2	4·00	3·00	3·50	1·50	5	3·40	3·00	3·40	2·20
13 ...	14	4·07	2 86	3·07	3·00	17	3·77	2 77	3 41	3 06
14 ...	32	4·72	2·91	3·41	2·97	20	4 50	2·85	3·70	2·95
15 ...	66	4·70	3·15	4·03	3·12	28	4 29	3·36	4 14	3·21
16 ...	80	4·81	3·26	4·34	3·59	55	4·71	3·18	4·42	3·69
17 ...	115	4·92	3·72	4·54	3·82	61	4·70	3·33	4·67	4·13
18 .	127	4·95	3·99	4·99	4·06	93	4 59	3 67	4·97	4 47
19 ...	173	4·98	4·26	5·27	4·49	81	4 98	4·12	5·07	4·83
20 ...	238	4·99	4·60	5·47	4·93	154	5·00	4·52	5·34	5·14
21 ...	256	4·98	4 82	6·00	5·21	146	4 98	4·72	5·83	5·47
22 ..	236	4·99	4·86	6·55	5·60	157	5 00	4·81	6·37	5·81
23 ...	188	4·99	4·96	7·32	5·72	127	4·98	4·87	7·13	6·02
24 ...	172	5·00	4·91	7·91	6·14	119	4·99	4 92	7·68	6·40
25 ...	128	4·99	4 93	8·63	6·45	109	5·00	4·90	8 38	6·72
26 ...	105	5·00	4·93	9·54	6·52	104	4 99	4 99	9 07	6 95
27 ...	84	4·99	4·98	10·29	6·75	76	5·00	4·96	9·84	7·20
28 ...	93	5·00	5·00	11·05	6·97	68	5·00	4·99	10 78	7·24
29 ..	64	5·00	4·99	12·09	6 92	48	5·00	5 00	11·54	7 45
30 ...	54	5·00	5·00	12·78	7·22	49	5·00	4 96	12·29	7·75
31 ..	29	5·00	4·97	13·45	7·58	42	5·02	4 98	13·21	7·79
32 ...	14	5·00	5·00	14·36	7·64	16	5·00	4 94	14·12	7 94
33 ...	15	5·00	5·00	15·13	7·87	7	5·00	4·86	15·14	8·00
34 ...	4	5·00	5·00	15·75	8·25	3	4·67	4·67	16·33	8·33
35 ...	3	5·00	5·00	16·00	9·00	1	5·00	5·00	16·00	9·00
36 ...	...	...	...	...	...	1	5·00	5·00	16·00	10 00

Table XVI.—Apportionment in flowers of the German races with the number of total organs varying from 4 to 47.

No. of organs.		Bonn.					Heidelberg.				
		No. of flowers.	Sepals.	Petals.	Stamens.	Carpels.	No. of flowers.	Sepals.	Petals.	Stamens.	Carpels.
4	...	1	1·00	1·00	1·00	1·00	...	...	...	...	...
5-7	...	0	...	...	...	...	...	...	...	...	...
8	...	2	3·00	2·50	2·50	0	...	...	...	...	...
9	...	1	3·00	3·00	2·00	1·00	...	...	...	...	...
10	...	2	3·50	2·00	4 00	0·5	...	...	...	...	...
11	...	2	5·00	3·00	2 50	0 5	1	3·00	4·00	1 00	3·00
12	...	0	...	..	...	...	3	4·00	2·66	3·66	1·66
13	...	3	3·66	2·67	3 33	3·33	4	4·50	2·75	2·75	3·00
14	...	4	4·00	3·00	4·25	2·75	12	4·58	2·50	3·50	3·42
15	...	7	4·14	3·14	5·00	2·71	23	4·87	3·09	3·96	3·09
16	...	15	4·60	3·13	5·07	3·20	45	4·73	3·00	4·51	3·75
17	...	37	4·90	3·22	5·00	3·89	73	4·79	3·34	5·18	3·68
18	...	44	4·73	3 44	5·75	4·09	97	4·87	3 30	5·72	4·11
19	...	88	4·98	3·29	6·21	4·52	162	4·97	3·33	6·27	4·43
20	...	153	4·92	3·55	6 73	4·78	174	4·97	3·44	6·75	4·84
21	...	157	4·94	3·74	7·23	5·09	221	4·99	3·69	7·13	5·19
22	...	173	4·97	3 80	7·80	5·42	155	4·96	3·77	7·85	5·43
23	...	162	4·98	3·96	8·34	5·73	132	4 96	4·05	8·20	5·79
24	...	150	4·96	4·12	8·80	6·12	112	4·99	4·33	8·60	6·08
25	...	88	5·00	4 35	9·09	6 56	69	5 02	4·39	9·18	6·42
26	...	47	5·00	4 40	9 81	6·77	46	5·04	4·22	9·91	6·83
27	...	34	5 00	4·71	10·28	7·00	27	5·00	4·55	10·15	7·30
28	...	13	5 08	4·69	10·77	7·46	10	5·10	4·70	10·50	7·70
29	...	9	4·89	4·67	12·11	7·33	5	5·40	5·40	11·60	6 60
30	...	1	5·00	5·00	11 00	9 00	4	4·75	5·00	11·50	8·75
31	...	4	5·00	5 00	13·50	7·50	2	5·00	5·00	14·50	6·80
32	...	2	5·00	5·00	14·00	8·00	1	5·00	5·00	15·00	7·00
33	...	1	5·00	5·00	14·00	9·00	1	5·00	5·00	16·00	7·00
34	...	1	5·00	5·00	17·00	7·00	1	5·00	4·00	10·00	15·00
35	...	1	5·00	5 00	16·00	9 00	0	...	...	...	...
36	...	0	...	...	...	...	1	9·00	5·00	15·00	7·00
37-40	...	0	...	...	...	...	0	...	...	...	...
41	...	1	8·00	7·00	16·00	10·00	0	...	...	...	...
42-46	...	...	...	...	...	...	0		...	...	...
47	...	...	...	...	...	...	1	7·00	7·00	17·00	16·00

Apportionment in the German races.—I give in table XVI the figures for the German races. As in the Kew race so here, in poor flowers the sepals are most numerous and in rich flowers the stamens are most numerous. But in these German races the petals do not claim their full number until the flower is rich enough to have 29 or 30 organs and on the part of the carpels no tendency to be satisfied can be detected.

Mathematical expression of the curves in formulæ seems to be by no means impossible although they are complicated.

There is no fiat which says "this will be a flower of *Ranunculus arvensis*, the organs may vary in number a little from the ideal." But the fiat says "this will be a flower and must run throughout all its moods. So long as all are present let them jostle for their compliment." So they jostle and the older win as far as they may by being already established at the time when the younger begin to compete; the sepals take what they want only being forbidden from getting the whole five when that would leave too little for the other moods; and the petals following claim their portion in the same way but a little less strongly. There is left a residue for the stamens and carpels, and the larger it is, the more organs do the moods of both sets, but especially the stamens, obtain.

Nutrition.—If seeding be prevented, *Ranunculus arvensis* dies flowering in utter depletion. Therefore I could get from this little proletarian flowers formed under the best conditions and under the worst possible conditions of nutrition, and so seek the effect of starvation on the moods spoken of. My earlier paper (*Journ. Linn. Soc., Botany*, Vol. XXXI, p. 235) contained a note on this plant to show that in it, as in several other plants, the first formed flowers are richest in stamens and carpels; I can now give fuller statistics, and shall show distinctly that the flower is pauperised with the ageing of the plant. I have divided the flowering period of the plants grown in 1895 into three periods and of those grown in 1898 into four periods. The decrease with age in the number of parts in the flower is shown by the following averages:—

Table XVII.—Kew, Old. Average number of organs in flowers at different periods.

	Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Sepals	4·99	4·98	4·99	4·89
Petals	4·95	4·85	4·66	3·95
Stamens	11·58	7·81	6·17	4·93
Carpels	6·78	5·97	5·28	4·15

Table XVIII.—Kew, New. Average number of organs in flowers at different periods; periods as in Table XVII.

	Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Sepals	4·99	4·99	5·00	4·77
Petals	4·97	4·84	4·67	3·81
Stamens	11·63	7·95	6·14	5·07
Carpels	7·22	6·51	5·74	4·36

Table XIX.—Bonn. Average number of organs in flowers at different periods.

	Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th.	Period 3. August 30th to middle of September.
Sepals	4·96	4·92	4·98
Petals	4·22	3·43	3·69
Stamens	8·80	7·74	6·85
Carpels	5·71	5·58	4·75

Table XX.—Heidelberg. Average number of organs in flowers at different periods; periods as in Table XIX.

	Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th	Period 3. August 30th to middle of September.
Sepals	5·00	4·94	4·98
Petals	3·92	3·70	3·49
Stamens	8·24	6·99	7·07
Carpels	5·21	5·16	5·01

With this reduction in number of parts there is a reduction in the size of the flower and there is also a loss of fertility in the anthers. This loss of fertility is shown in the following tables.

Table XXI.—Staminodes in Kew plants at different periods; the periods the same as in Tables XVII and XVIII.

		Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Kew, Old	Total number	91	1360	1572	1777
	Percentage of stamens reduced ...	2·58	21·31	47·49	56·48
	Average per flower ...	0·30	1·66	2·91	2·78
Kew, New	Total number	23	1072	1534	1178
	Percentage of stamens reduced ...	0·78	25·88	64·73	54·09
	Average per flower ...	0·09	2·06	3·98	2·74

Table XXII.—Staminodes in the German races at different periods; periods as in Tables XIX and XX.

		Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th.	Period 3. August 30th to mid-September.
Bonn ...	Total number ...	24	82	33
	Percentage of stamens reduced ...	2·04	1·13	4·01
	Average per flower ...	0·18	0·09	0·27
Heidelberg ...	Total number ..	37	75	36
	Percentage of stamens reduced ...	1·86	1·13	2·61
	Average per flower ...	0·15	0·08	0·19

I think it will be conceded that poverty of organs and sterility of stamens are alike marks of the plants becoming worn out.

Different organs are unequally reduced in numbers, the stamens most of all and before the others. Tables XVII to XX show how the different organs are differently affected by the reduction: but to make this quite evident the following tables are given :—

Table XXIII.—Rate of reduction of organs in the Kew plants from period to period; periods as before.

		Periods 1 to 2	Periods 2 to 3.	Periods 3 to 4.
Kew, Old ...	Sepals	Practically *nil.*		0·10
	Petals	0·10	0·19	0 71
	Stamens	3·17	1·64	1·24
	Carpels	0·81	0·69	1·13
Kew, New ...	Sepals	Practically *nil.*		0·23
	Petals	0·13	0·17	0·86
	Stamens	3·68	1·81	1·07
	Carpels	0·71	0·77	1·38

Table XXIV.—Rate of reduction of organs in the German races from period to period; periods as before.

		Periods 1 to 2.	Periods 2 to 3.
Bonn ...	Sepals	Practically *nil.*	*Very small increase*
	Petals	0·79	*slight increase*
	Stamens	1·06	0·89
	Carpels	0·13	0·83
Heidelberg ...	Sepals	0·06	*increase of* 0·04
	Petals	0·22	0·21
	Stamens ...	1·20	*increase of* 0·08
	Carpels	0·05	0·15

It is easily seen that at the beginning of the flowering period a large reduction is made in the male organs; but that the reduction in other organs is chiefly at the end. The following table shows this excess of masculinity, which occurs at the beginning of the flowering period and is soon done away with after flowering has commenced.

Table XXV.—The percentage which the Stamens (fertile and infertile) make out the total of organs in the flowers, at different periods; periods as before.

	First period.	2nd period.	3rd period.	last period.
Kew, Old	68·52	56·68	53·89	54·29
Kew, New	61·16	54·98	51·68	53·77
Bonn	60·68	58·11		53·76
Heidelberg	61·13	60·93		58·55

It is impossible to dissociate the lack of nutrition felt, it must be believed, by the flowers of the worn out plants and the right of primogeniture spoken of. The power to satisfy the sepaline mood and the petaline mood and to form abundant stamens and carpels is in the nutrition of the flower.

On page 110, it was said that the moods jostle for their compliment of organs and that the older win by being already established when the younger begin to compete. There is a reservation to make in regard to this statement, to demonstrate which table XV has been recast in table XXVI. The latter table shows that in well and fairly well fed flowers—say with 20 organs and more—the proportion falling to the carpellary mood is nearly constant, and that, as already made more or less evident, the staminal mood is residuary legatee for the extra vigour. Therefore for the richer flowers the vigour may be said to be roughly apportioned between on the one hand the sepaline, petaline and staminal moods which three jostle each other, and on the other hand the carpellary mood. In flowers poorer in organs than 20, the carpellary mood seems less prepared for and is subject in like degree to the staminal mood to the jostling for space.

Thus do the richer flowers appear more pre-apportioned than the poorer ones and therefore more knit together into an unit in the direction in which the flowers of most Phanerogams are knit together. We may easily believe that, given a flower with its moods so knit together that they vary together, the force of pressure of organ on organ in the bud may finish the shaping of the whole.

We can see that the flowers of the Kew race are a little more knitted into an unit than those of the German races. Thus the petals and sepals are much more often equal in number, and (as is shown on p. 103) when we get a flower of the Kew race departing in the sepals from normal by losing one, then the other organs are more likely to lose in proportion than in the German races. In short there is more see-sawing of mood on mood in the German races than in the Kew race.

However there are irregularities in the curves with which I have been dealing which cannot clearly be attributed to the struggling of the moods for satiety and their relative advantages from primogeniture. These are made obvious in the recast table XV which we now have in XXVI.

The chief irregularities of the Kew race are:—

(i)—Between 15 and 20 the stamens are above what would seem reasonable, rather more so at 15, 16, 18 and 19 than at 17 and 20.

(ii)—At 23 the stamens are a little above what would seem reasonable, the carpels below.

I do not intend to attempt any explanation of these facts, but I must observe that if we cut out of our figures all flowers which have both their sepals and their petals other than five in number, the irregularities just noted almost disappear: and they do not disappear if we cut out only those flowers with sepals other than five: and this indicates that between 15 and 20 the stamens are able to add to their number from the petals. This is done in table XXVII.

Table XXVI.—Percentages of organs in the Kew race falling to the different moods in flowers of various numbers of parts.

No. of Organs.	Kew, Old.				Kew, New.			
	Sepals.	Petals.	Stamens.	Carpels.	Sepals.	Petals.	Stamens.	Carpels.
8 ...	...	...	...	...	...	37·50	12·50	50·00
9 ...	...	...	...	...	...	...	...	...
10 ...	...	...	...	...	20·00	30·00	40·00	10·00
11 ...	38·64	15·91	22·73	22·73	...	...	...	...
12 .	33·33	25·00	29·17	12·50	28·33	25·00	28·33	18·33
13 ..	31·32	21·98	23·62	23·08	28·96	21·26	26·24	23·53
14 ...	33·70	20·76	24·33	21·20	32·14	20·36	26·43	21·07
15 ..	31·31	21·01	26·87	20·80	28·57	22·38	27·62	21·43
16 ..	30·08	20·39	27·11	22·42	29·43	19·88	27·61	23·07
17 ...	28·95	21·89	26·70	22·45	28·64	19·57	27·48	24·30
18 ..	27·51	22·18	27·73	22·57	27·18	20·37	27·59	24·85
19 ...	26·22	22·42	27·72	23·63	26·19	21·70	26·70	25·40
20 ...	24·96	23·00	27·36	24·66	25·00	22·59	26·72	25·68
21 ...	23·73	22·93	28·53	24·79	23·74	22·47	27·75	26·02
22 ...	22·69	22·08	29·78	25·46	22-72	21·89	28·95	26·45
23 ...	21·72	21·58	31·85	24·86	21·64	21·15	31·02	26·[illegible]9
24 ..	20·83	20·61	32·97	25·58	20·79	20·52	32·00	26·68
25 ...	19·96	19·71	34·53	25·78	20·00	19·59	33·50	26·89
26 ...	19·23	18·97	36·70	25·09	19·19	19·19	34·87	26·76
27 ..	18·47	18·43	38·09	25·00	18·52	18·37	36·45	26·65
28 ..	17·81	17·81	39·47	24·88	17·85	17·80	38·49	25·84
29 ...	17·24	17·18	41·70	23·87	17·24	17·24	39·79	25·72
30 ...	16·66	16·66	42·59	24·67	16·66	16·53	40·95	25·85
31 ...	16·13	16·01	43·39	24·47	16·20	16·05	42·62	25·11
32 ...	15·63	15·63	44·86	23·88	15·62	15·43	44·14	24·80
33	15·16	15·16	45·87	23·84	15·15	14·72	45·89	24·24
34 ...	14·70	14·70	46·32	24·26	13·73	13·73	48·04	24·51
35 ...	14·28	14·28	45·71	25·71	14·29	14·29	45·71	25·71
36 ...	...	...	...	...	13·89	13·89	44·44	27·77

Table XXVII.—Percentage of stamens present in flowers with sepals and petals any number, with sepals 5 and petals any number, and with both sepals and petals 5.

Total organs.		14	15	16	17	18	19	20	21	22	23	24
Kew, Old ...	All flowers ...	24·33	26·87	27·11	26·70	27·73	27·72	27·36	28·53	29·78	31·85	32·97
	Flowers with K5 ...	24·41	25·72	26·68	26·56	27·65	27·68	27·29	28·38	29·72	31·84	32·99
	Flowers with K5 C5 ..	...	13·33	25·00	21·27	23·61	24·54	25·66	27·76	29·22	31·36	36·62
Kew, New ...	All flowers ...	26·43	27·62	27·61	27·48	27·59	26·70	26·72	27·75	28·95	31·02	32·00
	Flowers with K5 ...	25·60	25·34	26·64	27·10	27·27	26·65	26·72	27·61	28·95	30·93	31·92
	Flowers with K5 C5 ..	...	...	...	14·71	22·22	23·80	25·16	26·57	28·44	30·43	31·44

Now it comes about from this tendency of stamens to gain below 20 in percentage at the expense of the petals, and from the tendency of the carpels above 20 to show satiety, that the excess of stamens over carpels is likely to be least at 20 and greater both above and below that number. Thus is the sex-proportion continually shifting along our curves.

Half staminodal petals were found in flowers of the Kew race as follows; it will be noticed that towards the end of the flowering period they appeared but one at a time in the flowers.

Table XXVIII.—Half Staminodal petals.

		Period 1	2	3	4
Kew, Old ...	Number	7	30	20	19
	In flowers	3	23	18	19
	Percentage	·47	·76	·79	·75
Kew, New ...	Number	9	16	11	14
	In flowers	5	·63	11	14
	Percentage	·72	·63	·61	·85

Lastly I have an abnormality to notice; it consists of a lobing of the petals, one lobe being larger than the other. I found this abnormality in the Kew race to be fairly frequent and further I found it to be most abundant when the number of staminodes was highest.

Table XXIX.—Lobed petals.

		Period 1	2	3	4
Kew, Old ...	Number	10	30	21	19
	In flowers	2	17	16	9
	Percentage	·605	·756	·839	·753
Kew, New ...	Number	5	17	13	7
	In flowers	3	16	12	6
	Percentage	·399	·674	·721	·427

Summary.

I have shown first of all (Tables I–IV) how the flowers of *Ranunculus arvensis* in the races studied, vary; and how each set of organs varies in a different way; so that the curves which may be plotted for sepals, for petals, for stamens, and for carpels are unlike, most of them neither perfect Quetelet-Galton nor perfect half Galton curves.

I have shown secondly (Tables V–XIV) that a correlative increase and decrease occurs between the different sets of organs; so that when the stamens or any other set of organs depart from normal, it is probable that all other sets of organs will depart from normal, but chiefly those which follow. This is important as it indicates a division of vigour among the various sets, to be distinguished from an increase of the one at the expense of another.

In Tables XV–XVI and in the graphic representation of them on page 106 I have followed this up by showing how if we take the total number of organs in the flower as a measure of the vigour in the bud, we find that the ring of sepals, being the first-formed of the sets of organs, has the first pull on the vigour and is most likely to get a full complement, the ring of the petals being the next in order, is the next to be satisfied, and that stamens and carpels obtain the surplus the stamens chiefly so. I consider that the curves might with some little trouble be translated into formulăe by a mathematician.

In Tables XVII–XX, I show that the power to produce organs diminishes as the plant grows weaker towards its death. Sometimes a slight recovery occurred at the very end: I do not feel justified in suggesting a cause for it. In Tables XXI and XXII, I show that sterility of the stamens increases towards the death of the plant.

In Tables XXIII–XXV, I show that the stamens—the organs which profit chiefly as we have seen by the extreme of vigour—lose by its loss; and consequently the flowers are most male when blossoming begins.

In Table XXVI, I have represented Table XV in a different way, so as to bring out sharply the division of vigour (*i.e.*, number of organs) between the different sets (moods). I can show by it that the flowers with more than 20 organs, there apparently is a setting aside *ab initio* of so much vigour for the carpellary mood, the staminal mood becoming residuary legatee; while in flowers with fewer than 20 organs the carpellary mood has to jostle with the preceding ones for its place. I show also by it and by the Table which follows it (XXVII), that there are certain irregularities which seem to be due to a borrowing of organs by the staminal set from the petals, which

borrowing as may be noticed in Table XII, (see p. 102) probably is a more common occurrence in the German races than in the Kew race.

The last two Tables (Nos. XXVIII and XXIX) show the relative abundance of abnormal petals and staminodal petals at different times in the plants flowering.

The net result of the investigation is that we have in *Ranunculus arvensis* just a little of what (for want of a better term) may be called foresight in the formation of the flower. We find the flower completed however scanty the nutrition for it may be; and, when the nutrition is adequate, provision is, it seems, made in good time for the carpellary mood. The next problem will be to show how far in such a flower as that of Parnassia or of any Phanerogam, the constancy of the carpels is due to provision made for them when the bud first begins to be formed. Can the sepaline mood lead the carpellary by the nose, or is the carpellary not too important to the race to be without an assertiveness of its own?

It is interesting to observe that the staminal mood forms a sort of residuary legatee to the three early moods of the flower; interesting because we not uncommonly find that mood to disappear under conditions which have generally been ascribed to something disadvantageous to the plant (see Willis, On Gynodiœcism, 3rd paper, *Proc. Cambridge Phil. Soc.*, viii., 1893, p. 129).

We have sought in passing for any indication in the flower which might suggest that pressure of organ on organ exercises an influence in shaping the flower; and we found that flowers of 20 organs did come near to having the formula $K_5C_5A_5G_5$: and in Table V we saw K_4C_4 and K_3C_3 to be commoner combinations than $K_4C_{3 \text{ or } 5}$ (especially 5) and K_3 C_4 or indeed any other number, and in Tables VI and VIII ten stamens to be commoner than nine or eleven in association with five sepals or with five petals. These observations do not suffice for building up any very definite statement.

It is equally advisable at present from these tabulutions to make no statement regarding the possibility of female organs demanding per unit for their inception more nutriment than male organs.

One notices in regard to the variation of the flower of *Ranunculus arvensis* that it is always hungry, *i.e.*, always capable to taking in more organs; the hungriest of its moods is that for the formation of stamens, next that for the formation of carpels, thirdly that for petals and least hungry that for sepals.

Just as we find sepals to tend to be constant in number throughout our larger groups such as the Dicotyledons and Monocotyledons; petals to be constant in number in lesser groups; carpels to serve by their constancy for the defining of orders, and stamens to be by number the least serviceable in the making of a classification of Phanerogams, so do we find sepals to have the greatest tendency to be constant in *Ranunculus arvensis*, petals next so, carpels in the third place and stamens last, *i e.*, what we see in a broad view of the whole Phanerogamic Sub-Kingdom, we see again in the variation of the flower of this little weed.

I had intended to deal with variation in *Nigella sativa* and *Delphinium Ajacis*, when writing on *Ranunculus arvensis* but my facts, are insufficient. They may, however, be said to be indicative of a reduction in number of all parts with age. For the present I withhold them.

My thanks are cordially given to the Cambridge Botanic Garden Syndicate for the facilities afforded to me in the University Garden, and to all who have helped me. The tedious operation of casting my figures into tables has in Calcutta occupied the time for several months of a clerk, Babu Kanai Lall Das.

PLATE IV.

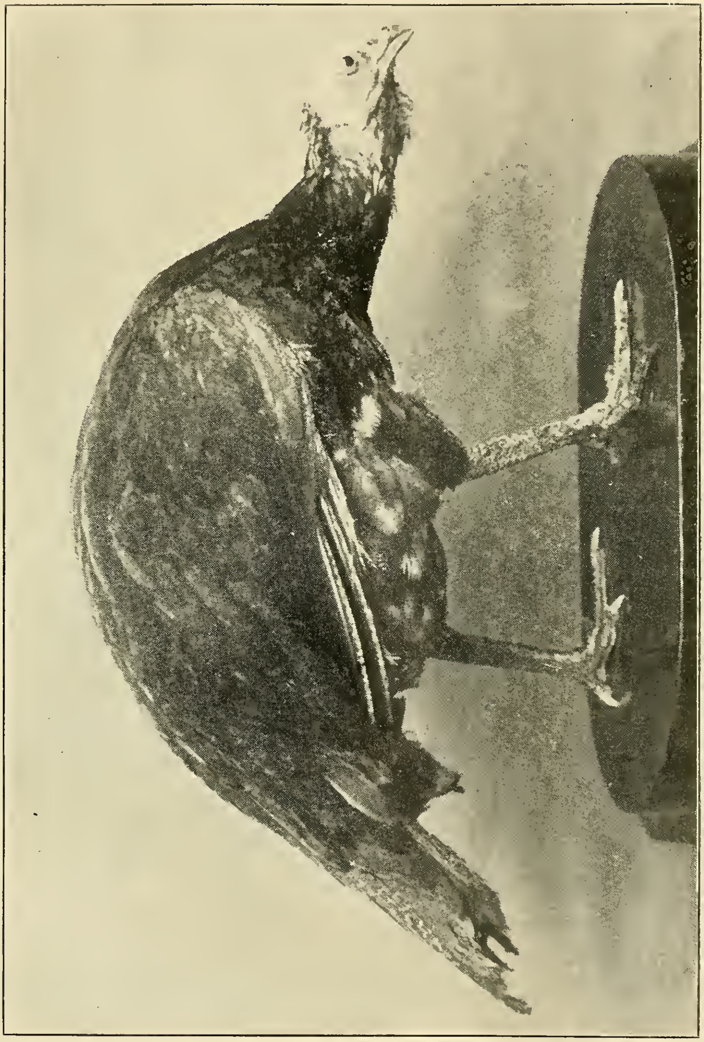
GALLINULA PYRRHORHOA (*Blyth's Mauritius Specimen*).

PLATE V.

BILLS AND FRONTAL SHIELDS OF MOOR HENS.

G. PYRRHORHOA (*Mauritius.*) — G. GALEATA. — G. GALEATA (*Lake St. Clair.*) — G. CHLOROPUS.

PLATE VI.



HYBRID BETWEEN GUINEA-FOWL AND COMMON FOWL.

NEW SERIES. VOL. LXXI. CCCCIII.

JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL,

Vol. LXXI. Part II, No. 3.—1902.

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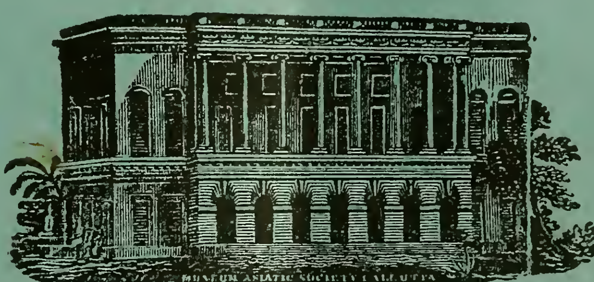

"The bounds of its investigation will be the geographical limits of Asia: and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."—SIR WILLIAM JONES.

*** *Communications should be sent under cover to the Secretaries, Asiat. Soc., to whom all orders for the work are to be addressed in India; or care of Messrs. Luzac & Co., 46, Great Russell Street, London, W. C., or Mr. Otto Harrassowitz, Leipzig, Germany.*

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Page 104 eight lines from bottom

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JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL,

Vol. LXXI. Part II.—NATURAL SCIENCE.

No. III.—1902.

X.—*On a collection of Birds from Upper Burmah.—By* Lieut. H. Wood, R.E., *and* F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

(With Plate VII.)

[Received 30th April. Read 7th May, 1902.]

In the following paper Lieut. Wood is responsible for the general introduction and remarks on localities where the birds were collected; while the birds have been identified and annotated at the Indian Museum by the Deputy Superintendent. Almost all of the specimens have been generously presented to that institution by Lieut. Wood, and the accession is a particularly welcome one, as several rare species are represented, such as *Trochalopterum erythrolaema.*

The collection is also noteworthy as containing examples of two species new to the Indian fauna, Père David's Babbler (*Babax lanceolatus*) and the Marsh Tit (*Parus palustris*). It has been deemed worth while to have these figured, on account of their interest from a distributional point of view. (See Plate VII).

The collection was made in that part of Burmah which is bounded on the west by the high range which divides the Pakokku and Minbu districts from the Chin Hills, and on the east by a parallel range which runs more or less due north and south, distant about 30 miles, and known locally under different names as the Pontaung

Nwamataung, Dudwataung, &c. Latitude 22° formed approximately the northern boundary and 20°15′ the southern. A few specimens were however procured outside this tract while marching from Pakokku, the headquarters of the district of that name and situated on the River Irrawaddy.

The country within the boundaries described above is hilly, the average height of the eastern range being about 1,500 feet while some of the peaks are higher.

From this range the country is broken up by a number of smaller ranges, each slightly lower till the foot of the western range is reached. Along the foot of the eastern slopes of this range there is nearly always a large river which breaks through the range and then turns immediately due north or south and flows in this direction for some distance till it finds a low place in the eastern range through which it can pass. The Maw, Man, Salin and Mon Rivers are all met in this way. The western range is much higher than those to the east. The average height being about 5,000 to 6,000 feet, while Mount Victoria (the highest peak in Burmah, 10,300 feet) is one of the peaks on the range within the limits. The country is heavily forested except in the valleys of the main streams, where rice is principally grown.

Pakokku, Long. 95°10′, Lat. 21°18′, height 300 feet. The headquarters of the district of that name. It is situated on the west bank of the Irrawaddy River and is in the dry zone of Upper Burmah. Outside the cultivation which surrounds the town, the country is covered with scrub jungle.

Kanhla, Long. 95°2′, Lat. 21°17′, height 400 feet. A small village on the Pakokku-Pauk Road; surrounding country scrub jungle.

Pauk, Long. 94°30′, Lat. 21°29′, height about 900 feet. A large village on the Pakokku-Tilin cart-road, situated just to the east of the first high range met with while marching west from the Irrawaddy River. The Yaw River flows about a mile to the east of the village. Outside the cultivation there is scrub jungle which gradually changes to forest as the hills are approached. It is on the west edge of the "dry zone"

Kyin, Long. 94°18′, Lat. 21°37′, height about 2,000 feet. A small village on the Pauk-Tilin cart-road, situated to the westward of the first high range which is met with while marching westward from the Irrawaddy River. A small area of cultivation surrounds the village; beyond this is dense forest.

Ta-hnyin-taung, Long. 94°15′, Lat. 21°37′, height about 2,500 feet. A spur running westwards from the first high range met with while going west from the Irrawaddy. This high range is known locally under a number of different names but it runs more or less along meridian of 94°20′. It is covered with dense forest.

Tilin, Long. 94°8′, Lat. 20°13′, height about 1,500 feet. A large village at the foot of the Chin Hills on the right bank of the Maw River. The cart-road to Gangaw from Pakokku passes through the village. Outside the cultivation the country is covered with dense jungle.

Man, Long. 94°17′, Lat. 21°18′, height about 1,500 feet. A small village on the Pauk-Pasok cart-road, situated to the west of the first high range met with while going west from the Irrawaddy. The village is surrounded by dense jungle outside the small patch of cultivation.

Pontaung, Long. 94°18′, Lat. 21°20′, height 1,900 feet. The first high range met with while going west from the Irrawaddy; on the lower slopes the forest is principally bamboo, which gradually changes into timber trees (teak, etc.), as the range rises in height.

Laungshé, Long. 94°10′, Lat. 21°0′, height about 1,000 feet. A large village situated at the foot of the Chin Hills just where the Salin River breaks through. A good deal of rice is cultivated in the valley and it was on the cultivation that most of the birds were shot here.

Kanpetlet, Long. 94°0′, Lat. 21°14′, height 7,000 feet. At this place on the slopes of Mount Victoria the headquarters of the Pakokku Chin Hills are being built. It at present consists of two or three houses, while barracks for about 60 sepoys are being built. Mount Victoria, the summit of which is 10,300 feet, is the highest hill in Burmah and is the culminating point of the high range which runs from Manipur southwards more or less along the meridian of 94°. A long spur emanates from the summit running in an easterly direction, and it is on this spur that Kanpetlet is situated. In the valleys the forest is very dense, while on the spurs there are large open spots covered with grass alternating with tracts of fairly open fir forest. Birds labelled Mount Victoria were shot on the way up to Kanpetlet from Saw, the village at the foot of the spur.

Dudawtaung, Long. 94°18′, Lat. 21°5′, height about 2,000 feet. A range of hills about 2,000 feet high running north and south, the first high one that is met while marching west from the Irrawaddy River. It is covered with fairly dense forest.

Yinkwètaung, Long. 93°58′, Lat. 20°44′, height 5,500 feet. The local name of one of the spurs which run eastward from the high range which forms the boundary between Pakokku district and the Chin Hills. Near the summit the spurs are bare of trees and covered with grass. In the valleys and on spurs below about 5,000 feet there is dense jungle.

Nwamataung, Long. 94°18′, Lat. 20°4′, height about 2,500 feet. A local name of the same range which to the north is known as Dudawtaung.

Salin, Long. 94°44′, Lat. 20°35′, height 250 feet. A large village on the Salin River about 10 miles on the west of the Irrawaddy River. It is in the dry zone and outside the cultivation is scrub jungle.

Sidôktaya, Long. 94°15′, Lat. 20°25′, height 2,000 feet. A large village situated at the foot of the Chin Hills on the bank of the river Mon. A large area of cultivation lies to the east of the village, while to the westward dense jungle comes very close.

Dalet Choung, Long. 94°0′, Lat. 20°10′, height 300 feet. A river which rises in the Arakan Yomas and flows due south reaching the sea between Akyab and Kyaukpyu. The surrounding hills are all densely covered with bamboo jungle.

Family **Corvidæ.**

Urocissa occipitalis. *Red-billed Blue Magpie.*

Two, Laungshé, January 11th, 1902; one, Kyin Village, November 30th, 1901.

Dendrocitta rufa. *Indian Tree-pie.*

One, Laungshé, January 12th, 1902; one, Man, December 25th, 1901.

Crypsirhina cucullata. *Hooded Racket-tailed Magpie.*

One, Sidôktaya, February 14th, 1902.

Garrulus oatesi. *Indo-Chinese Jay.*

One, Kanpetlet, January 3rd, 1902.

Parus palustris. *Marsh-Tit.*

One, Kanpetlet, January 14th, 1902.

This specimen undoubtedly belongs to one of the races of *P. palustris.* The dimensions are rather large, the length being 4·9 inches, wing 2·5, tail 2·1, bill from gape ·4, and shank nearly ·6. The colour above is olive grey, or drab; below a dirty drab-white. The cap and nape are glossy black, and the sides of head and neck pure white; the throat black with white tips to the feathers. The bill and feet are greyish black in the skin.

[The specimen agrees perfectly with some Chinese specimens of *P. palustris*, recently procured by Captain Walton, I.M.S.]

Family **Crateropodidæ.**

Garrulax leucolophus, *Himalayan White-Crested Laughing-Thrush.*

Two, Laungshé, January 12th, 1902.

Garrulax pectoralis. *Black-gorgeted Laughing-Thrush.*

One, Dudawtaung, December 26th, 1901; one, Laungshé, January 11th, 1902. The latter has the under-surface buff throughout up to the chin. Both have the light tips to the tail-feathers pure white.

GARRULAX MONILIGER. *Necklaced Laughing-Thrush.*

One, Ta-hnyin-taung, December 10th, 1901.

The ear-coverts of this bird are *entirely* black; tips of tail pure white.

BABAX LANCEOLATUS. *Père David's Streaked Babbler.*

One, Kanpetlet, January 4th, 1902.

As this bird does not seem to be well known, I give a description of the specimen. Length about $11\frac{1}{4}$ inches; wing 3″·8; tail 5; bill from gape 1·1; shank at front 1·2.

Plumage striated, with the exception of the visible parts of the wings and tail, which are plain olive, as also the upper tail-coverts. Centres of the feathers above blackish, shading into chestnut on each side, with the outsides edged on the neck with creamy white and on the back with olive. Lores, ear-coverts, and eye-brow, white slightly mixed with black; a strong black moustache running into a mottled black-and-white patch behind the ear-coverts. Under-surface creamy white streaked with black, the black streaks getting finer upwards and fading out on the throat, and becoming bordered with chestnut on the flanks; lower tail-coverts plain buff.

From the descriptions and figures of David and Oustalet (Oiseaux de Chine) J. Verreaux (Nouv. Arch. du Museum, Bull. VII, 1871) and Dr. R. B. Sharpe (B.M. Cat. Birds, Vol. VII.), *Babax lanceolatus* would appear to have a uniformly chestnut head, the dorsal plumage edged with grey, not olive, and the ventral surface less striated than in our bird, in which also the tarsi seem considerably shorter.

At the same time, without specimens for comparison, I do not like to regard the present bird as deserving of specific distinction; if it be so I would propose the name of *Babax woodi* for it.

TROCHALOPTERUM ERYTHROLÆMA. *Hume's Laughing-Thrush.*

Two, Yinkwètaung, January 19th, 1902; one, same locality, January 20th, 1902.

TROCHALOPTERUM VIRGATUM. *Manipur Striated Laughing-Thrush.*

One, Kanpetlet, January 3rd, 1902; one, Kanpetlet, January 4th, 1902.

ARGYA GULARIS. *White-throated Babbler.*

Two, Pakokku, November 19th, 1901.

MYIOPHONEUS TEMMINCKII. *Himalayan Whistling-Thrush.*

One, Yinkwètaung, January 27th, 1902.

LIOPTILA GRACILIS. *Grey Sibia.*

One, Yinkwètaung, January 18th, 1902; two, January 27th, 1902; one without date or locality.

Aegithina tiphia. *Common Iora.*

One, Pakokku, November 21st, 1901; one, Pauk, November 27th, 1901; one no date or locality.

Chloropsis aurifrons. *Gold-fronted Chloropsis.*

One, Ta-hnyin-taung, November 8th, 1901; one, same locality, December 2nd, 1901; one, same locality, December 10th; one, Man, December 14th; one, same locality, December 20th; one, same locality, December 24th; one, Dudawtaung, January 7th, 1902.

Chloropsis chlorocephala. *Burmese Chloropsis.*

One, Ta-hnyin-taung, no date; one, same locality, December 3rd, 1901.

Hypsipetes psaroides. *Himalayan Black Bulbul.*

One, Yinkwètaung, January 29th, 1902.

Hemixus maclellandi. *Rufous-bellied Bulbul.*

One, Yinkwètaung, November 2nd, 1901; two, same locality, January 18th, 1902; one, same locality, January 19th; one, same locality, January 27th; one, same locality, no date available.

Alcurus striatus. *Striated Green Bulbul.*

One, Yinkwètaung, January 20th, 1902.

Molpastes burmanicus. *Burmese Red-crested Bulbul.*

One, Tilin, December 12th, 1901.

Xanthixus flavescens. *Blyth's Bulbul.*

One Kanpetlet, January 4th, 1901.

Otocompsa flaviventris. *Black-crested Yellow Bulbul.*

One, no data; one, Ta-hnyin-taung, December 3rd, 1901; one, same locality, December 6th.

Family **Sittidæ.**

Sitta himalayensis. *White-tailed Nuthatch.*

One, Yinkwètaung, January 20th, 1902.

Sitta nagaensis. *Austen's Nuthatch.*

One, Kanpetlet, January 4th, 1902.

Sitta frontalis. *Velvet-fronted Blue Nuthatch.*

Two, Ta-hnyin-taung, December 7th, 1901; one, Man, December 25th.

Family **Dicruridæ.**

Dicrurus ater. *Black Drongo.*

One, Pakokku, November 23rd, 1901; a decidedly small specimen.

Dicrurus cineraceus. *Grey Drongo.*

One, Ta-hnyin-taung, December 8th, 1901.

Bhringa remifer. *Lesser Racket-tailed Drongo.*

One, Ta-hnyin-taung, December 8th; one, same locality, December 10th.

Dissemurus paradiseus. *Larger Racket-tailed Drongo.*

One, Ta-hnyin-taung, December 5th, 1901; one, no locality.

Family **Lanidæ**.

Lanius collurioides. *Burmese Shrike.*

One, Pakokku, November 19th, 1901; one, Yinkwetaung, February 2nd, 1902. The first specimen has the *two* outer pairs of tail-feathers white with black shafts, and the *next* pair white with a long black patch on the inner web, the rest being black tipped with white; the under-parts are also very pale, creamy white in fact. The dimensions are also smaller than those given in the *Fauna of British India*, Vol. I, p. 463. The crown and nape are dark ashy, and the forehead and lores black. The second has the tail normally coloured, and pale fulvous under-parts.

Tephrodornis pelvicus. *Nepal Wood-shrike.*

One, Ta-hnyin-taung, December, 1901.

Pericrocotus fraterculus. *Burmese Scarlet Minivet.*

One, Ta-hnyin-taung, November 4th, 1901; two, same locality December 4th; one, Pauk, November 27th, 1901; one, Mt. Victoria, December 30th; one, Kanpetlet, January 4th, 1902.

Pericrocotus brevirostris. *Short-billed Minivet.*

One, no locality or date; one, Kanpetlet, January 4th, 1902.

Pericrocotus peregrinus. *Small Minivet.*

Three, Man, December 22nd, 1901; one, Pauk-Tilin Road, November 29th, 1901.

Family **Oriolidæ**.

Oriolus tenuirostris. *Burmese Black-naped Oriole.*

One, Pauk, November 27th, 1901.

Oriolus melanocephalus. *Indian Black-headed Oriole.*

One, Ta-hnyin-taung, December 4th, 1901; one, same locality, December 8th; one, Pakokku, 22nd November; one, Tanksoh, February 9th, 1902; one, Man, December 22nd, 1901; one, Dudawtaung, January 7th, 1901.

Family **Sturnidæ**.

Graculipica burmanica. *Jerdon's Mynah.*

One, Pakokku, November 20th, 1901; one, no date.

The birds referred to *Sturnia nemoricola* in J. A. S. B. 1900, pt. II. p. 116 are, I find, of this species; at least the four specimens kindly presented by Colonel Bingham to the Museum belong to it.

Family **Muscicapidæ**.

Cyornis rubeculoides. *Blue-throated Flycatcher.*

One, Ta-hnyin-taung, December 2nd, 1901; one, Pontaung, February 2nd, 1902.

Culicicapa ceylonensis. *Grey-headed Flycatcher.*

One, Ta-hnyin-taung, December 8th, 1901.

Rhipidura albifrontata. *White-browed Fantail Flycatcher.*

One, Pakokku, November 20th, 1901.

Family **Turdidæ**.

Pratincola caprata. *Common Pied Bush-chat.*

Three, Pakokku, November 19th, 20th and 21st, respectively; one, Laungshé, January 12th, 1902.

All have the black plumage fringed throughout with fulvous, except the bird killed on November 21st, which shows no such edgings at all except a few barely perceptible specks on the belly.

Copsychus saularis. *Magpie-Robin.*

One, Pakokku, November 21st, 1901.

This is by plumage a female, and has the fulvous parts of the under-surface finely cross-barred with a lighter shade.

Petrophila erythrogastra. *Blue-headed Rock-Thrush.*

One, Kanpetlet, January 3rd, 1902; two, same locality, following day.

Petrophila solitaria. *Eastern Blue Rock-Thrush.*

One, Pakokku, November 11th, 1901.

Not typical, but only showing a little chestnut on the under-tail coverts.

Petrophila cyanus. *Western Blue Rock-Thrush.*

One, Dudawtaung, January 7th, 1902; one, Laungshé, January 11th; one, Nwamataung, February 2nd, 1902. The last shows one red under-tail covert.

Oreocincla dauma. *Small-billed Mountain-Thrush.*

One, Dudawtaung, January 8th, 1902.

Family **Fringillidæ**.

Passer flaveolus. *Pegu House-Sparrow.*

One, Pakokku, November 21st, 1901; one, same locality, November 23rd.

Family **Nectariniidæ.**

Arachnechthra asiatica. *Purple Sun-bird.*

One, Salin, February 4th, 1902.

Family **Picidæ.**

Gecinus occipitalis. *Black-naped Green Woodpecker.*

One, Pakokku, November 19th, 1901; one, Man, December 24th.

Hypopicus hyperythrus. *Rufous-bellied Pied Woodpecker.*

One, Kanpetlet, January 4th, 1902.

Iyngipicus canicapillus. *Burmese Pigmy Woodpecker.*

One, Ta-hnyin-taung, December 4th, 1901; one, same locality, December 7th; one, Dudawtaung, January 7th, 1902.

Tiga shorei. *Himalayan Golden-backed Three-toed Woodpecker.*

Two, Ta-hnyin-taung, killed on December 5th and 7th, respectively. Both have the rudimentary hallux previously described by me as characteristic of this species. (J. A. S. B. 1899, pt. II. p. 242).

Chrysocolaptes gutticristatus. *Tickell's Golden-backed Woodpecker.*

One, Ta-hnyin-taung, December 11th, 1901.

This specimen, a male by plumage, has the red of the rump running right up to the shoulders, but shows none on the wings or scapulars.

Family **Capitonidæ.**

Thereiceryx lineatus. *Lineated Barbet.*

Three, Ta-hnyin-taung, December 2nd, 4th and 5th, respectively; one, Pontaung, December 21st.

Cyanops asiatica. *Blue-throated Barbet.*

One, Ta-hnyin-taung, December 4th, 1901.

Family **Coraciidæ.**

Coracias affinis. *Burmese Roller.*

One, Pakokku, November 20th, 1901; two, Laungshé, January 12th, 1902; one, Man, December 26th, 1901.

Family **Meropidæ.**

Merops viridis. *Common Indian Bee-eater.*

One, Pakokku, November 20th, 1901; one, no date.

Both very rufous on head, nape and upper back.

Family **Alcedinidæ.**

Ceryle varia. *Indian Pied Kingfisher.*

One, Pakokku—Pagan Road, November 25th, 1901.

HALCYON SMYRNENSIS. *White-breasted Kingfisher.*

One, Pakokku, November 20th, 1901; one, Kanhla, November 21st; one, Laungshé, January 12th, 1902.

Family **Bucerotidæ.**

ANTHRACOCEROS ALBIROSTRIS. *Indo-Burmese Pied Hornbill.*

One, Dalet Choung, February 27th, 1902. A small specimen, but rather over the measurements given in the *Fauna of British India* for the smaller race of this species.

Family **Upupidæ.**

UPUPA INDICA. *Indian Hoopoe.*

One, Ta-hnyin-taung, December 6th, 1901.

Family **Cuculidæ.**

RHOPODYTES TRISTIS. *Large Green-billed Malkoha.*

Two, Kyin Village, November 30th, 1901; two, of which the data are illegible, all the specimens being very greasy, and mostly unfit to keep. All possess eyelashes, although the genus is stated (F.B.I. Birds, Vol. III, p. 230), to want these.

CENTROPUS SINENSIS. *Common Coucal or Crow-Pheasant.*

One, Man, December 6th, 1901.

Family **Psittacidæ.**

PALÆORNIS TORQUATUS. *Rose-ringed Paroquet.*

One, Pakokku, November 22nd, 1901; one, Pauk-Tilin Road, November 29th.

PALÆORNIS FASCIATUS. *Red-breasted Paroquet.*

One, Pakokku, November 21st, 1901.

Family **Asionidæ.**

ATHENE BRAMA. *Spotted Owlet.*

One, Pakokku, November 19th, 1901.

Family **Falconidæ.**

SPILORNIS CHEELA. *Crested Serpent-Eagle.*

A pair of feet with a few feathers attached clearly belong to this species.

BUTASTUR TEESA. *White-eyed Buzzard-Eagle.*

One, Pakokku-Pauk, November 24th, 1901.

HALIASTUR INDUS. *Brahminy Kite.*

One, Pakokku, November 22nd, 1901.

FALCO JUGGER. *The Laggar Falcon.*

One, Pakokku, November 22nd, 1901.

A beautiful adult example of this species.

TINNUNCULUS ALAUDARIUS. *Kestrel.*

One specimen without data.

MICROHIERAX EUTOLMUS. *Red-legged Falconet.*

One, Ta-hnyin-taung, December 9th, 1901.

Family **Phasianidæ.**

PHASIANUS HUMIÆ. *Mrs. Hume's Pheasant.*

One specimen obtained at Kanpetlet, January 2nd, 1902. This is by plumage a male, and is of the typical Manipur form with steel-blue rump-feathers narrowly edged and barred with white. Only the front of the neck, however, is steely-*black*, the sides and back of the neck being steely-*grey*, contrasting with the colour of the throat and breast.

GENNÆUS sp. ?

One female specimen obtained at Yinkwètaung on February 2nd 1902, most closely agrees with Mr. Oates' description of what he calls (Manual of the Game-Birds of India, Vol. 1, p. 365,) the North-Arrakan Silver Pheasant; but it has the *two* centre pairs of tail feathers chestnut with dark brown pencillings, the rest being black with chestnut pencillings progressively diminishing to the outermost feathers.

ARBORICOLA INTERMEDIA. *Arrakan Hill Partridge.*

One, Yinkwètaung, January 27th, 1901.

Family **Charadriidæ.**

HOPLOPTERUS VENTRALIS. *Indian Spur-winged Lapwing.*

One, Kanhla, November 24th, 1901.

AEGIALITIS DUBIA. *Little Ringed Plover.*

One, Pakokku, November 11th, 1901.

XI.—*Notes on Animals observed at the Alipore Zoological Garden, No. 2. A brief note on the "Doctrine of Telegony" with reference to facts observed in the Zoological Gardens, Calcutta.—By* Rai R. B. Sanyal, Bahadur, *Superintendent.*

[Received April 29th. Read May 7th, 1902.]

The doctrine of telegony as it is understood in Europe and Australia is practically unknown in India.

There is a vague notion among some of the cattle-breeders, especially in parts of Bengal and Behar, that when first covered, a heifer ought to have a high-class bull for its mate.

Be that as it may, no scientific experiments, as far as I am aware have ever been undertaken in India to test the correctness or otherwise of the doctrine to which I have alluded.

I have ventured to bring the following facts to the notice of the Society, not so much for the sake of throwing any light on the subject, especially as Professor Cossar Ewart has already, after a series of careful experiments, proved that there is no equine telegony, but as they were the results of experiments in which a most interesting species of wild cattle was concerned.

In 1898 the Zoological Gardens, Calcutta, came in possession of a small herd of Bantengs (*Bos sondaicus* Müller and Schleg.) a species of wild cattle which mostly inhabit the plains of Burma and the Malay Peninsula and the islands of Borneo, Java, and Bali. One of the heifers was covered by an ordinary country male, which, though not a Brahmin bull as it is ordinarily understood in India, was a sturdy young bull of a very superior character. The offspring of this pairing was a healthy brindled male calf, which already promises to be a fine bull. The opportunity which this occurrence presented of examining the theory of telegony by futher experiments was duly taken advantage of, and the dam of the brindled calf was mated, in proper time, with a healthy bull of its own species. The offspring of this union was a pure bred Banteng calf without any traces of the previous strain. The same cow has had a second pure-bred calf lately.

XII.—*Note on a disputed point in the Life-History of* Helopeltis theivora. —*By* Harold H. Mann, B.Sc.

[Received April 30th; Read May 7th, 1902.]

As is well known, *Helopeltis theivora*,—the "Tea Bug of Assam" as it was called by Mr. Wood-Mason, the "Mosquito Blight" as it is generally termed—is the most alarming pest which has yet appeared on tea cultivated in India. It causes the more disquietude as it tends to increase as years go by,—fluctuating according to season, but generally increasing, and invading new areas. During 1901, which was a particularly bad year in almost all districts subject to the pest, a very moderate estimate gives seven lakhs of rupees as the nett loss to the Indian Tea Industry from this cause alone.

Though we have a knowledge, thanks to Peal,* Wood-Mason,† Dudgeon,‡ Watt§ and Green,¶ of the general life-history of the insect from the egg to the adult stage, yet there remain several points which have been very obscure. Of these the most important is the question as to what becomes of the insect during the time when it apparently disappears from the tea bush. So complete is this disappearance, as a rule, that most planters living in affected districts in North-East India have hardly ever seen a single insect during January, February and March. Mr. Dudgeon has suggested that it hibernates in the ground, but offers no evidence for his position, and declares frankly that he had not been able to verify his conjecture. It has also been supposed that hibernation takes place in water and swamps, but again, not a scrap of evidence in favour of the view exists, and the same may be said of the very general idea among tea planters that in the cold weather the *Helopeltis* goes on to various jungle trees.

With a view of acquiring information on this point, I have spent a considerable time in January, February and March of the present year in two of the districts most affected by the pest—the Darjeeling-Terai, and Cachar—at a period when the insect was supposed to be hibernating. As a result I have come to conclusions of which the following is a summary.

The *Helopeltis theivora* can be found on the tea bush in every stage of development during every period of the year. The cold weather

* Tea Cyclopedia, 1881.

† The Tea Bug of Assam, 1884.

‡ Indian Museum Notes. Vol. III pp. 33-38.

§ The Pests and Blights of the Tea Plant 1898.

¶ Royal Botanic Gardens, Ceylon. Circular, No. 21 (1st Series), 1901.

kills off the bulk of the mature insects and practically all the larvæ, but at all times sufficient remain to carry on the pest to the next season, and in addition the bushes are full of eggs. These latter were found not only in the usual position on the young shoot, but also at a much lower part of the bush than has previously been noticed, embedded in the usual fashion in the midrib of the large mature leaves. The larvæ were found on 11th January in small numbers on unpruned and sheltered bushes, then forming about $2\frac{1}{2}$ per cent. of the total number of insects caught. By 12th February, however, a very different proportion of adults and larvæ were obtained, and now instead of $2\frac{1}{2}$ per cent. the larvæ formed 80 per cent. of the total catch. This proportion was approximately kept up during several weeks from that date. The difficulty in obtaining evidence of their presence at this time is due to their attacking almost entirely the slightly shaded young leaves, the surface growth being rarely injured in the early part of the year.

The insect could, further, not be found on any jungle plant at this time. Though jungle of very miscellaneous character was system atically searched both by myself and by the children who are regularly catching the insect, and who are extremely expert at the work, not a single one was discovered in any form.

It appears, therefore, evident that there is, from present knowledge, no need to assume a hibernating stage at all for *Helopeltis theivora*, and that the insects remain and can be found in every stage of growth from the egg to the mature female full of eggs, in the tea-bush, at all times of the year. Whether the egg found low down in the bush, as described above, can be considered as a special hibernating egg, I can hardly say, but there certainly was no difference in structure or in method of deposition from that usual during the regular season. Inasmuch, then, as there is absolutely *no* evidence of the cold weather being passed by the insect in the soil, in water, or on other trees, and furthermore, as careful observation can always detect the insects and their eggs on tea bushes in affected districts, there is no need to imagine any hibernation stage at all in India, and beyond a certain retardation in development due to the reduced temperature, the reproduction of the insect may be considered to take place in a similar manner throughout the year, and to be carried out on the tea bush itself during the whole period.

These observations have a practical interest, and may lead to a sound method of attempting to deal with the pest, and experiments in this direction are now in progress.

XIII.—*On a pair of Abnormal Deer Horns.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent, Indian Museum.*

[Received May 28th; Read June 5th, 1902.]

I am indebted to His Highness the Maharajah of Cooch Behar, and to Mr. David Ezra (who procured me the loan of them) for the opportunity of exhibiting the very remarkable pair of antlers figured below.

As will be seen they resemble those of the Sambhar (*Cervus unicolor*) in general appearance and in their rough and deeply furrowed surface; but the terminations are much more branched than is usual in this species, which has only two terminal tines. In the present specimen there are no less than five terminal points, and the two horns are not at all alike, the branch representing the longer terminal tine in the normal horn being palmate or flattened in the left horn of this pair. (See figure on page 135.)

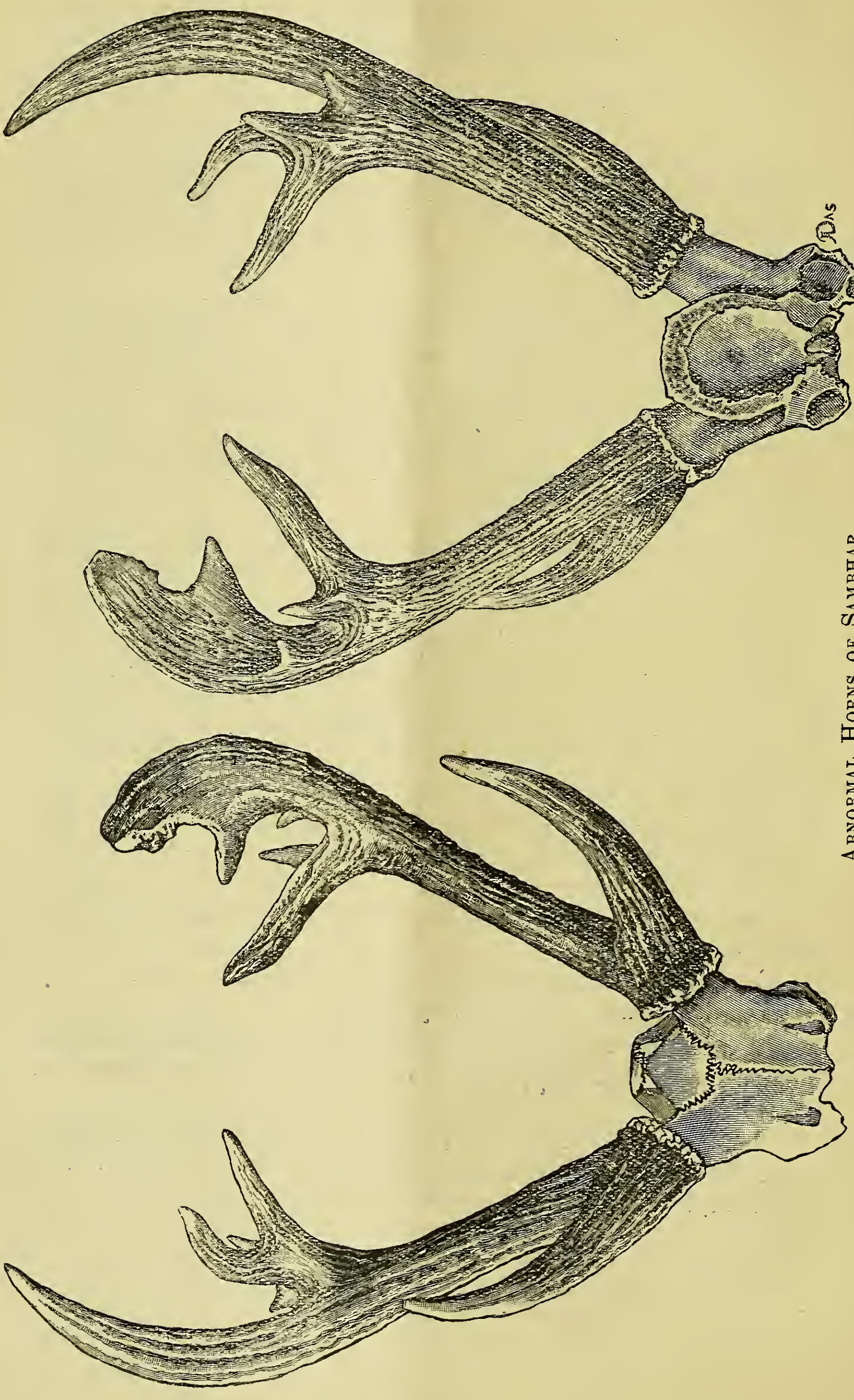
The number of points in this specimen no doubt accounts for the statement that was made to me by Mr. Ezra, that the animal which bore the horns was a hybrid between the Sambhar and the Barasingh (*Cervus duvauceli*). But in the absence of any information as to the appearance of the rest of this stag's body, I am inclined to put the specimen down as an abnormal Sambhar, some Sambhar horns in the collection exhibited in the Mammal Gallery also showing supernumerary points, though not to this extent. A very fine head in the Asiatic Society's collection, alluded to by Mr. W. L. Sclater in his pamphlet "Notes on Indian Horned Game," has nine points, both terminal tines of the right horn and the anterior or outer terminal tine of the left, being bifurcated.

Another has a third terminal tine on the right horn, directed downwards and backwards.

A third has a snag to the brow tine of the right horn, the terminal tines of the beam of which are very small.

A fourth has three small snags at the base of the beam of the right horn, and a small accessory snag on the large outer terminal tine of the left.

It is noteworthy that in all these cases the excess of points affects the right horn; but in one specimen, the single extra point, a very small one, is on the inner terminal tine of the left.



Abnormal Horns of Sambhar.

Mr. Ezra informs me that the present animal was killed in the Maharajah's territories six years ago.

XIV.—*Notes on Animals observed at the Alipore Zoological Garden.* No. III. *Melanic specimens of Common Palm Squirrel* (Sciurus palmarum, *Linn.*)—*By* Rai R. B. Sanyál Bahadur, *Superintendent, Alipore Zoological Garden.*

[Read June 4th, 1902.]

Squirrels, it is well known, are subject to great diversity in size, form and colour. The upper surface of the body of the large Indian Squirrel (*Sciurus indicus*, Erxl.) is usually of a maroon red colour, but darker, almost black individuals with thicker coats are not uncommon. Apart from their seasonal dimorphism, no two specimens of the *Sciurus bicolor* of Sparrmann are alike; and it is no wonder that the species proved a puzzle to Desmarest, Horsfield, Is. Geoff. St. Hilaire, and other naturalists of classic repute, each of whom described it under a different name. Palm Squirrels (*Sciurus palmarum*, Linn.) so common and abundant in Bengal, North-Western Provinces, the Punjab, and Central India, are also remarkable for great diversity of form and colour, and this tendency to variation in colour, which is so characteristic of the genus, has led, in the case of the Palm squirrels, to an increase in the deposition of pigment, resulting in the production of a definite melanic form.

Melanism as a common colour phenomenon is well known to naturalists, but as far as I remember, I have seen no case of complete melanism in squirrels recorded in the literature of the genus, and I have therefore ventured to exhibit to the Society a melanic specimen of a Palm squirrel which lately came under my observation. The following notes sent to me by Haji Mahammud Mustapha Khan of Aligarh, the donor of the animals, will, I hope, be found interesting:

"Some time in December last [1901], so far as I can recollect, my bearer came to me in Aligarh and said he had seen four or five black squirrels in the jungle at Burhegaon. Burhegaon is the headquarter village of my estate, in Tahsil Atrauli in this district, and lies about 25 miles east from Aligarh. I told him to try and catch them, and explained to him how best to do it by the usual basket snare. About a fortnight later, when I had gone to stay for a time at Burhegaon, he brought one of the squirrels to me. A couple of weeks after that he brought a second one. So far as I can judge they seem to be a male and a female. There was a third, he told me, which eluded capture on the second occasion. They seemed to me uncommon, and remembering to have heard, at a District Board Meeting, that the Secretary of the Zoological Gardens at Alipur would be glad of help in procuring interesting additions to his family, I mentioned the matter to Mr. Brownrigg, then Collector of the District. I have always taken an interest in animals, but had never seen any black squirrels like these before. I am told that there are still, perhaps, three or four more at large in the jungle where this pair came from, but they are now very wild, and do not allow any one to approach them. I am also informed, by those who have seen them, that these black squirrels live apart by themselves on separate trees, and do not associate with their less distinguished grey-mantled brethren. The boycott is probably mutual. I have no reason to think that they came to Burhegaon from any outside source. So far as I can see they are a freak of nature."

It would be interesting to observe other forms of animal life in the jungle in which these melanic squirrels were found, and to note whether there is any preponderance of black in them also. The fact, if proved in the affirmative, will give additional support to the theory of colour change induced by environmental causes.

This is, however, not the first time that melanic squirrels are exhibited in the Calcutta Zoological Garden. In 1877, a couple of them were obtained from Assam, and lived for about a year.

On Tidal Periodicity in the Earthquakes of Assam.—By R. D. Oldham, *Superintendent, Geological Survey of India.*

(Communicated by permission of the Director of the Geological Survey of India). [Received July 21st, Read August 6th, 1902.]

I.—Introductory.

Ever since earthquakes were first studied there have been repeated and persistent attempts to trace the action of the sun, the moon, and the planets in producing them, or at the least in influencing their relative frequency. Mallet, from the discussion of his great earthquake catalogue [1], found that there was a marked periodicity, which caused earthquakes to have a maximum frequency towards the end of each century, with a minor, but nearly as great, maximum a little before the middle; and, more recently, Dr. A. Cancani has remarked a similar peculiarity in the earthquakes of Italy.[2] Periods of this length, however, have no direct and obvious connection with the movements of the heavenly bodies, and more interest attaches to variations of shorter periods. Perrey, and following him Mallet,[3] believed that they had detected such variations, and that the frequency of earthquakes showed a relation to the distance of the sun and the moon from the earth, and to their relative positions in the heavens, at the syzygies and quadratures. As a result of this careful investigation it had been generally accepted that earthquakes were more frequent during winter than in summer and during the night than during the day.

In 1889 the subject was again attacked by M. F. deMontessus de Ballore,[4] who started by preparing a catalogue of 45,000 earthquakes. From this he proceeded to discuss the diurnal periodicity, and found that though each individual list and record showed a distinct periodicity, there was no agreement among them and that the larger the number of shocks taken the more uniform became the resulting distribution of earthquakes throughout the day and night. In a subsequent paper [5] he applied the same treatment to the seasonal periodicity with a similar result and came to the conclusion that there was no real variation in the frequency of earthquakes, which he regarded as a purely geological phenomenon, unaffected by either astronomical or meteorological influences.

About the same time Dr. Davison began his investigation of

[1] Rep. Brit. Ass., xxviiii, (1858).

[2] Boll. Soc. Sismol. Ital. vii, 205-209 (1901).

[3] Brit. Ass. Rep., xxviii, (1858).

[4] Archives des Sciences Physiques et Naturelles, 3. Ser., xxii, 409, (1889).

[5] Archives des Sciences Physiques et Naturelles, 3. Ser., xxv, 504, (1891).

earthquake frequency, and in a laborious paper,[1] on the annual and semi-annual periodicity of earthquakes, came to the conclusion that, treating each region separately, there was a distinct variation in frequency, which was in excess of that which might be expected if the occurrence of earthquakes was in no way connected with the seasons.

From this brief review it will be seen that the question, of whether earthquakes are at all affected by extra-terrestrial influences, is at present an open one, and for this reason I made every effort, after the great earthquake of 1897, to obtain the fullest possible record of the extremely numerous after-shocks, thinking that if there was any external cause at work it should be especially easy to trace at a time when, and in a region where, the earth's crust was evidently in an extremely unstable condition. The discussion of these records is not complete but iu the case of one of them it has been completed, so far as one particular phase of the frequency is concerned, and the results obtained appear to be of sufficient interest to justify some notice of them.

In July of 1897, Mr. T. D. LaTouche, who was then in Shillong reporting on the results of the earthquake, constructed a seismograph on the duplex pendulum system, which was set up by the Executive Engineer, and from which continuous records have been taken ever since. The instrument, like all seismographs, is far from a perfect one, it does not record many shocks which can be distinctly felt, and it does not record the time, yet the records are of great value. In the first place we know that every shock recorded attained a certain standard of range of motion of the wave particle and of violence, if such a word may be applied to what in many cases are merely slight shocks, and that all the shocks exceeding this standard are recorded. The absence of automatic time record is more serious, but as the time of the shock was, in every case, recorded by the observer we may take it that there is no very serious error or omission in this respect. Every shock recorded represents one at approximately the time given, and the only cause likely to affect the periodicity is a possible error in the case of the night shocks: it is possible that the instrument may at times have registered a shock while the observer was asleep, and the record afterwards referred to one, felt when he was awake, which did not affect the instrument. The uncertainty due to this cause is, however, slight, as the gentlest shock registered by the instrument is sufficiently strong to usually awake a sleeper.

From this instrument we have received records from August 1897, but those discussed as yet only extend to the end of 1901; so far they have only been examined with a view to the hourly variation in

[1] Phil. Trans. clxxxiv, A, 1107 (1893).

frequency, and instead of contenting myself with a mere record of the relative frequency of the earthquakes, as has usually been done in the past, I have made an attempt to see whether there is any trace of extra-terrestrial influence in this frequency.

As pointed out by me in a short note published in 1901[1] any effect which the attraction of the sun and the moon may have, will be most effectively, if not solely, exerted by the Tide-producing forces they set up, and that, to trace the effect of these, it is not sufficient to merely tabulate earthquakes by the hours in which they occur. The time at which the tide-producing forces reach their maximum depends on the declination of the sun and the moon, that is to say it is subject to seasonal variations, and to determine whether these forces have any influence it is necessary to classify the records, according to the position of the sun or moon with reference to the equator, and then examine the frequency to see whether there is any variation which can be correlated with the tidal forces.

II.—Statement of the Problem.

There is neither space nor occasion to recapitulate what is known of the theory of the tides, but a brief account of the form of the tide-producing influence of the attraction of the sun and the moon is desirable, that the nature of the effect to be looked for may be clearly understood, and the review will be simplified by the fact that we need not consider the theory of the tides themselves, but merely of the stresses to which they owe their origin. Omitting all reference to the why, it will be sufficient to point out that the effect of the attraction of a satellite—and in this connection the sun is regarded as a satellite equally with the moon—is to produce a stress equivalent to an upward force at the spot which is at any moment directly under the satellite, and at the antipodes of that spot. Along the great circle half way between these two spots, separated from each by 90° of arc, there is a force acting downwards towards the centre of the earth, and equal in amount to one half of the upward force. At spots between these two points and the great circle just referred to, the stresses produced are equivalent to forces acting in directions away from the vertical, and along a circle which is distant about 54° 44′ 14″ from the spots where the satellite is in the zenith or nadir the force acts horizontally.

Now if we suppose the force exerted at any point to be resolved into two separate forces, one acting vertically and the other horizontally, then the vertical force attains its upward maximum where the satellite is in the zenith or nadir, and its downward maximum along the great circle intersecting the line joining these two points and lying at right

[1] Geol. Mag. 4. Decade, viii, 449, (1901).

angles to it. The horizontal force attains its maximum along two circles distant about 54° 44′ from the zenith and nadir respectively, the direction being towards the satellite in the former case and away from it in the latter. If then the tidal stresses have any influence in determining the time of origin of earthquakes we should look for the effect in connection with these circles.

Both sun and moon, as is well known, vary their position in the heavens, travelling alternately north and south of the equator, the sun moving to about 23°, and the moon to about 26°, from it. From this it follows that neither can ever be in the zenith of any spot distant more than 26° from the earth's equator, that is in more than 26° of latitude either north or south, and no spot situated outside those limits can ever experience the maximum upward force. Within those limits, at either one or two periods in each year, when the declination of the sun and the latitude of any given place are the same in amount and sign, the maximum upward force, due to the sun, will be experienced at midday and midnight; and similarly in each lunar month there will be either one or two periods at which the maximum upward force will be experienced, when the moon is either overhead, mid-moon-day, or underfoot, mid-moon-night. Outside the limits of the two 26° parallels, and within them at all times when the declination of the sun or moon is different in amount or sign from the latitude, the maximum upward force will not be experienced, but, as the earth revolves on its axis, the circles of maximum horizontal and downward force sweep over its surface, and pass any given place at an interval, before and after the meridian passage of the satellite, which depends on the declination of the satellite at the time and the latitude of the place.

From these considerations it will be seen that, before discussing the frequency of earthquakes with reference to the tidal stresses, it is necessary to group them according to their place of origin, and then see whether, for any one district, there is a connection between the relative frequency of earthquakes and the times of passage, over the epicentre, of the circles of maximum tidal force.

One method of discovering whether there is any such connection would be to calculate for each earthquake the exact time which separated the time of its origin from that of the passage of each of the circles of maximum tidal force, and then to classify the records according to these intervals, and see whether there was any preponderance of earthquakes at or about these times. The process would be a laborious one, and, in view of the want of exact accuracy in the times, did not seem worth going through, as a result within the limits of accuracy of the records can be obtained in a simpler manner.

We may assume that the epicentres of the earthquakes now under consideration all lie in 26° N. Lat., without introducing any material error, and, calculating for that latitude the time intervals, which elapse between the meridian passage of the satellite and the passage of the tidal circles, we obtain, for extreme and mean values of declination the intervals given in the tabular statement below, [1] where 0 h represents the lower, and 12 h. the upper, meridian passage, or midnight and midday in the case of the sun.

I.—*Table showing the times of passage of circles of maximum horizontal and vertical Tide-producing force; calculated for Lat. 26° N.*

Decl.	Hor. force, Direct.	Vert. force, Downward.	Hor. force, Indirect.
	12 h. ±	0 h. ±	0 h. ±
	h. m.	h. m.	h. m.
26° N.	4-15	4-38	——
9° N.	3-31	5-34	2-14
0°	2-59	6-0	2-59
9° S.	2-14	6-26	3-31
26° S.	——	7-22	4-15

From this table it is obvious that, if the total number of shocks is divided into three groups, according to the position of the sun, the first comprising those which occurred when the sun was more than 9° N., the second when its declination did not exceed 9° N. or S. and the third when the declination was more than 9° S., then in the first group the effect of the horizontal force must be looked for between $3\frac{1}{2}$ and 4 hours before and after midday, and within two hours on each side of midnight; in the second group the effect is to be looked for between 3 and $3\frac{1}{2}$ hours on either side of midnight and midday; while in the third the condition will be the same as in the first, with the substitution of midnight and midday. Moreover, as the effect may be due rather to the rapidity of changes in the amount, than to the actual amount, of the force exerted, the horizontal force may have but small influence when the passage of the circles takes place at less than two hours on either side of the meridian passage, that is to say, when the intersection of the circles is oblique, and the rate and range of change in the amount of force is less than when the passage takes place at a greater time-interval than 2 hours from the meridian passage. This, combined with the much greater length of time during

[1] The intervals are not exactly the same on either side of the meridian passage on account of the motion of the sun and moon in the heavens, but the inequality is not sufficient to be of importance in this connection.

which the interval exceeds three hours, shows that in a general list of all the shocks the effect must be looked for between 3 and 4 hours on either side of midday and midnight. Further, as it is a common phenomenon in nature that the maximum of effect lags behind the maximum of cause, it may be that the effect will not be found between 3 and 4 hours on either side of the meridian passages, but at some time after that epoch. Another effect which may be looked for, which follows from the consideration of the greater efficiency of the force when its rate of variation is greater, is that we may expect the number of shocks recorded during the day to be proportionately greater when the sun is more than 9° N., that is during the summer, and the night shocks to be proportionately more numerous during the winter, when the sun is more than 9° South of the equator.

There is another supposition which must also be tested, that the effect, if any, of the tidal forces is not to be looked for in connection with the times when they attain their maximum, but with the times at which the rate of change, of amount and direction of the forces, is at its maximum. For any particular place the rate of change always reaches its maximum at 3 hours before and after the meridian passage, but along a great circle, passing through the place of observation and the place where the satellite is in the zenith, the maximum rate of change is at 45° from the latter, and it will be useful to see what is the time interval for different declinations at which a circle 45° distant from this spot passes the place of observation. The result is given in the following table.

II.—*Times of passage of circles of maximum rate of change of the Tide-producing forces calculated for Lat.* 26° *N.*

Decl.	Direct.	Indirect.
	12h ±	0 h ±
	h. m.	h. m.
26°N.	3·22	——
9°N.	2·56	1·56
0°	2·33	2·33
9°S.	1·56	2·56
26°S.	——	3·22

It must be distinctly understood that the times given in this table are not those at which the rate of change is actually greatest, but those at which the rate is greatest, as measured along a different circle to the east and west one, along which the place of observation travels. In the solitary case where this place and the satellite are both on the equator the two agree, and in no other; but the table is useful, for the closer the value in the table approximates to 3 hours the greater is that rate of change, and the closer it lies to 0 h. or 12 h. the less is the rate of variation of the tide-producing forces.

The passage of the circles of maximum vertical force is not subject to the same changes as that of the other circles, and never varies more than 1 h. 22 m. from six o'clock; the effect of this force must therefore be looked for about that time in the morning and evening or somewhat later.

Finally, it is necessary to notice one objection, which might be raised to the preceding passages, that the effect is not necessarily to be looked for at any fixed time before or after the meridian passage of the satellite, but that, for each place, there will be something equivalent to what is known as the "establishment" of a port in the case of marine tides. The objection, however, is not valid, for in this case we have not to do with free travelling waves, like that of the tides, which take a greater or less time to travel from the place where they originate to the place where they are felt, but with the direct effect of the stresses which produce the waves. These depend solely on the latitude of the place and the declination of the satellite, and for them there is nothing in any way analagous to the " establishment " to be considered.

III. Discussion of the Data.

After this preliminary exposition of what is to be looked for, we may pass on to a consideration of the results obtained. In the record discussed there are contained 1274 distinct shocks, and, on counting these, it was found that, in each hour of the twenty-four, the number of shocks recorded was as given in the tabular statement No. III, where all shocks recorded from 0 h. to 0 h. 59 m. are placed under 0, those between 1 h. and 1 h. 59 m. under 1 and so on.

The most casual inspection of this table shows that the shocks are not at all uniformly distributed during the twenty-four hours, and that there is, a great preponderance during the hours preceding midnight, with a lesser increase towards 6 A.M. It may also be noted that the night shocks seem more numerous when the sun is more that 9° S and the day shocks when it is more than 9° N, but no proper comparison is possible on account of the difference in the total number of shocks in each line. For comparison they must be brought all to the same ratio, and this may be done, either by calculating the percentage of the total number of shocks recorded in each hour, or more simply by dividing each figure by the mean value for the line; this gives a result showing the proportion of the number of shocks recorded in each hour to the average number for one hour. In this way we get the result shown in the next tabular statement.

III.—*Hourly distribution of Shocks.*

Sun's Declination / Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL.
>9°N ...	11	15	16	12	13	24	24	8	22	12	22	21	16	13	22	12	27	16	14	17	21	30	28	20	436
9°N–9°S ...	5	8	14	14	26	14	16	16	9	15	13	14	11	18	9	22	22	11	12	13	19	17	21	19	358
>9°S ...	17	21	29	29	22	19	30	16	10	15	8	19	16	12	17	13	22	19	22	20	20	24	41	19	480
TOTAL ...	33	44	59	55	61	57	70	40	41	42	43	54	43	43	48	47	71	46	48	50	60	71	90	58	1274

IV.—*Proportionate distribution of Shocks by hours.*

Sun's Declination / Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
> 9°N ...	·61	·83	·88	·66	·71	1·32	1·32	·44	1·21	·66	1·21	1·16	·88	·72	1·21	·66	1·49	·88	·77	·93	1·16	1·65	1·54	1·10
9°N-9S ...	·33	·54	·94	·94	1·74	·94	1·07	1·07	·60	1·01	·87	·94	·74	1·21	·60	1·47	1·47	·74	·81	·87	1·27	1·14	1·41	1·27
>9°S ...	·85	1·05	1·45	1·45	1·10	·95	1·50	·80	·50	·75	·40	·95	·80	·60	·85	·65	1·10	·95	1·10	1·00	1·00	1·20	2·05	·95
All shocks ...	·60	·80	1·09	1·02	1·19	1·07	1·30	·77	·77	·80	·83	1·02	·80	·84	·89	·93	1·35	·86	·89	·94	1·14	1·32	1·67	11·1

Shillong Seismograph 1897-1901. Hourly curve of frequency smoothed by means of 3 hours.

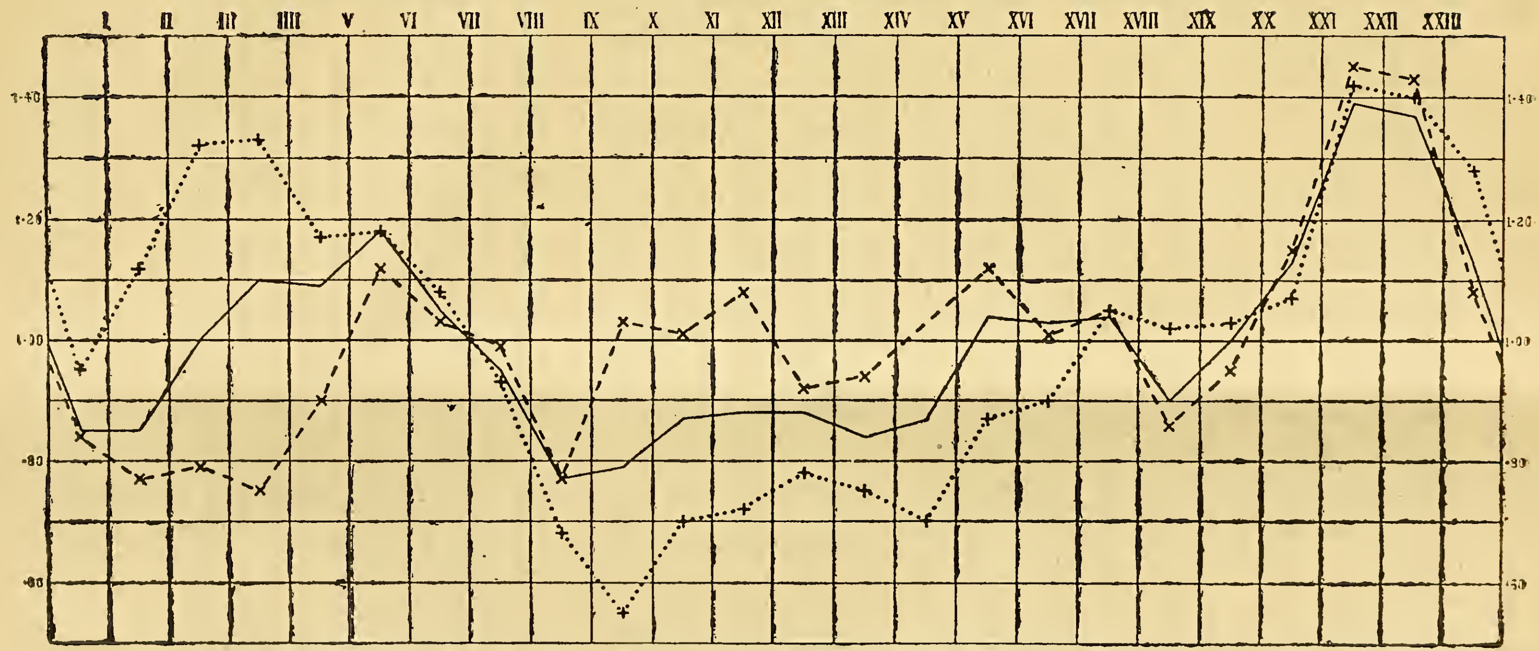


Fig. 1. Curves of diurnal distribution of earthquakes. The continuous line is the general curve obtained from all shocks. The broken line represents the distribution of shocks occurring when the sun's declination was more than 9°N. The dotted line is the curve for shocks occurring when the declination as more than 9°S.

Here we again see that the day shocks are proportionately more numerous when the sun has declination of more than 9°N. than when the sun is more than 9°S. of the equator, and that in the latter case the night shocks are proportionately more numerous than in the former. It is also evident, from the irregularity of distribution from hour to hour, that the number of shocks is not enough to give a near approach to the true curve, when plotted directly, and a process of smoothing has to be adopted. This has been done by adding together the number of shocks recorded during each group of three successive hours and, by regarding them as grouped round the centre of the middle hour, obtaining a fresh series of hourly means, from which a great deal of the irregularity of the curve has disappeared. The result is represented graphically in Fig. 1, so far as the shocks which occurred when the sun was more than 9° north and south of the equator respectively.

From this curve it will be seen that as regards the shocks occurring about two hours before midnight there is little difference, but that for the rest of the twenty-four hours the curve for south declination is steadily above that for north declination throughout the twelve hours of the night, and below it for the day. Moreover there is a distinct maximum in the earthquakes recorded round three hours after and two hours before midnight, while the earthquakes recorded near midnight are much more frequent than when the sun was more than 9° north of the equator. Turning to the shocks recorded when the sun was north of the equator, not only are they proportionately more numerous, than when it was south but there is again a distinct pair of maxima, shortly before and three hours after midday. Among the shocks recorded when the sun was within 9° of the equator we have maxima distinctly marked at about 5 hours after midnight and midday, another at about 2 hours before midnight and a less marked one at about 2 hours before midday.

There is consequently an approach to what might be expected if the tide-producing forces caused by the attraction of the sun had their effect in determining the time of origin of earthquakes, but it is also evident that, if these forces have any effect, it is so small and so complicated by other causes, giving rise to a greater variation in frequency than they do, that it is necessary to adopt some method of discussion, which will more or less completely eliminate the effects of variation, other than those due to the tide-producing forces.

The most obvious of these would be the conversion of the solar into lunar times. The moon moves through the heavens at a rate which brings it on the average about 50 minutes in advance of the sun for each day. If, then, we consider the interval between the two successive similar meridian passages of the moon as representing 24 lunar hours, and convert the recorded times into lunar times, it is obvious that, in a long series of observations, any irregularity of frequency, at any particular hour of solar time, will get spread over the whole of the lunar day, and in its place will be introduced any fresh irregularity due to the position of the moon. Now as the moon has twice the efficiency of the sun, as a tide producer, any irregularities due to the tide producing forces should be double as great as in the case of the sun.

Unfortunately the test cannot be applied in this case as, on trial, it was found that the series of observations was not sufficiently long to eliminate the effect of the diurnal irregularities.

This method of elimination failing, we must fall back on the recorded times, to see whether there is no other method of eliminating the non-tidal diurnal variation, and a method appears which depends on the fact that, taking the year as a whole, the tidal effect is on the average the same all through, since the times of passage of the tidal circles during the six hours on either side of midnight are the same for a south declination as the times on either side of midday in the case of the same amount of north declination.

If, then, we take the recorded frequency of shocks for each hour, write them down in two lines, placing those for the hour after midday under those for the hour after midnight and so on, and then add the two lines, we obtain a series of numbers representing the semi-diurnal curve of frequency. In this curve any diurnal periodicity, which is of a harmonic nature, is completely eliminated, and any non-harmonic periodicity largely reduced in amount. On the other hand any semi-diurnal periodicity which is harmonic in character, or which, if not harmonic, has its irregularities similarly distributed with regard to midnight and midday, will be exaggerated; that is to say the effect we are looking for will be increased, while that which we wish to eliminate will be reduced, in amount.

In the next tabular statement the process is illustrated as regards the total number of shocks, and four more lines given, showing the results obtained in the case of certain combinations of shocks, which will be referred to further on.

V.—*Semidiurnal distribution of Shocks.*

Hours.	0 12	1 13	2 14	3 15	4 16	5 17	6 18	7 19	8 20	9 21	10 22	11 23
All shocks 0 h. to 11 h. Do. 12 h. to 23 h. Sum	33 43 76	44 43 87	59 48 107	55 47 102	61 71 132	57 46 103	70 48 118	40 50 90	41 60 101	42 71 113	43 90 133	54 58 112
Sum ÷ Mean	·72	·81	1·01	·96	1·26	·97	1·11	·85	·95	1·06	1·25	1·05
Day shocks > 9° N. Night shocks > 9° S.	·80	·82	1·23	·99	1·18	·84	1·11	·67	1·01	·87	1·52	96·
All shocks 9° N. to 9° S.	·53	·87	·77	1·20	1·61	·84	·94	·97	·94	1·08	1·14	1·11
Day shocks > 9° N. All shocks 9° N. 9° S. Night shocks > 9° S.	·69	·84	1·04	1·08	1·36	·84	1·04	·80	·98	·95	1·36	1·02
Night shocks > 9° N. Day shocks > 9° S.	·77	·77	·94	·71	1·00	1·23	1·26	·94	·94	1·29	1·03	1·12

Here we see two very marked maxima, in the distribution of the shocks, one during the fifth hour after, the other during the second hour before, the meridian passage, and these maxima may be taken as grouped around $4\frac{1}{2}$ hours and $10\frac{1}{2}$ hours of the morning and afternoon. That is to say they both follow by $1\frac{1}{2}$ hours the epoch corresponding to three hours before and after the meridian passage, a time which corresponds more closely to the passage of the maximum rate of change of tidal force, than to that of the circle of maximum horizontal stress.

If we turn to the next line in the table, representing the distribution when the tide producing forces may be expected to be most effective, we find the same features, except that the maximum following the meridian passage is less marked than that which precedes it, and that though the latter is proportionately greater than in the case of the whole number of shocks the former is less.

The next line shows the distribution when the sun is within 9° of the Equator, when on the average the conditions—so far as the tide generating forces are concerned—are the same during the day as the night. Here we find the two maxima again, but it is that following the meridian passage which is most conspicuous, the other being small and ill defined.

The fact is that in both these cases the total number of shocks considered is too small to get an approach to a true average, and, in this small number of shocks, accidental variations of distribution may produce an irregularity of the curve which exceeds its normal variation.

To some extent this difficulty may be overcome. If we refer to the tables I and II, we will see that when the sun is within 9° of the equator, there is not a very great variation in the times of passage of the tidal circles as compared with the times of passage during the day when the sun is north, and during the night when it is south, of the equator. On the other hand the night when the sun is north, and the day when the sun is south, of the equator, show a much greater range of time in the passage of the circles and not only is the range of time greater and the effect consequently less conspicuous, but during part of the time the maximum of horizontal force is not felt at all, and during the rest of the time the passage is so oblique that the rate of change is slow and the tidal forces probably less effective.

Excluding these shocks we may add together the two groups of shocks already considered and so obtain a larger one, in which the tidal effect is tolerably uniform. The result is given in the table, and shown graphically in Fig. 2. Here it will be seen that the two maxima preceding and following the meridian passage are both distinct, and exceed those obtained from the total number of shocks.

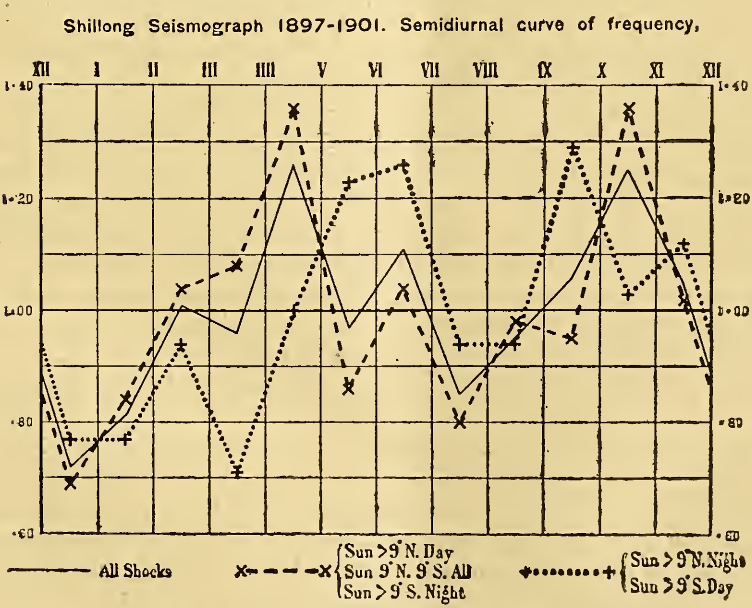


Fig. 2. Semidiurnal curves of frequency.

We have consequently the effect which was to be looked for if the frequency of earthquakes is influenced, either by the amount of the horizontal tide generating force, or by the rate of change of the tide generating forces, and the fact that this effect becomes more marked the larger the number of shocks—suitably distributed as regards time of occurrence—which are taken into consideration, lends support to the supposition that the apparent relation between cause and effect is a real one.

Passing on to the last line, representing the night shocks when the declination is north and the day shocks when it is south, that is to say a time when the rate of variation of the tidal stresses is at its lowest and less effect to be looked for, we find that the marked maxima have disappeared, and that there is an almost equally distinct increase in frequency about six o'clock, that is at a time corresponding to the passage of the circles of maximum vertical force. This has the appearance of indicating that the purely vertical stresses have less influence than those which have a large element of horizontal stress, and that the effect of the former only becomes apparent when that of the latter becomes small. Too much stress must not, however, be attached to this conjecture, as the number of shocks dealt with is smaller than in any of the other combinations, and the possibility of fortuitous irregularities in the curve more probable in a corresponding degree, and besides this the effect here only lags half an hour behind the presumed cause, while in the case of the $4\frac{1}{2}$ and $10\frac{1}{2}$ hour maxima it lags $1\frac{1}{2}$ hours behind the presumed cause.

It appears then that the tidal stresses have a distinct effect in determining the time of origin of earthquakes, though their influence is small in proportion to other causes, but at the same time it is necessary to enter a caution that, though the facts in this case seem to support the conclusion, they are far from proving it. For proof a more extended series of observations are required, not only from Assam, but from other stations also, and even in the record discussed in this paper there is reason to doubt the correctness of the conclusion, inasmuch as the effect found appears to be out of proportion to the cause invoked.

When we consider that the maximum upward tidal force exerted by the moon is only 1/8, 450,000 of gravity, that this corresponds very closely to the difference in downward strain which would be produced by the removal or replacement of half a grain on a one-ton weight, that the maximum horizontal tide generating force is only three quarters of this, and finally that the tide generating forces set up by the sun are a little less than half of those set up by the moon, it is surprising that they should have any effect at all. On the other hand when we consider that these forces are sufficient to give rise to the tides, and that the difference between the spring tides and the neaps is due to the forces whose effect has been searched for in this paper, it is quite conceivable that they should not be without effect in determining the moment at which a gradually increasing strain becomes too great for the resistance, and the fracture is produced which gives rise to an earthquake.

IV.—Conclusions.

From what has gone before we may draw the following conclusions.

1. That there was a very large variation in the diurnal distribution of earthquakes in Assam during the years 1897-1901, shocks being most frequent between 10 and 11 P.M., and again between 6 and 7 A.M. This greater frequency is a real one and not merely due to a larger number of shocks happening to be recorded at those times.

No satisfactory cause can be assigned for this irregularity of distribution, which must for the present be accepted as a fact true for a limited period and area.

2. Superimposed on this large and unexplained variation in frequency, there is a smaller variation which has the appearance of being due to the tidal stresses set up by the attraction of the sun.

3. If this smaller variation is really due to tidal stress, then the horizontal stress is much more efficient than the vertical stress, and the effect is less due to the amount of the stress than to the rate and range of its variation.

4. That these conclusions must be taken as purely provisional and require verification from a more extended series of observations. For their verification we require an instrumental record from some station within or near the tropics, where earthquakes are fairly frequent, and extending over 19 or 20 years.

XVI.—*General Notes on Variation in Birds.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

A. Some Striking Cases of Variation in Structural Characters.

I have occasionally been able to note marked deviations instructure, which might conceivably have been useful in some cases.

Thus I saw at a Pigeon show in Oxford, on October 23rd, 1891, a white Fantail Pigeon with the two inner front toes on each foot webbed. The abnormality is not common, but has been recorded by Darwin. (*Animals and Plants under Domestication,* Vol. I. *p.*, 160).

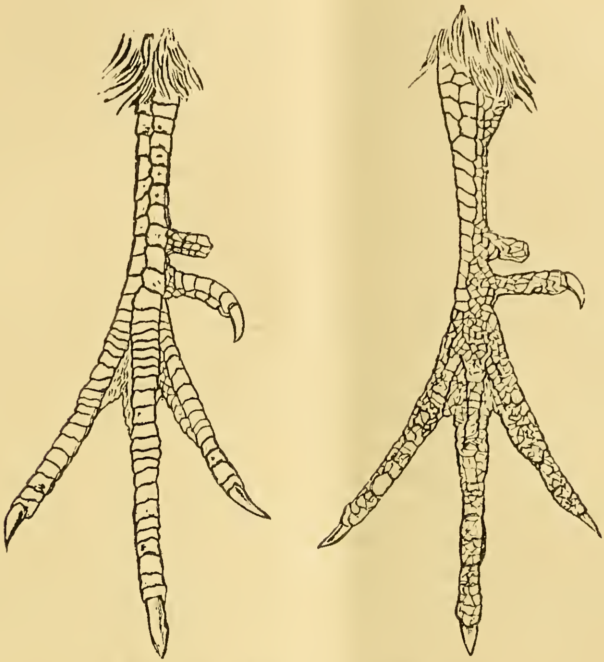
I obtained in Port Said in 1894 the feet of a common fowl with a long hallux like a Curassow's but not apparently capable of flexion at the terminal joint, being more like the supernumerary hallux so often present in these birds—especially in Port Said specimens, where every gradation between this and the normal hallux may be seen.

In Zanzibar, where the fowls are usually of the long-legged Malay type, I occasionally saw a very short-legged specimen with the usual long neck. As there are some breeds of fowls, *e.g.*, the Japanese Bantam, wherein the legs are always very short, this is probably an easily perpetuated and abrupt variation.

At a meeting of the British Ornithologists' Club last year, Mr. W. B. Tegetmeier showed the head of a wild Rook (*Corvus frugilegus*) with a remarkably elongated beak approaching in form that of a Chough.

The Chough itself (*Graculus graculus*) in confinement is liable to an elongation of the bill which is often very regular, and makes the beak resemble that of an Ibis. This might well occur in the wild state—as overgrowth of the upper chap is known to do in some birds—and be of service. The subjacent tissues may also penetrate the overgrowth of horn, for Mr. Rutledge found on attempting to cut back the overgrown bills of some Choughs that this could not be done, as blood was drawn in cutting off the first half inch.

Recently I procured in the Calcutta Bazaar a common Quail (*Coturnix communis*), possessing on each foot five toes like a Dorking fowl. In each case, as so often happens in five-toed fowls, the true hallux was higher up the shank than usual. The upper supernumerary hallux was quite distinct, but shorter than the normal one, whereas in five-toed *fowls* it is usually longer. One only of these extra toes had a claw, but as it was loose on the other, and ultimately came off, it had evidently become accidentally detached from one toe. An enlarged drawing of these feet is given below.



FIVE-TOED FEET OF COMMON QUAIL.

As five-toed birds do not occur as natural species, this instance may seem off the point, but it has its interest from the point of view of Analogous Variation.

In the London Zoological Garden last year there was a male Curassow with the yellow nasal knob on the bill double, the extra part being somewhat out of line with the normal lump, and extending behind it.

B. SOME COLOUR-VARIATIONS IN WILD BIRDS.

The Garganey or Blue-winged Teal (*Querquedula circia*) is very liable to produce a pallid variation, in which the usual brown markings are reproduced in a pale dun shade. These pale forms vary in pallor, but do not grade into the normal type. Males and females are about equally affected. The irides of such birds are normal, but their bills and feet are flesh-coloured instead of slaty. A white Garganey I once saw as a skin seemed, however to have had dark bill and feet. Mr. E. C. S. Baker records (*J.B.N.H.S.*, Vol. XII., *p.* 446), a Garganey with orange feet, with, I presume (as he says nothing to the contrary) normal plumage. After examining hundreds of both this species and the Common Teal (*Nettium crecca*), I have never seen any variation in the latter.

Snipe (*Gallinago cœlestis* and *G. stenura*) frequently present pallid forms, which, as in the Garganey, vary *inter se* but do not grade into the type. I was fortunate last winter in procuring, in addition to a pallid specimen of the Fantailed species, a Pintail Snipe, which was a pied bird of remarkable aspect. The general plumage was normal, but the dark-streaked buff plumage of the fore-neck and breast was interrupted by a longitudinal white patch, and there was a great deal of white in both wings. The right wing had the first three primaries white, together with nearly all the wing-coverts of the outer part of the wing, forming a conspicuous patch. On the left wing all the primaries were white, and a still greater extent of the wing-coverts. The irides, bill and feet were normal, except that the toes were fleshy orange instead of olive-green like the shanks. (Ind. Mus. Reg. 24155, ♂.)

I have thought it worthwhile to have this specimen figured (Plate VIII, fig. A), together with two pallid specimens of this species (*G. stenura*) (Plate VIII, figs. B, C) of different shades.

Pallid forms of the Indian House-Crow (*Corvus splendens*) are not rare; one of a pale fawn, with the face and wings darker, lived 15 years in the Calcutta Zoological Garden; this had fleshy white bill and feet. Some rather similar specimens in the Indian Museum have, however, evidently had dark bills and feet. The white specimens we have have had fleshy white bills and feet, and this has been the case with all the white Jackdaws (*Corvus monedula*) I have seen in England; about half-a-dozen in all. (I believe, however, these white Jackdaws are a domesticated race).

I have thrice in seven years secured pallid varieties of the Rain-Quail (*Coturnix coromandelica*), once only of the common Quail (*C. communis*), though this is more abundant in the Calcutta Market. These birds have always been hens. I have now got another hen Rain-Quail with all the primaries and their coverts, with the two outer feathers of bastard-wing, pure white in the left wing; on the right side, all the primaries but the fourth, ninth and tenth, with the distal primary coverts, were white, but bastard-wing normal. The centre of the throat and a patch on the fore-neck, were also white. (Reg. No. 24229). The irides, bill, and feet were normal.

Grey or slate-coloured varieties are not common, but I have seen two such in the Jackdaw (*Corvus monedula*), one in the King-crow or Black Drongo (*Dicrurus ater*) and one in the Bengal Bulbul (*Molpastes bengalensis*). In the last-named bird the red under-tail-coverts persisted.

Recently Mr. Rutledge obtained a pale ash-coloured House-crow (*Corvus splendens*), a young bird, with dark-lead-coloured bill and feet, and wings and tail faintly barred with darker grey than the ground-colour.

White varieties are so well known as to need little comment; they are seldom pink-eyed like albino mammals. Red often persists in such; I have seen an albino red-whiskered Bulbul (*Otocompsa emeria*) retaining the red "whiskers" and under-tail-coverts, and an albino Goldfinch (*Carduelis carduelis*) retaining the red face and yellow wing-bars.

In India I have seen two pale varieties of the crimson-breasted Barbet or Coppersmith (*Xantholæma hæmatocephala*), one in the Indian Museum, and one now alive at the Alipore Zoological Garden. In the former (Reg. No. B5031) the plumage is yellowish white except the primary-coverts and several quills from the sixth onwards, which are normal. The stiff glossy frontal feathers and breast patch are pale yellow instead of scarlet. The beak is yellowish white in the skin. In the latter, captured adult, the red of forehead, breast, and feet persists. The bill is flesh-coloured instead of black. The plumage is pale yellow, irregularly marked with green. It has not changed in moulting.

The common Ring-Parroquet (*Palæornis torquatus*) frequently produces a yellow variety, in which the red bill in both sexes and red collar of the male persists. I have also seen, besides numerous green birds splashed with yellow, a bird of an even intermediate tint between yellow and green. Specimens shaded with green on a yellow ground are not uncommon. Mr. W. Rutledge knows of a case where two normally coloured wild birds constantly produced a yellow brood.

The large Ring-Parroquet and its races (*Palæornis nepalensis*, *&c.*), is very rarely lutinistic; we have, however, in the Indian Museum a green-tinted lutino of the large-billed Andaman race still showing the red wing-patch. (Reg. No. 22071).

The Rose-headed Parroquet (*P. cyanocephala*) is not infrequently yellow, when the head is pink (as in specimen 23981, Ind. Mus. Reg.).

In the Indian Museum there is a specimen of the Blue-crowned Hanging Parroquet (*Loriculus galgulus*) with primaries nearly all yellow and many other yellow feathers. The bill is black as in the normal birds, but the blue patch on the head is replaced by a faint red one. (Reg. No. B. 342).

I once, in England, saw a wild Song-Thrush (*Turdus musicus*) with the tip of the tail regularly white; but it had an abnormal-looking patch of white on one wing also.

The Calcutta Zoological Garden once possessed a Coucal or Crow-Pheasant (*Centropus sinensis*) with bill and feet normally black, normal red irides and chestnut wings, and all the rest of the plumage white, where it should have been black. In the Museum is a pale dun bird of this species with pale chestnut wings, and the two central tail feathers decidedly fibrous and loose in texture. (Reg. No. B. 7220 procured in Purneah 1871). Mr. Rutledge recently had a dun-coloured male Koël (*Eudynamis honorata*) with fleshy-white bill and feet, but normal eyes. Its plumage faded before moulting, to cream-colour, like a dun pigeon's, the new feathers being strikingly darker.

I have discussed the question of the white-headed form of the Ruff (*Pavoncella pugnax leucoprora*) in *J.A.S.B.*, *Pt. II*, 1902, *p.* 82. Both the living Ruffs mentioned there assumed pure white ruffs and ear-tufts this year; but one had a rufous-marked back, and the other—with the white tertiaries—a grizzled one.

C. Reversion to Normal Colour in Abnormal Varieties.

A much-prized albino or lutino specimen, taken in that condition, often disappoints its owner by moulting out into the normal colour. Mr. W. Rutledge tells me that this is always liable to happen unless the individual has pink eyes or an abnormally white bill or feet. I have seen entire or partial resumption of the normal colour in two House-Mynahs (*Acridotheres tristis*), and a Babbler (*Crateropus canorus*) in his possession. (See paper on Variation above quoted, *J.A.S.B.* 1902, also Bateson, *Materials for the Study of Variation*, p. 43, foot note 2).

Pallid specimens are also liable to revert in this way. A male cream-coloured sparrow I recently obtained put out new feathers of a nearly normal colour, and I have seen a skin of the House-Mynah in the same condition. The grey Bengal Bulbul above alluded to, however, has never reverted; its bill and feet are normally black, as were those of the two grey Jackdaws mentioned with it.

The same phenomenon has occurred in the case of melanism. A Bullfinch (*Pyrrhula pyrrhula*) found as a black nestling in an otherwise normal brood, attained on moulting ordinary female plumage (Howard Saunders, *Manual of British Birds*, p. 188, ed. 1889).

It seems to me that such facts as these furnish a simple explanation of the case of those Herons which are white only in youth.

Variations in Relation of Immature to Adult Plumage.

Darwin gives several cases of this on Blyth's authority, and I can add a few myself.

The skin of a young Crow-Pheasant (*Centropus sinensis*) in the Indian Museum (Reg. No. 11265 from Bhowra) already shows in perfection the rich blue-black body and chestnut wings of the adult, instead of the usual barred plumage of immaturity. Birds resembling the adult in everything except in being duller are quite common.

The young of the King-crow (*Dicrurus ater*) and the small Indian Cormorant (*Phalacrocorax javanicus*) are supposed to be mottled with white beneath, but all the nestlings I have seen in Calcutta have been black like adults. Yet the *Dicrurus* does undoubtedly have a white-spotted immature plumage, and some young Cormorants I reared afterwards *moulted out* mottled below, so that apparently a reversion may take place at the moult.

Similarly, the young Pied Hornbills (*Anthracoceros albirostris*) frequently sold here are always coloured like the adult; but one I knew of moulted out in confinement with white tips and bars to the feathers; a white-barred feathering being given as the young plumage of the closely-allied *A. coronatus* by Parker (Blanford, *F.B.I. Birds*, Vol. III., *p.* 145).

The young of the common Mynah (*Acridotheres tristis*), normally resemble the adult except in being duller, but I have seen two with brown heads instead of black; this is much more common in the young of the allied Bank Mynah (*A. ginginianus*).

The young females of the Golden-backed Woodpecker (*Brachypternus aurantius*), are described as having a black forehead, whereas that of the old bird is spotted with white. Often, however, young hens occur in which the forehead is spotted, sometimes as clearly as an adult's.

D. Variation in Prepotency.

The silver-grey gander mentioned in the note on the variations of the Gray Goose was an example of spontaneous prepotency. Such a variation in the wild state might easily have produced the white and partially white males in the sexually dimorphic species of the genus *Chloëphaga*; *C. hybrida*—the Rock-Goose of Darwin—and *C. magellanica*, the familiar Magellan Goose of waterfowl fanciers, the Upland Goose of the *Origin of Species*, and a third species barely distinct specifically from *C. magellanica*—*C. dispar*, in which the male is barred beneath like the female.

The species *C. rubidiceps*, which is extremely like a small female of *C magellanica*, may be taken as one in which no variation in the direction of gray-and-white ganders has appeared, or if it did occur, has not been perpetuated by natural or sexual selection.

I have come upon some curious instances of the opposite attribute to prepotency in pigeons. In 1894 I crossed a well-developed and fully-adult Black Fantail Cock with a young and hitherto unmated Homer hen. The Fantail had 33 tail-feathers, the Homer of course only the usual twelve. Yet the pair of mongrel squabs which resulted from their union had only 14 and 15 tail-feathers respectively. I may mention that the Homer hen's subsequent offspring by a cock of her own breed showed no trace of the Fantail; indeed, were telegony better established than it is, so weak a sire could hardly be expected to produce any telegonic phenomena.

A similar case was the failure of the Silver chequer Homer hen, paired to a Blue chequer, to reproduce any offspring of her own colour, either directly or in the second generation, as recorded in *Nature*, June 12th, 1902, *p*. 157.

E. Progressive Variation.

Cases of a variation carrying on the line of development of a species are probably much commoner than is supposed, the attention of naturalists having hitherto been fixed rather on reversionary types than progressive ones. (*Cf.* Bateson; *Materials for the Study of Variation*, p. 307).

Such a case is the tendency to extension of the green ocellated spots in a skin of a male *Polyplectron bicalcaratum* (Malay Peacock-Pheasant) described by me recently from a skin (unfortunately a poor specimen) in the Indian Museum. (Reg. No. 21344). In this the black speckling on the upper back is in groups of spots in certain feathers, richly glossed with green, forming rudimentary ocelli in a non-ocellated region; and the black patches of the outer webs of the lower tail coverts are green-glossed to some extent, thus approaching ocelli in quite another way. (*Nature*, Vol. LXV., *p*. 367).

Another example is afforded by the Gold-backed Woodpecker (*Brachypternus aurantius*), whose orange-yellow back frequently shows a strong admixture of red, as I have often observed in young birds at all events. (See also Blanford, *F.B.I. Birds*, Vol. III, *p*. 50).

The Bronze-Cap Teal (*Eunetta falcata*), which has of late years been invading India in unusual numbers, was so common last winter 1901-1902 in the Bazaar that I secured no less than a dozen specimens, most of them females. Among these I noticed one with a strong green gloss on the head; one with a tail as purely grey as a male's, and one with a tail as distinctly barred as a female Gadwall's, there being thus two cases of progressive as against one of reversionary variation.

The dull male of the Gadwall (*Chaulelasmus streperus*) closely allied to this species, sometimes shows a green gloss on the head (see Hume; *Game-birds of India*, Vol. III, *p*. 186): I have never seen this myself, but have seen one with a plum-coloured gloss.

The peculiar Teal of the Andamans (*Nettium albigulare*) is now frequently white all over the face, whereas in Hume's time it was exceptional for the white eye-ring and white loral patch to join, and nothing is said by Count Salvadori in the *British Museum Catalogue* (Vol. XXVII., *p.* 257) about any extension of the white. The heads of a normal (Reg. No. 18671) and a white-faced (Reg. No. 18671) bird are figured, from a photograph, in Plate IX. The white-faced specimen was one procured as many as twelve years ago, so that the variety existed then; but it is now quite freqnent, though not always so white in face as the bird figured; this specimen is a male, as also is the normal bird shown with it.

F. Variation directly induced by Confinement.

This is not nearly so common as currently believed among ornithologists, and most of the variations which do occur among birds kept in captivity are well-known and recorded.

In male birds of the Finch family which have a carmine or pink colour in their plumage, this hue is not stable, but usually disappears after the first moult in a cage, as I have often seen.

In the Linnet (*Acanthis cannabina*) the red on head and breast leaves no trace at all; the same is the case with the Eastern race when kept in India (*A. cannabina fringillirostris*).

The Redpoll (*A. rufescens*) loses the red on the breast and rump entirely; that on the crown changes to greenish-gold.

The Rose-finch (*Carpodacus erythrinus*) changes the general carmine hue of its plumage to dull ochreous yellow.

The Sepoy-finch (*Haematospiza sipahi*) offers a curious case; it is allied to the Rose-finch, but is a brilliant scarlet, not carmine at all; yet a bird which died half through the moult in Calcutta, had changed, where the feathers had come out newly, to bright yellow.

The Bull-finch (*Pyrrhula pyrrhula*) is very liable to become dull in the red colour; and sometimes turns completely black, usually owing to a too free use of hemp-seed. But this may occur without the bird having tasted any, and also in a wild bird (*see above* p. 158).

Melanism is also common in captive Bulbuls; I have seen it in the Bengal Red-vented species (*Molpastes bengalensis*) the white-cheeked (*Otocompsa leucogenys*) and the white-eared (*Molpastes leucotis*) in which last I have seen it combined with albinism in the same individual.

The Gold-finch (*Carduelis carduelis*) kept under unfavourable conditions, is liable to have its red face become dull orange.

The Red Cardinal (*Cardinalis cardinalis*) becomes dull red if not kept out of doors in a good light; this has happened in Calcutta.

The common Troupial (*Icterus vulgaris*) becomes yellow from amber in confinement if the conditions are unfavourable.

The Pekin Robin (*Liothrix luteus*) is apt to fade as to its orange, yellow, and green tones in confinement; it is also liable, in the plains of India at all events, to melanism, becoming either irregularly splashed with jet-black, or regularly washed or clouded with a dark smoky hue, as if it had bathed in ink. Both these variations occurred in two birds out of about a couple of dozen kept under exactly the same conditions in Calcutta. Their companions manifested no dislike to them.

The Rosy Starling (*Pastor roseus*) in confinement in Europe fades to a dirty cream-colour; in India it gets clouded with black, black edgings appearing on the feathers. A bird of mine, deposited at the Calcutta Zoological Gardens, and treated in the same way as about a dozen others, became almost completely black. The bird was in good condition, with the plumage glossy and sleek, and the colour looked quite natural. As these birds are always quarrelling, it was not easy to make out how its companions regarded it.

A pair of Striated Finches (*Uroloncha striata*) kept by a friend of mine in England in an out-door aviary many years ago became during one season heavily mottled with black all over the white belly; but they afterwards reverted to the normal colour.

Conversely, a Black-backed Porphyrio (*Porphyrio calvus*) at present in the Calcutta Zoological Garden has on one occasion moulted out with all the black parts mottled with white; but it has since become, and remained, black again.

A male Red Dove (*Turtur tranquebaricus*) in the same garden, living under the same conditions as many others of the same species and sex, became nearly all white over the normally vinous red part of the plumage.

One of many specimens of *Turtur damarensis* brought by me to the London Zoological Garden in 1892, had last year (1901) when I saw them become very largely white in big patches.*

The male Golden Oriole (*Oriolus galbula*) of Europe, according to Bechstein, never retains its full yellow hue in confinement, but reverts to the streaky green plumage of the female.

The red summer plumage of the barred-tailed Godwit (*Limosa lapponica*) is not always assumed in confinement, for of a pair in the London Zoological Gardens last year (1901) the male was in red colour, but the female showed no sign of it.

* By some accident these birds have never been registered in the Zoological Society's list, but I am quite certain about the species; I took specimens of the live Pigeons I brought home, to Count T. Salvadori who kindly identified them, being then at work on the group for the British Museum Catalogue of Birds.

Similarly, the adult female Scarlet Ibises (*Eudocimus ruber*) in the Calcutta Zoological Gardens always remain of a rich salmon-pink, while the male shows stains of scarlet in places in the spring.

A young female bred in these gardens moulted out white feathers at first from her brown immature dress, whereas a young male's first adult plumage came out pink.

Some of the hens kept in Calcutta, on the other hand, assume in the breeding season a goitre-like enlargement of the throat; this never occurs in the cock. The fact that the species here remains red at all is noteworthy, as in Europe it becomes very pale, getting more so at each moult, whereas our adult birds here have remained equally bright for years.

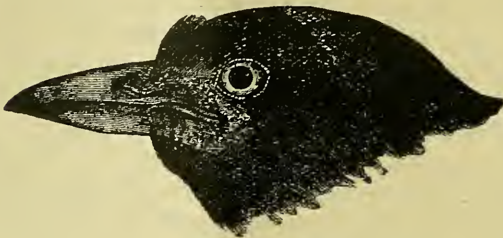
The legs of Finches which in the wild state are black, become usually fleshy white after moulting in confinement, as is well known to fanciers in the common Goldfinch (*Carduelis carduelis*). I find the same thing happens with the Himalayan Goldfinch (*C. caniceps*) when kept in Calcutta, also with the Eastern race of the Linnet (*Acanthis linaria fringillirostris*). The toes are first affected.

G. Pathological Variation.

In the cases above-mentioned, the birds seem to be healthy, but when a bird is in poor health, certain variations present themselves which are more or less constant and definable. They may occur under domestication or in the wild state, but are naturally more frequently observed in the former case, since a sickly bird cannot survive long in nature.

Baldness in certain places is very common; the lores, and in bad cases the whole space round the eye, are apt to become bald in the domestic Duck and its ancestor the Mallard, in unhealthy surroundings, as when confined in a coop. The nearly allied Spotted-bill (*Anas pœcilorhyncha*) does not suffer in this way, nor does any other Duck so far as I know.

Baldness round the eyes also occurs in the Starling (*Sturnus vulgaris*) and sometimes in the Rosy Starling (*Pastor roseus*). In the latter species I have seen one or two birds affected while the rest, treated in exactly the same way, were exempt. The head of a tamed specimen of the Jungle Mynah (*Æthsiopsar fuscus*), which has become bald-faced while living at perfect liberty, is figured below. The resemblance to the normal state of affairs in the adult Rook (*Corvus frugilegus*), is obvious, and suggests a hereditary incapacity to retain the facial plumage in that species.



HEAD OF JUNGLE MYNAH, ABNORMALLY BARE IN FACE.

The rump becomes bald in many birds, and the tail-coverts and lesser wing-coverts drop out.

Baldness over the whole head frequently occurs in caged birds; and I have seen it in a wild House Mynah (*Acridotheres tristis*) more than once. In this case the whole bare skin of the head was bright yellow like the skin round the eye, which is normally bare in this species.

In caged House-Mynahs in England (but not in India) I have seen this circum-ocular skin faded to white, while the bill and feet remained yellow. The white facial skin characterizes the *young* bird naturally.

A Cassowary (*Casuarius galeatus*) at the London Zoological Gardens last year (1901) showed a large amount of irregular naked skin on the back, which was coloured pink and blue, in faint imitation of the hues of the bare head and neck. In a Cassowary which recently died at the Calcutta Zoological Garden I found to my surprise that the skin on the body was dull white like human skin.

The overgrowth of the bill, claws, and scales of the shank is pathological, and is not necessarily due to old age or absence of wear, which cannot affect the scales of the shank. I have seen a Canary become very scaly-legged in its second year, while another, ten years old, had feet and legs as smooth as a bird of the year.

The feathers frequently become more or less reverted, as in frizzled fowls, in wild gallinaceous birds kept entirely under cover; this I have seen in India in several species of Pheasants and Quails. In one case a single hen Pheasant (the species was *Phasianus torquatus*) was affected, while a cock and several other hens, kept under the same conditions, were not.

H. SPONTANEOUS VARIATION UNDER DOMESTICATION.

While Darwin has very fully and completely gone into the question of the extent of the modifications which can be effected by selective breeding, little attention seems to have been paid to the range of spontaneous variation in birds under domestication, the material, in fact, on which breeders have had to work. I shall therefore take a number of domestic or protected species in detail, and discuss the colour-variations to which each appears to be subject without the intervention of selection.

THE CANARY (*Serinus serinus canaria*). Dr. Bowdler Sharpe in *The British Museum Catalogue of Birds*, treats the Wild Canary of the Atlantic islands as an insular form of the European Serinfinch (*Serinus serinus*); it differs from this continental bird in darker colouration and longer tail. It varies much when not bred systematically.

Birds of the wild colour, called green in the fancy, are common; they are often mistaken by people not well-acquainted with Canaries for Mules or hybrids. They are the strongest in constitution. Yellow birds or lutinos are, as is well known, the commonest. They may be either "buff," *i.e.*, pale whitish yellow, or "yellow," which is bright yellow. If "yellow" birds are continually paired, the offspring is scanty in feather.

A pallid form is not rare, in which the plumage is pale brown with slightly darker streaks; this is the "cinnamon" of the fancy. Once I have seen specimens of a *dark* brown form among common singing Canaries in England. These birds, although undoubtedly pure-bred Canaries, showed in one or two instances no trace of green or yellow, being simply warm brown with dark streaks, and looking rather like hen linnets. White canaries have recently been bred. (*Feathered World*, June 13th, 1902, p. 1039.)

I have read of grey forms, but have never seen any such. Pied birds are very common; the marking is commonly asymmetrical. The parts most prone to exhibit dark feathers in light-pied birds are the secondary quills, feathers round the eye, and two outer tail-feathers. Dark-pied birds run to white in the tail. Cinnamons may be pied, but no gradation seems to occur between cinnamon and green.

I have once or twice seen green birds among Chinese specimens with the central part of the quills and tail marked with yellow as in the Greenfinch. A male Green Canary I once knew for several years began to show yellow about the head with advancing age.

The bills and feet of Canaries are horny in the green, and fleshy-white in the light-coloured types. The retention of the dark colour in the legs is noteworthy, considering the evanescence of this in wild-caught captive Finches of other species.

In view of the variability of the tame Canary, the following opposite instances in allied Finches are interesting:—

Mr. G. C. Swailes (*Avicultural Magazine*, Vol. I., 1894-95, p. 118) gives his experience with the Twite in confinement (*Acanthis flavirostris*). A pied cock, about half-white, and a pure white hen, being paired, produced five young; the only two reared were both normally coloured.

"This" says Mr. Swailes, "I expected, as I have reared a large number during the past few years from both white, pied, and cinnamon Lesser Red-polls, and have in-bred them, but have never had one vary in the least from the normal colour."

The Java Sparrow (*Munia oryzivora*) of the East-Indian Archipelago has long been domesticated in Japan, and tame and wild specimens are now both commonly kept as cage-birds. It is not a variable bird in its wild state; I have never seen any variation in wild birds of the species, nor has Mr. W. Rutledge in his very large experience.

The tame-bred Japanese birds may either be pure white or pied with the normal colour. The dark colouring in this case is confined to the upper plumage as a rule, but is not very regular. The head is almost always pure white, and the tail also. The bill, feet, and eyelids are normal. Dr. A. G. Butler, who has bred the white variety, found that a young bird he reared was grey above till its first moult; paired with a normally coloured cock (which it did not desert for white ones) it produced two young like its own first plumage, one like a young wild bird, and two intermediate, all in the same brood. (*Foreign Finches in captivity, p.* 262).

Mr. F. Groser, who has also bred both forms in Calcutta, tells me that they kept distinct whenever they could find mates of their own colour.

The tame white birds are larger and stronger than the wild type. They are more phlegmatic, but also more spiteful; the small sexual distinction, in the stouter and larger head and bill of the male, is more marked. The song of the white birds is quite different, according to Dr. Butler.

The Sharp-tailed Finch (*Uroloncha acuticauda*) of Eastern Asia has also long been domesticated in Japan, and its tame forms are the "Bengalee" of English fanciers. Dr. A. G. Butler, who in his *Foreign Finches in Captivity* beautifully figures the three tame varieties, considers with the late J. Abrahams that this little domestic Finch originated in a cross between the Striated Finch (*Uroloncha striata*) and the Indian Silver-bill (*Aidemosyne malabarica*). I cannot agree with this, as my observation of these birds leads me to conclude they are simply derivatives of the Sharp-tailed Finch (*Uroloncha acuticauda*); I have never seen one resembling the Silver-bill or the Striated Finch, and all three species are well known to me in life as well as in the skin. The late Dr. K. Russ, the greatest authority on small birds in captivity, gave *Uroloncha acuticauda* as the ancestor of the domestic bird. Some tame forms resemble the type, but they are generally pied with white, the amount of this colour varying from a few white feathers to complete whiteness. The pied markings are irregular and unnatural-looking. There is a cinnamon form, showing the markings of the dark-brown type on a fawn-coloured ground. This is generally pied with white, grading, as the dark-pied birds do, into complete whiteness, and pied irregularly like them.

Pure white birds are less common than pied ones, but more so than dark-brown typical or pure cinnamon birds.

There is no intergradation between the brown and cinnamon forms.

The bill and legs vary as in the Canary; they are normally coloured in normal or nearly normal types, fleshy white in cinnamon, white, and light-pied forms The upper chap may be black and the lower fleshy white, in correspondence with the head-marking.

The cinnamon and white forms are smaller than the dark-brown ones.

The Collared Dove (*Turtur risorius*). The exact origin of the domestic Turtle-dove is unknown; its varieties are of three types The ordinary form is creamy-fawn with drab primaries and white tips to the tail-feathers except the central pair; a half-collar on the nape and the proximal half of all the tail-feathers below are black. The bill is black, the iris red, the feet purple-red, and the eyelids creamy-white. The sexes are similar, though the cocks are almost imperceptibly lighter about the head. The young have no distinct collar, have fleshy-coloured bills and paler red feet. This form does not vary more than a wild bird, and English- and Indian-bred specimens are alike.

There is also a white form with a flesh-coloured bill and paler red eyes; the pupil is often red (non-pigmented) in these. This may have a dark collar, but is generally without it.

There is an intermediate form, coloured generally as in the common type, but with the primaries white, collar drab, all tail feathers white but the two central, which are buff, and grey at base of tail below instead of black. The bill in this form is flesh-coloured and the irides light red as in the white birds. I have only seen this in India.

Mr. D. Ezra, to whom I showed birds of this intermediate form tells me he got somewhat similar birds by crossing the white and black-collared fawn types. He is sure they were not pied or splashed as Pigeons often are.

I have seen in cages of these Doves specimens of a drab colour with with dark ring, identical in plumage with the wild *T. douraca* of India, but in the absence of opportunities of studying these individuals I cannot say whether they were tame or wild specimens; I think the latter.

The Rock-Pigeon (*Columba livia* and *intermedia*) has been so long bred selectively that it is not a good species on which to study spontaneous variation, since it is hard to find it in a really unselected state. Both the Western and Eastern forms produce chequered individuals when wild.

By studying Pigeons not selected for colour, or living in a semi-feral state, as in towns where they pick up their living in the streets, the following leading types are evident :—

(*a*) As in wild type; common, but not the most numerous.

(*b*) Silver, a pallid form, greyish cream-colour with the wing-bars and tail-tip dark drab; bill flesh-colour. Not uncommon. Correct for many breeds.

(*c*) Blue-chequer, with the back and wing-coverts mottled with black; very common, in fact the most numerous in semi-feral pigeons, and also occurring frequently among birds in a perfectly wild state.

(*d*) Silver-chequer, the corresponding marking in cream and drab.

(*e*) A sandy-red form with grayish white primaries, rump and tail; very common. Often the wings are chequered with whitish, when the bird is a red chequer.

(*f*) Silver-dun; a sort of ashy-grey, with dark-reddish-brown neck and wing-bars; no tail-bar; very common.

(*g*) Black, of a dull slaty shade, very common.

(*h*) Pure white; rare.

Intermediate pied and splashed forms are numerous, generally asymmetrical; the quills and tail are often more or less white, or again may be markedly darker than the body when this is or white. In this case the marking is symmetrical, but ill-defined. Blue and black, blue and blue chequer, and blue chequer and black, grade into each other commonly; but not, as a rule at all events, any of the blue shades with red or silver; nor do these last grade into black as a rule.

The beak is fleshy-white in light forms, the feet and eyes remaining normal, except in whites, where the eyes are dark ("bull" of the fancy).

The pigeon certainly shows convincingly what can be done by careful selection of structural variations, for in its feral state it is not by any means a structurally variable bird. In form a lot of feral pigeons are as uniform as most wild birds, and much more so than some species.

The Budgerigar (*Melopsittacus undulatus*). This little Australian Parrakeet, known in books as the Undulated Grass-Parrakeet, has been exported only during the last half-century, and many are still brought over; but it is largely bred in captivity.

In domestication the usual colour is the typical one, but three varietal forms occur.

One is a pallid form, of a general greenish-yellow tint with the dark markings faintly indicated; the blue cheek spots are present in full development. I have seen at least five of this form.

Another is a pure lutino, clear uniform yellow throughout, with pink eyes. I have seen two of this type.

Two blue specimens, in each case the offspring of yellow birds, have been known. (J. Abrahams, *vide* Mr. R. Phillipps, *Avicultural Magazine*, Vol. VIII., 1902, *p.* 75.)

One or other of the first two is being fixed by breeders, but I cannot say to which form the "Yellow Budgerigars" so often advertised belong. I have seen no pied, splashed, or otherwise intermediate forms.

The Blue Mountain Lorikeet (*Trichoglossus swainsoni*) was bred yearly for about four years previous to 1890, at the Blackpool Aquarium and Menagerie, according to Mr. W. Osbaldeston (*Avicultural Magazine*, Vol. VIII., *p.* 167, 1902). Mr. Osbaldeston, after giving an account of the conditions under which the birds were kept, says "One year a very curious, handsome, 'sportively' plumaged bird was reared. The head was red with lacings of white, and the shoulders were tinted with green. The greater portions of all other parts of wings, body, and tail were of a bright chrome yellow, intermixed with green feathers here and there; and the tail feathers were tipped with red; making a really handsome, showy, and rare bird. It was a young bird in May 1891, and was alive some three years afterwads to my knowledge. I went many times to look at and admire this rare-feathered Lorikeet. . . On one occasion, I noticed that its claws had grown very long. It was always kept in the same cage with the others."

The Pheasant (*Phasianus colchicus*) has been more or less artificially cared for ever since the time of the Romans, and so may be fairly reckoned a protected bird. Its variations fall into two main types :—

The pallid "Bohemian" form, in which the cock's ground-colour is a lustreless buff, with the usual dark edgings to the feathers and dark neck almost devoid of gloss. I can find no account of the hen.

The white form, which is found in both sexes.

Intermediates between Bohemian and normal seem not to occur. White-pied birds are common; the white marking is irregular and mostly confined to the upper surface. Pied birds will produce their like if paired, and will give some pied offspring with normal birds; but a white and a normal bird will not usually produce pieds, though some whites may be bred from such a mating. (Tegetmeier, *Pheasants for Coverts and Aviaries*, 3rd edition, 1897, *p.* 150).

White specimens are weaker than normal.

The Golden Pheasant (*Chrysolophus pictus*) of China has been bred in confinement over a century.

It is generally true to the type, but a variety, the Black-throated Gold Pheasant, is known (*C. pictus obscurus* of Schlegel) in which the cock's cheeks and throat are dark brown instead of buff, and the scapulars blackish instead of bright red, while all the tail-feathers are barred, the central ones with the rest. The hen of this form is darker than that of the type, as also are the chicks. It is believed to be a variation which has arisen in captivity, as it is only known in that state.

As the Amherst Pheasant (*C. amherstiæ*) the only near relative of the Golden species, has a dark throat and barred central tail-feathers, the peculiarities of this form seem to be more probably due to a reversion to the ancestral type of the genus than to an approach to melanism.

Mr. P. Castang, the well-known wild-fowl dealer of Leadenhall market, tells me that this variety used to be more common, but was not liked, on account of its dull appearance.

The Silver Pheasant (*Gennaeus nycthemerus*) has given no variations in captivity.

The Fowl (*Gallus gallus*) is obviously excessively variable in colouration. As I showed some time ago (*Nature*, Jan. 30, 1902, *p.* 297) the characteristic colours of all except the highly specialized pencilled, laced and spangled breeds occur in common Indian Bazaar fowls.

I stated on this occasion that the colouration of rufous with a black tail was not recognized as correct for any breed in hens, but in making this statement I overlooked the Nankeen Bantam breed, in which both sexes are thus coloured. This colouration is perhaps the commonest met with in domestic poultry allowed to interbreed freely.

A few more details may here be added :—

The colour of the legs and feet in unselected fowls varies much, being fleshy-white, blue-grey, black, yellow, or olive-green (" willow " of the fancy). The only intermediate form which occurs is the black-mottled white or yellow accepted for Houdans and Anconas respectively

The ear-lobe, as in the wild bird, varies from red to white ; it may present a combination of the two colours. Creamy-yellow ear-lobes also occur. The ear-lobe is blue in the dark-skinned " Silky " breed.

The bill is dark as in the wild bird except in birds which have white or yellow legs, in which case the bill is of the same colour, sometimes marked along the ridge with black.

The naked skin of the comb and face, &c., is uniformly red as a rule, whereas the wild-bird's face is flesh-coloured. A dark purple face may occur, as in the Brown-Red Game, which is hence called "gipsy-faced." The whole skin, as is well-known, is dark in the Silky breed, as is also in this case the periosteum of the bones. This breed has white plumage, but usually dark-faced fowls are dark-feathered also. I have never seen a dark-faced *cock* in India except, of course, a "Silky."

The comb in mongrel fowls is usually single; but rose-combs often occur, and pea-combs less commonly. The single comb is always larger than in the Jungle-fowl, and higher and more arched in outline in the cocks. The wattles are also larger, and are developed in the hens, which is not usually the case in the wild bird. Small crests and a muff of feathers on the throat occur in mongrel fowls of both sexes, but not together as a rule. Tame hens are also often spurred, which is rarely the case in the Jungle-fowl, though Blyth obtained such a specimen. The legs and feet are always larger and coarser in tame fowls than in wild, and the tail is carried more erect.

The wattles may be occasionally aborted, and a median dewlap take their place. This tends to be the case in the Indian Aseel or fighting-cock; and in two fighting-cocks of a larger breed, from Saigon, I saw at Mr. Rutledge's establishment some time back, not only were the wattles absent and replaced by a dewlap, but there were no earlobes either. Their combs were small and non-serrated, and as the neck and head were all bare and red, the general appearance strikingly recalled that of a Condor (*Sarcorhamphus gryphus*).

THE PEACOCK (*Pavo cristatus*) varies at times in its wild state in India. Mr. Hume (*Game-birds and Wild-fowl of India*, Vol. I., *p.* 89) records, on Sanderson's authority, two hens of a dirty yellow. Mr. W. Rutledge once received a cock of the colour of a new copper coin, as he described it.

Most tame Peafowl conform to the ordinary wild type.

White specimens are not rare, with fleshy-white bills and feet. Pied specimens are also not uncommon; the colouration, though not quite regular, and unlike a natural marking, follows certain rules, the neck, primary quills and belly being white, and the rest of the plumage coloured.

Most important of all is the Japan or Black-winged form (*Pavo nigripennis* of Sclater) in which the male has all the wing, except the primaries, black, glossed at the edges with blue and green; the primaries are chestnut with clouding of black along the shaft and edge. The thighs are also black in this form, and the train more glossed with copper than in the type. The hen in this variety is white with the upper surface grizzled with black, and longitudinal central black splashes on the rump-feathers; the tail is black, and the primaries chestnut as in the male.

The feet are fleshy-white in both sexes.

The young are all white in the down and first feather, with a pink flush on the wings; but the young cocks soon become dark. The variety has been abundantly shown by Darwin to arise in either sex as a sport from the type in domestication; it seems in one instance to have occurred wild. It is smaller and weaker than typical birds, and not a match for them; yet when they are allowed to interbreed indiscriminately the black-winged form swamps the other. Mr. Castang tells me that black-winged birds will throw back to the type, but generally speaking the variety breeds true.

THE GUINEA-FOWL (*Numida meleagris*), although so recently domesticated, varies a great deal. I have discussed the colour-variations in *Nature* (June 5th, 1902, p. 126). Since then I have seen two or three of a type I had only previously seen in one pied bird, *i.e.*, lavender without spots. I find self-coloured birds of this type have barred primaries like the dark-purplish self-coloured birds.

Mr. L. Wright (*loc. cit. infra*) says that pied birds are the result of crossing white and coloured specimens.

There is also a form with white ground-colour and dark spots, but this I have never seen. (L. Wright's *Illustrated Book of Poultry*, Cassell & Co., 1890, p. 511). In all the forms the white of the lower cheeks invades most of the sides of the head and neck; and in most birds, even the normally coloured ones, the toes and more or less of the shanks are orange yellow. The white of the face also often invades the wattles, and both these and the face may be stained with blue.

The loose naked skin of the throat is much more developed in Indian than in English Guinea-fowls, often forming a dewlap an inch deep, and frequently coloured a bright sky-blue instead of dull purple.

I procured some time ago a normally-coloured male specimen with a pendulous throat-tuft of feathers coloured like the adjacent feathered part of the neck, of a plain purplish-slate.

THE TURKEY (*Meleagris gallopavo*) of Mexico was found domesticated when the Spaniards invaded America, and very soon was kept in Europe. It has not been bred selectively till lately.

The colour-variations in domestication are few and well-defined. The typical bronze form is not very common in Europe; and in India I have only seen it once in seven years' residence. This bird in colour exactly resembled the plate of this species in Elliot's *Monograph of the Phasianidæ*. The commonest type is one in which the bronze part of the plumage is replaced by black, bronze only in certain lights, the brown and white markings being retained.

The pure black form is also not uncommon.

A white form with the body and tail-feathers subterminally barred with black in a very regular manner is not infrequent; the primaries in this are smoky-black on the inner and white on the outer web, not barred as one would expect. Pure white, fawn, and grey varieties occur in Europe, but apparently not in India.

The legs of dark forms of domestic birds are horn-colour, not pink as in the wild bird; in light forms they are pinky-white.

The occurrence of a downy crest in tame Turkeys has been discussed by Darwin; I have never come across an instance.

The tame Turkey shows a distinct increase in the size of the naked head processes and caranculations as compared with the wild bird; and the tame Turkeys of India, as Blyth long ago remarked, similarly show a marked increase of development of these parts as compared with European domestic specimens.

The feet are also coarser than in the wild bird.

The Mute Swan (*Cygnus olor*) of Central Europe and Asia has been tame for many centuries in Europe, but has practically lived the life of a wild bird, largely shifting for itself, and often, when left unpinioned, reverting to the wild state, so that its exact natural range is doubtful.

The species has continued true to type except for the production of one well-marked variety:—

The Polish Swan (*Cygnus immutabilis* of Yarrell). In this the plumage is white at all ages; and the nestling-down is white. The feet are flesh- or clay-coloured instead of black, and the frontal knob is smaller. Sometimes the cygnets are fawn-coloured in this form.

The variety is known to be propagated truly for at least one generation. It has occurred in a wild or feral condition, and has been bred from the ordinary type both in England and of late years on the continent.

Intermediate forms occur, for the characters are not sufficiently constant to allow of this type ranking as a species, to say nothing of its origin. Those few specimens which I have seen were, however, all readily recognizable and typical. The variation is not recorded to be at all sexually limited.

The Muscovy Duck (*Cairina moschata*) of Tropical America, was, like the Turkey, found in a domesticated state by the Spaniards, but it also exists wild.

Domestic birds are often nearly true to the wild type, but seldom completely so, as they usually show a few white feathers about the head. The head and upper neck are often grizzled throughout with black and white, ending very definitely, while the rest of the body remains normal.

Pied birds are common, the black being usually mostly restricted to the crest, back, and tail, but the marking is not very regular. The primaries are always white in pied birds. A variety with white body and black crest occurs, and has been fixed as the "Peruvian" breed.

A slate-grey variety occurs, but is rare.

Pure black and pure white specimens are not uncommon.

The bill and feet in the latter are pale sickly yellow, and the irides light blue, instead of the usual orange-brown.

The bill and feet remain normal in most birds, but the terminal portion of the toes and webs are often pale yellow in pied birds, the rest of the limb remaining normal. The bare face of the drake varies much in extent and development, being either moderate and smooth, or excessively carunculated. It is sometimes nearly all black instead of red, even in white birds. The duck has the bare face and carunculations like the drake, but on a smaller scale, and the development varies similarly.

The form is often heavy and clumsy, but the birds can generally fly, and often display a strong perching instinct.

The Grey-Lag Goose (*Anser ferus*) of the temperate parts of the Old World is the oldest of all domesticated birds, a white tame variety having been known in the days of Homer. It is unusually variable in the wild state, according to Mr. Hume (*Game Birds of India*, Vol. III., *pp*. 63, 64). I have not noticed the variations he mentions, the comparatively few birds I have seen having been very uniform, but I have several times seen a slight difference of colour which he does not appear to have found, *viz.*, the nail of the bill being horn-coloured instead of white. Mr. J. G. Millais (*Wild-fowler in Scotland*, p. 31) records a white Grey-lag which for four winters frequented the Tay Valley with others of its species—thison the authority of a Mr. C. M. Innes, who ultimately wounded but lost it.

This goose has varied very little in colour, presenting only the following types:—

(*a*) Resembling the wild form; correct for Toulouse breed.

(*b*) Silver-grey; only known as a sport in Toulouse ganders. The case, as reported by a well-known water-fowl breeder, Mr. J. K. Fowler, in Mr. L. Wright's *Illustrated Book of Poultry* (Cassell & Co., 1890), *p*. 559, is so important that it may be given in full:—"Some time ago I bought for a change of blood a fine gander from a celebrated fancier, which differed from my own strain in colour, being of a beautiful *silver-grey* instead of dark like my own, though otherwise the markings were exactly similar. I bred from him that year some splendid stock, which all took after their maternal relatives in colour with one exception, consisting of a gander, which came of exactly the same hue as his sire. Since that time, in each succeeding year, I find one or two—seldom more—come silver-grey; and strange to say, they are always *ganders*, and generally remarkably fine, and superior to their brothers. I have never yet bred a single goose of this lighter shade."

(*c*) Pure white, correct for Embden and Sebastopol breeds.

(*d*) Sandy-coloured; never seen by me. "Sandy-coloured (common) geese are not infrequent in some parts." (Rev. Dr. Goodacre on *The Question of the Identity of Species of the Common Domestic and the Chinese Goose, P.Z.S.*, 1879, *p.* 711.)

The bill and feet in all tame birds are usually orange, but still a good many have flesh-coloured feet. The irides are dark except in white or light-pied birds, wherein they are blue.

Pied intermediates are common, ranging from white-quilled birds to the more common type of white body with grey neck and head, patch on back, and one on each flank. Ganders are almost always white in rough-bred geese; seldom grey, and still more seldom pied.

Mr. Hewitt found that in crossing the Embden and Toulouse, for which he preferred females of the latter and a male of the former, that the goslings came "'saddle-backed' in the feather, with the head and upper portion of the neck grey, and a patch of the same colour on the thighs, the whole of the remainder of the plumage being white. Singularly enough, the majority of the young ganders and a fair proportion of the geese thus bred are slightly crested, though this peculiarity is not possessed by either parent." (Cassell's *Illustrated Book of Poultry*, p. 562.) Tame geese are much heavier in build than wild, but can fly.

The Pink-footed Goose (*Anser brachyrhynchus*) produces a variety with the feet and band across the bill orange instead of pink in the wild state (see Sir R. Payne-Gallwey, *Letters to Young Shooters*, *p.* 69, foot-note). The same variation occurs in semi-domestication.

Mr. Cecil Smith, in Mr. H. E. Dresser's *Birds of Europe* (*pp.* 71, 72, published 1878), writes:—

"My original pair were perfectly true Pink-footed Geese, there being no suspicion of orange about the bill or legs and feet of either; the colour on these parts, however, became very pale and faded after the breeding-season, and continued so long into the autumn, but towards the end of autumn it got much brighter, the colour being most intense at the beginning of the breeding-season; it is the same with those of their young which have orange legs and bills. This pair hatched three young in 1872; of these only one reached maturity. The legs and bills of the young were all alike, very dark olive-green, showing no trace of pink as long as they were in the down; but soon after they began to assume their feathers the colour on the legs and bills began to disclose itself, and those parts in the only survivor of this brood were and still are orange. Since then the old ones have bred every year, some of the young having orange legs and bills, and some pink like their parents. This year the first orange-legged one, a female, had a brood, some of which had orange and some pink bills and legs. I have never seen any mixture of the colours, the legs and bill being either bright orange or bright pink; there seems to be no gradation between the two. As to the bills, the dark portion (that is, the nail and the base) remains the same whether the other part is orange or pink; in fact, the only part of the bill that shows any change is the part which in the Pink-footed Goose is usually pink."

The Chinese Goose (*Cygnopsis cygnoides*) of Eastern Asia has long been domesticated in China and has been known as a tame bird in Europe for more than a century.

This Goose as usually seen in England shows two varieties. One in which the colour of the wild type is preserved throughout, and a pure white type, with bill as well as feet orange. I do not remember seeing intermediate pied forms, which no doubt occur.

The bill is shorter than in the wild type, and at the base there is a fleshy knob, level with the forehead above, and noticeably better-developed in the male. The form is of course heavier than would be the case in a wild bird.

The species can be modified to a greater extent, for the large Swatow breed, while typical in colour, has a very large knob, a pendulous feathered dewlap and abdominal fold.

A smaller lighter breed is imported to India from China, inferior in size to the type and much darker and greyer in colour, with the feet as well as the bill black, only just tinged with orange. There is no gular or abdominal flap, but the frontal knob is well developed, and the beak short.

The geese kept in India were considered by Blyth to be hybrids between the Chinese and the common goose, but so far as I have seen they show, in colour at all events, no trace of the latter. Their colour is not very often completely normal, as they frequently show some orange at the base of the beak, a white band of feathers round the base of the upper mandible, and a more or less perfect white belt across the breast. White birds are as described above. Pied birds are common, and usually have the dark colour on the back, flanks, and head. They are just as often ganders as geese, so that white is not sexually limited in this race.

The nasal knob is never very large, and grades into complete absence. Two young specimens imported direct from China, and normally coloured, had each a small round tuft at the back of the head.

The MALLARD (*Anas boschas*) of the Northern Hemisphere has been domesticated since the beginning of the Christian era, and has given rise to several distinct breeds. It varies to some extent when wild, and a great deal in an unselected condition, as when kept in India; the varieties are best considered separately as to sex.

The leading variations in drakes are as follows:—

(*a*) As in wild type; rare; correct for Rouen breed.

(*b*) As above, but no bay breast or white collar, the pencilled-grey of the under-surface running up to the green neck; common; said to supervene with old age in domesticated birds of recent wild stock.

(*c*) As in wild type, but bay of breast running cloudily along flanks; common.

(*d*) Black with a white patch on breast.

(*e*) Blue grey but with the usual markings; breast warm brown.

(*f*) Pure white; correct for Aylesbury, White Call, and Pekin breeds, the last-named being tinged with yellow.

Intermediate types are very common, generally irregularly marked; the breast is the first part to show abnormal white feathering, then the wings. I have never seen a *pure black* duck among mongrel Indian birds.

One pied type recurs so frequently, in various colours, that it deserves special mention. In this the head, breast and shoulders, and hinder part of body are coloured, the rest white. This is the correct marking for the new Indian Runner breed, in which the coloured part of the plumage must be fawn in tint.

As in the fowl, the female varies more than the male:—

(*a*) As in wild type; rare.

(*b*) As above, but light and dark head-markings obsolete, all head being uniformly speckled; speculum often whitish or brown like rest of wing.

(*c*) As in wild type, but lighter; throat and eyebrows white, belly shading into white; speculum normal; common.

(*d*) As in wild type, but ground-colour much darker, rich warm brown, correct for female of Rouen breed; common.

(*e*) Black with white patch on breast; speculum often whitish; common.

(*f*) Blue-grey, often with dark edgings to the feather; not uncommon.

(*g*) Pure white; correct for Aylesbury and other white breeds.

(*h*) White, with coloured speculum and some dark colour on rest of wings. Drakes are never marked like this.

The intermediate types are very numerous; the markings in pied ducks are the same as in pied drakes, which is remarkable when the great natural difference between the sexes is considered. For instance, the type with white neck, wings, and belly, and coloured head, breast and stern, corresponds closely with the drake so marked, and is correct for the female of Indian Runners.

The colour of the bill varies much; the iris, however, is not noticeably variable, being always dark as in the wild form. The legs and feet are always orange except in black and dark black-pied birds, where they are black or black with orange toes respectively; I have also seen some light brown types with dark olive feet, in females. The female's beak is extremely variable, usually a mixture of orange and black in varying proportions; but it may be black-and-slate in the darker and some of the lighter types. In white birds it is generally orange, but should be fleshy white in the Aylesbury, a colour not seen in Indian mongrels.

The drake's bill varies much as the duck's, being most commonly yellow or orange, often pied with black at the ridge and base. I never saw dark olive legs in a drake; except in black or black-pied birds they are always orange. The legs and general form are always coarse.

The Ostrich (*Struthio camelus*) has been domesticated for thirty years in Cape Colony (Mr. C. Schreiner, *Zoologist*, 4th series, Vol. I., 1897, *pp.* 99, 100).

An abrupt variation occurs in the colour of the naked skin, which is fleshy in some individuals, and grey of a dark or light shade in others. This difference of skin colouration is the main point relied upon to distinguish the various wild races now ranked as species. The plumage of the cocks varies from jet-black to rusty brown, the latter hue predominating in the moister coast districts. They may be more or less spotted with white, and in some the body feathers are curled. The hens vary from dark rich brown to light brown, grey, or ash; they may have wing and tail-plumes white, or be barred with white; and a male-plumaged specimen was in Mr. Schreiner's possession.

I. Moral Variability.

Variation in disposition is very familiar to bird fanciers, and as examples I may perhaps be allowed to detail some observations I made recently on two members of the Babbler group (*Timeliidae* or *Crateropodidae*) the Red-billed Liothrix (*Liothrix luteus*) and the striated Reed-Babbler (*Argya earlii*).

I had a couple of dozen of the former and one of the latter in a large cage together. Before the Babbler had been many days in the cage I began to notice the Liothrix often tickling and scratching its head, as they habitually do to each other, but the recipient of this kind attention did not try to return it.

After a little time I introduced eight more Reed-Babblers into the cage, six adults and two young birds. They fraternized with each other and the other member of their species, but before long I had to remove one bird, a young one, for bullying the Liothrix. Twice I caught it holding a Liothrix by the nape and keeping it suspended in the air as it perched, in one case the victim losing many of its feathers on escaping. It also drove the Liothrix from the food in sheer wantonness, whereas the other Babblers displayed no such selfish spirit. The bird was amicable enough with members of its own species. The Liothrix bore no grudge against these for the bad behaviour of their compatriot, for after its removal I saw one of them caressing one of the remaining Reed-Babblers in the usual way. But I never saw these take any trouble to return the compliment, any more than did the solitary individual. However, I did not long keep them in the company of smaller birds.

The Liothrix itself varies in temperament, although usually to be described as tame though nervous, harmless and good-natured; of the two dozen birds alluded to, one, a fine male with a large stout bill and somewhat clouded with black below (*A*) was inquisitive, always coming near me when I approach the cage; but he would not usually take food from my fingers. He was fonder of seed than any of the rest, and was not mischievous, though well able to hold his own. The others did not dislike him on account of his colour variation, unsightly as it was. Very likely his fondness for seed was responsible for the change.

Another bird (*B*) also a male, with a very short bill, was tame, would feed from the fingers, and was slightly inclined to be mischievous. When I put in an unfledged Paradise Flycatcher (*Terpsiphone paradisi*), this specimen made several attempts to pull it off the perch by the tail. *B* was not spiteful, but *A*, in spite of his bigger beak, was afraid of him.

A third male (*C*) normally coloured, with largish bill, was very tame, alighted on a food tray while I had it in my hand, and would peck from my fingers. It pecked several times at the head of the young Flycatcher above alluded to, and also bullied a young Tailorbird (*Orthotomus sutorius*) I put in experimentally. The second bird mentioned made no attempt to molest this little creature, in spite of his inhospitable behaviour towards the Flycatcher a few days previously. Nor did most of the other specimens touch either young bird, so that the interference was unusual in this species. On one occasion I saw *C* mischievously jerking and pulling *B* by the tail, while another was combing *B's* feathers.

Here, then, we have in two species of the same natural group considerable variation in disposition, both individual and specific.

J. Variation in Mental Powers.

It is familiar to bird-fanciers that some individuals of a species learn to speak or sing with greater facility than others.

In talking Hill-Mynahs (*Eulabes intermedia*) and Parrots of various species everyone must have noticed how few specimens can clearly ennunciate words. I have only seen two of the above Mynahs which I should call good talkers, and one of these was more perfect than the other.

Sex may be supposed to make some difference, but two out of the only three clearly-speaking Parrots I have known were females; these were a red-and-yellow Macaw (*Ara macao*) and a common Ring-necked Indian Parrakeet (*Palæornis torquatus*). The other was an African grey Parrot (*Psittacus erithacus*) whose sex I do not know.

I also noticed in a brood of young Cormorants (*Phalacrocorax javanicus*) I reared some years ago, that one was so tame that I could carry it about on my hand, while another was so wild and vicious that it was difficult to handle it at all.

Two young Bayas or Weavers (*Ploceus atrigula*) which I recently reared varied exceedingly in intellectual powers. Both were confiding, but one was also nervous and stupid, dashing off in aimless flights, and when coming to me settling sometimes on my nose; while the other's excursions were much more purposeful, and it would freely alight on my head or shoulder, or on those of others, hardly ever trying to settle on the face.

K. Variation in Taste.

A few instances of special preferences or the reverse in diet seem worth recording.

Mr. Meldrum of this city tells me that a Bhimraj (*Dissemurus paradiseus*) in his possession will not eat cockroaches; the specimens I have kept have usually done so readily, although supplied, as his bird is, with other insects.

I have noted above (p. 179) in one Liothrix (*L. luteus*) out of two dozen kept under the same conditions, a strong appetite for canary-seed. I have heard of a pair which ultimately killed themselves by too much indulgence in this article of food, although they had a choice.

Sexual variations in taste have been fully dealt with by Darwin, and it is plain that individual inclination to breed outside the species frequently occurs. (*Descent of Man*, 2nd edition, 1899, *pp.* 414, 415).

The aversion to particular males, however, often alluded to, is very probably due in many cases to the male in question not being strong enough to coerce a refractory female. Darwin mentions this (*Descent of Man*, second edition, 1899, *p.* 417) with regard to the fowl; and in the case of the Pigeon and Canary, the more frequent occurrence of the phenomenon seems to be connected with the greater equality of the sexes.

I once witnessed a case in which a male domestic collared dove (*Turtur risorius*) confined in a hutch with a recently wild caught Turtle-dove (*T. auritus*) female, bullied the unfortunate bird till she was nearly scalped, with the result that ultimately she laid, although no young were hatched from the eggs.

Had she been the stronger bird, this would certainly not have happened; I have seen a female Muscovy duck repulse ignominiously a male common drake which tried to pair with her.

The converse case, of a cock strongly objecting to a particular hen, has been recently recorded with the fowl by (Bateson, *Royal Society Reports to the Evolution Committee*, I., 1902, *p.* 100).

L. Variation in Habits.

Some habits of birds, such as the method of showing off to the female, of manipulating food—with or without the use of the feet—seem remarkably constant, but the ordinary way of living is subject to considerable variation. Darwin and Wallace have given a good deal of evidence on this head, and perhaps it will not be considered out of place if a little more be added.

The Pariah-kite of India (*Milvus govinda*), habitually takes cooked vegetable food in default of meat, such as boiled rice, bread, &c.

The White-breasted Kingfisher (*Halcyon smyrnensis*), a bird of varied general feeding-habits, as it takes both fish and land-animals such as earthworms, occasionally practises piracy; one which haunts the tank in the Museum grounds has taken to robbing the Dabchicks (*Podicipes albipennis*) living there of their fish; I have seen it make several attempts, one at least successfully.

The King-crow (*Dicrurus ater*) of India, although usually preying for itself, also practises piracy at times; and though normally insectivorous, it will also attack small birds and fish.

The Indian House-crow (*Corvus splendens*), though usually carrying objects with its beak like Passerine birds generally, may be occasionally seen carrying something in its feet like a bird of prey. As the object is always according to my experience, valueless, a leaf, bit of dry cow-dung, or a stick, it would seem that the prudence of the crow prevents the bird from experimenting on articles of food in this way, lest they be lost.

This crow certainly does learn new habits; those at the Museum are afraid to fish things out of the tank, but down by the Hooghly they take objects off water readily. At the Grand Hotel in Calcutta they have learnt to catch food on the wing, owing to being fed by residents in this way.

Mr. A. L. Butler observed in the Andamans one individual of the Chestnut-headed Bee-eater (*Melittophagus swinhoii*) capturing small beetles while clinging to a bank, while others of the species were hawking insects on the wing in the ordinary way. (*Journ. B.N.H.S.*, Vol. XII., *p.* 561).

I had a common domestic drake which learned to fly up and perch on a seat in company with two Muscovy ducks kept with him. His general power of flight also improved much by his association with these birds, which, as usual with the species, were much more powerful and ready with their wings than common ducks.

Rai R. B. Sanyal Bahadur records that some Wigeons (*Mareca penelope*) and White-eyed Pochards (*Nyroca africana*) kept in an aviary with many other birds learned in this way to fly up to the perches and sit there. (*Hand-book to the Management of Animals in Captivity in Lower Bengal*, p. 309, Calcutta, 1892).*

I observed that some common Teal (*Nettium crecca*) confined in another aviary at the same garden (Calcutta) used to perch on the narrow ridges of nest-boxes. This was also in all probability an acquired habit, as this Teal seems never to perch when wild. No other non-perching ducks in the same aviary acquired the habit, not even the Garganeys (*Querquedula circia*), nor the Wigeons or White-eyed Pochards, though perching ducks were confined with them.

Conclusions.

In most of this paper I have merely tried to record some facts which may be useful to students of variation, but with regard to the facts concerning the range of variation in domesticated birds given in Section H. (p. 164), the following conclusions seem justifiable :—

Domestication seems not to induce variation directly; it merely gives varietal individuals a better chance of surviving and multiplying, and of producing secondary varieties by crossing with each other or with the type. The frequent occurrence of varieties in the wild state shows that the tendency to produce them is there just as strongly.

Were domestication to act in inducing variability by the change of conditions, we should expect to find our protected species varying more

* The writer includes the Mandarin Duck (*A. galericulata*) as one of the species that acquired the perching habit; but this bird is naturally a percher.

in proportion as they were more unnaturally treated. But this is not the case ; the Java Sparrow and Collared Dove, bred for generations in small cages, do not vary more than wild birds ; whereas the Pheasant, which lives almost a completely natural life, is more variable than these.

Climate does not *directly* induce colour-variation. The same colours constantly recur in domestic birds in Europe and in India, without variation in intensity. But some types of colouration may be absent altogether in one or the other country. Here an *indirect* action of climate, weeding out colours which are correlated with an unsuitable constitution, may be reasonably suspected.

For so soon as a correlation between colour and some constitutional quality is detected, it will probably be found that selection steps in even in domesticated birds not bred for colour. Fighting cocks are very variable in colour, being judged solely by courage and prowess in the pit, and hence not selected deliberately for colour-points. Yet the quasi-natural selection to which they are exposed seems to act in suppressing some few colours; cuckoo-coloured (barred-grey) birds—so common among unselected fowls—were rare in English fighting game, and I have never seen a cuckoo-coloured Aseel or Indian game-cock. In this breed, which is even more courageous than the English game, and has to fight under more trying conditions, the range of colour is altogether more limited than among English birds; the hen, for instance, is never of the wild "partridge" colour, and very rarely shows any approach to it, though the cock usually has some likeness to the male of *Gallus gallus*, the Red-Jungle Cock, his ancestor.

On the other hand, the duck, domesticated in so unnatural a climate as that of India, shows much the same variations as it does in England.

Every species we have taken under our protection varies in its own way; the two tame geese, Grey and Chinese, so nearly allied that they produce a fertile hybrid, have not an identical range of variation.

The variations of domestic birds have mostly an abnormal and unnatural appearance, like casual variations among wild forms; this may in some cases be explained. For instance, most domestic species produce a white variety, and albinoes are common among wild birds; yet these are usually unfitted for the struggle for existence on account of their colour, and accordingly we find few white *species*. Those we do find may reasonably be supposed to have originated as albinistic sports ; in the family where white species are commonest—the Herons—we still find yet other species which commonly produce temporary or permanent albinoes. A bird with the primary quills only white at once looks unnatural, and yet it is an extremely common variation among both tame and wild birds. Examination of the white quills, either in pied or pure white varieties, will very commonly show them soft and abraded at the tips, a serious matter for a wild bird. Accordingly we find that white-quilled *species*, like white ones, are almost always large and strong, and well able to defend themselves.

Why no *species* is mottled or splashed or irregularly pied, as tame forms and varieties commonly are, is less easy to understand. But the fact that constitutional disturbance seems to cause a bird to become temporarily so marked, may afford a clue. Such birds may be weak in constitution, and unfitted to live in a wild state. The hens do not appear to object to them, witness the case given by Darwin of Sir R. Heron's pied Peacock, and that of the pied Black bird recorded by Mr. Bucknill in his *Birds of Surrey*. This latter was evidently weakly; his whiteness increased with age, and he died from natural causes.

At the same time, some species seem incapable of producing mottled or irregularly pied varieties; I have never seen such in the Turkey or Collared Dove, and the Guinea-fowl is never mottled or splashed, although its pied markings are not quite as regular as a wild bird's. The Canary, on the other hand, is particularly prone to be asymmetrical and irregular in its markings, as also is the Pigeon.

The tendency of so many domestic birds to become coarse and heavy-looking, especially marked in the Water-fowl, is probably due to the adding up of small variations in that direction; these would, especially on birds performing long and perilous migrations, be weeded out in each generation; but if allowed to breed, would, in accordance with a tendency well-known to fanciers, produce offspring coarser and heavier even than themselves, till a conspicuous difference in appearance resulted.

It is possible that the tendency to the increased production of fleshy out-growths, like the combs and wattles of poultry, is connected with this assumption of a coarse habit of body; but it must be remembered that such processes are peculiarly susceptible to external influences and constitutional changes, and, hence, if the environment is ever proved to produce an inherited effect on any bird, might be expected to show this effect early and conspicuously.

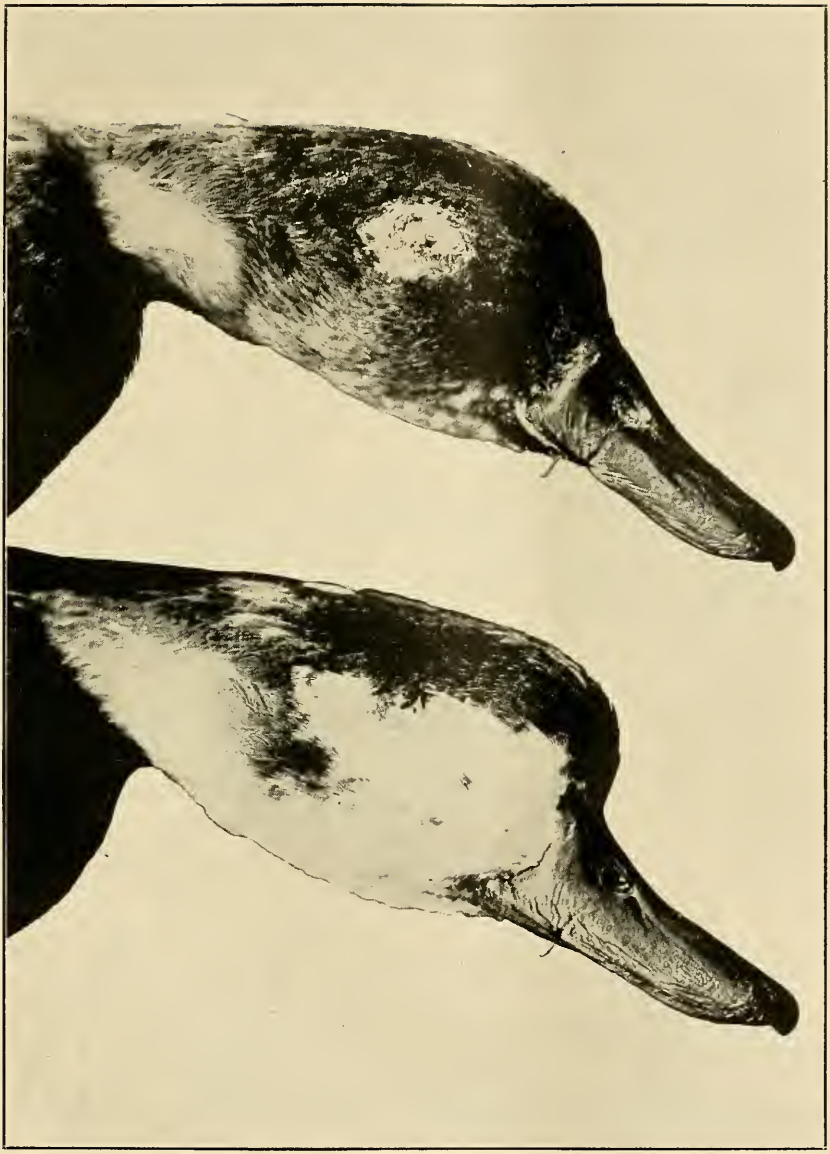
PLATE VII.

BABAX LANCEOLATUS.   PARUS PALUSTRIS.

PLATE VIII.

Variations of Pintail Snipe (*Gallinago stenura*).

PLATE IX.



A

B

NETTIUM ALBIGULARE.

A. *Normal form.*
B. *White faced variety.*

INDEX.

Names of New Genera and Species have an Asterisk (*) prefixed.

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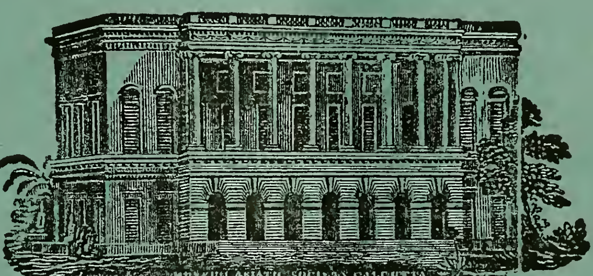

"The bounds of its investigation will be the geographical limits of Asia: and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."—SIR WILLIAM JONES.

*** *Communications should be sent under cover to the Secretaries, Asiat. Soc., to whom all orders for the work are to be addressed in India; or care of Messrs. Luzac & Co., 46, Great Russell Street, London, W. C., or Mr. Otto Harrassowitz, Leipzig, Germany.*

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･JOURNAL

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ASIATIC SOCIETY OF BENGAL,

Vol. LXXII. Part II.—NATURAL SCIENCE.

No. 1.—1903.

A Study on the Constitution of Dimercurammonium Salts.—By P. C. Râv, D.Sc.

[Read 3rd December 1902.]

A solution of mercuric chloride with ammonia yields what is commonly known as the infusible white precipitate for which two different formulæ have been proposed from time to time, according as it is regarded as the amido-derivative of the sublimate: NH_2-HgCl or as the mono-substitution product of sal-ammoniac: Hg. NH_2 Cl. Rammelsberg and Pesci even go a step further; they propose to double the formula of the compound and look upon it as a double salt of ammonium chloride and di-mercurammonium chloride: $NH_4Cl + NHg_2Cl$.

Hofmann and Marburg, who have recently repeated the experiments of Rammelsberg and Pesci, have come to the conclusion that through the researches of the last named chemists the formulæ of the mercurammonium compounds have been unnecessarily complicated, and they further maintain that the infusible white precipitate may be regarded as amido mercuric chloride, and as the salts of Millon's base contain "water of constitution," they should be looked upon as oxyidmercurammonium salts of the type $OHg_2 = NH_2X$.[1]

[1] Zur Kenntniss der Stickstoffquecksilber-verbindungen *Annalen*: Bd. 305, p. 191.

It is somewhat surprising that Hofmann and Marburg should have overlooked the valuable contributions of André, which throw considerable light on the constitution of the compounds in question. The French chemist has carefully studied the interaction of corrosive sublimate and ammonia under varying conditions and degrees of dilution,[1] and finds, moreover, that a solution of the sublimate and ammonium chloride when treated with potash (l.c. p. 1110) yields a compound which may be viewed as made up of equal molecules of dimercurammonium and dimercuroxy ammonium chlorides: $NHg_2Cl + NH_2OHg_2Cl$. It should be noted, however, that this rather complex formula admits of being simplified as $2NHg_2Cl + H_2O$.

Judging from analogy, I was naturally led to expect that mercuric nitrite solution with ammonia would yield a compound of the formula NH_2-Hg-NO_2. The expectation was in a way realised, only in place of the mono-, a di-substitution product was invariably obtained, *viz.*, N.Hg. Hg.NO_2 or dimercurammonium nitrite with a semi-molecule of water. When this nitrite is treated with hydrochloric acid and gently warmed, it dissolves to a clear solution, evolving nitrous fumes. On evaporation a crystalline double chloride of the formula $2\ HgCl_2 + NH_4Cl$ is obtained; hydrobromic acid also yields a compound of analogous constitution. The aqueous solutions of these double salts again, when treated with an excess of alkali, throw down precipitates of the type $NHg_2\ X$: where X represents a halogen atom.[2]

The haloids as obtained by me, however, seem to conform to the general formula $2\ NHg_2X.H_2O$. The water is obstinately held by these salts—even at 160° C.; and hence this water may be regarded as "water of constitution."

It may be urged that the hydrated compounds, in view of their high molecular weights, may all be taken to have *one* instead of a *semi*-molecule of water, and the percentages of mercury and nitrogen, &c., may still fall fairly within the range of "errors of experiment;" but the concurring testimonies of the analyses of the different compounds under the respective heads speak in favour of a semi-molecule.

As regards the question whether these salts should be regarded as of the type mercuroxy—or mercurammonium derivatives, my answer is in favour of the latter. On treating the double salt $2\ HgBr_2.NH_4Br$. with an alkali I have succeeded in preparing not only the *hydrated* bromide $2\ NHg_2Br.H_2O$, but also a salt of the formula $2\ NHg_2Br.HgBr_2$ which is absolutely *non*-hydrated. A corresponding chloride has been described by Kane, though prepared under different conditions. [*Ann. Chem. Phys.*

[1] *Compt. Rend.* T. 108, pp. 235, 290, 1108, 1164.

[2] Trans. Chem. Soc. (1902), Vol. 81, p. 644.

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PART II.

TITLE PAGE AND INDEX

FOR

1902.

(2) 72, 215.] Again, the mercuroxy-ammonium chloride, if it exists at all, when heated, decomposes into ammonia, nitrogen, water, and calomel (Kane). But both the chloride and the bromide as obtained by me decompose according to the equation: $2\,NHg_2X.H_2O = N_2 + 2\,HgX + Hg_2 + H_2O$—a reaction which has been established quantitatively, as will be shown in a subsequent communication. Scarcely a trace of ammonia could be detected even by Nessler's reagent; I thus find myself in agreement with Weyl's observations, though his salt is non-hydrated. André, as has been already noted, goes halfway between Kane and Weyl and believes in the existence of two distinct compounds: NHg_2Cl and $OHg_2=NH_2Cl$, often formed side by side.

In the case of infusible white precipitate, as we have already seen, Kane attributes to it the formula, NH_2HgCl. Rammelsberg, on the other hand, looks upon it as a "double salt," having the composition, $NHg_2Cl + NH_4Cl$. He is supported in his contention by the compound "dissociating" into NHg_2Cl and NH_4Cl on treatment with H.OH, or better K.OH. A study of the decomposition of the compound under the action of heat, on the other hand, corroborates the other view of its constitution. For, if Rammelsberg's formula be accepted, the decomposition might be expected on the following lines (*cf.* decomposition under heat of ammonio-magnesium chloride):—

$$NHg_2Cl\ NH_4Cl.$$
$$\downarrow$$
$$NHg_2Cl + NH_4Cl,$$
$$\downarrow$$
$$N + Hg + HgCl + NH_4Cl.$$

But the amount of ammonium chloride was relatively insufficient, nor was there any free mercury found. The slight amount of ammonium chloride may well be due to a secondary reaction between calomel and ammonia. Here the decomposition is found rather to agree with Kane's view of the constitution.

We thus find that both these views about the constitution of the infusible white precipitate are supported by experimental data, which can well be explained by having recourse to considerations of "tautomerism." Although we know little or next to nothing about the molecular configuration of the so-called "double salts," it would be interesting to note that such instances of "tautomerism" are given in *inorganic* chemistry. (*cf.* in this respect, Hantzsch, on the tautomerism of hyponitrous acid and its salts, *Annalen*, Bd. 292, 340).

The so-called mercuroxy-ammonium chloride, $NH_2(Hg.OHg)Cl$, which we have regarded as $NHg_2Cl + H_2O$, breaks up, according to Kane, into nitrogen, ammonia, water, mercury, and calomel. The anhydrous salt, NHg_2Cl, according to Weyl, breaks up into $HgCl + Hg + N$. Our results with the *hydrated* variety conform to Weyl's result with the *anhydrous* salt. It would thus appear that there is no necessity for setting up two distinct types of compounds, *viz.*, (1) mercuroxy-ammonium, and (2) dimercurammonium, for the salts supposed to belong to the former class do not yield any appreciable ammonia as they are stated, by Kane, to do. *Therefore the salts regarded as mercuroxy-ammonium compounds may very reasonably be looked upon as (hydrated) dimercurammonium salts.* [*cf. Trans. Chem. Soc.*, Vol. 81, (1902), pp. 645-46].

This conclusion is further corroborated by the corresponding bromine compound, which behaves exactly like the chloride. But a stronger argument in favour of the non-oxylic constitution of this class of compounds seems to be based upon a study of the dimercurammonium nitrate, which I have prepared according to two distinct methods (see below).

Dimercurammonium Nitrate.—By P. C. Rây, D.Sc.

Preliminary.—When dimercurammonium nitrite is treated with halogen acid, nitrous fumes are evolved and a clear solution is obtained, which on concentration yields the double salt, $2\,HgCl_2.NH_4Cl$, or $2\,HgBr_2$ NH_4Br, as the case may be. [*Vide Journ. Chem. Soc., Trans.*, Vol. 81 (1902), p. 648]. The behaviour of nitric acid towards the nitrite, however, affords a marked contrast, giving rise to the formation of a practically insoluble compound. Here, the nitrite molecule evidently does not undergo a complete "break-up" and the reaction seems to consist in the replacement of the radical NO_2 by NO_3, just as silver nitrite under similar conditions is converted into silver nitrate.

For making a comparative study, the so-called mercuroxy-ammonium[1] nitrate was also prepared and its properties studied.

Preparation.—To the pale yellow dimercurammonium nitrite strong nitric acid is added from a pipette, till the evolution of nitrous fumes ceases. After a time the clear supernatant acid liquid is decanted off and the substance dried over sulphuric acid till the weight is constant. The mother liquor on testing indicates the presence of traces of mercury, showing that the compound is only very slightly soluble in nitric acid.

[1] The nomenclature adopted is as given in the new Edition of Watts' *Dictionary of Chemistry.*

The nitrate thus obtained is a white amorphous powder; it retains moisture, which is not driven off even when the salt is dried in the steam-oven. It approaches closely to the formula $2NHg_2NO_3 + H_2O$.

Analysis.—The analyses given below are of distinct preparations :—

Table of Analyses.

	°/o Mercury	°/o Nitrogen	°/o Water
$2NHg_2NO_3 + H_2O$ requires ...	82·47	5·77	1·86
Found ...	83·13	6·02	
	82·71	5·92	
	82·48		
NHg_2NO_3 requires ...	84·03	5·88	

Behaviour.—When heated in a bulb tube the salt decomposes, without fusion, with a sudden puff, giving off nitrous fumes, mercury, and water, and leaving a reddish yellow residue, consisting mainly of mercuric oxide.

"*Mercuroxy*"-*ammonium Nitrate.*

Preparation.—To a moderately strong solution of mercuric nitrate containing the minimum amount of the free acid dilute ammonia solution was added with constant shaking till there was a persistent smell of ammonia. A bulky, flocculent, very pale yellow precipitate was obtained, which was thrown on the filter-paper, washed and dried in the steam-oven. The filtrate, though smelling distinctly of ammonia, gave on testing indications of the presence of notable quantities of mercury.

Analysis.—Prep. I. In this, the preparation was washed with cold water :—Hg = 83.20 °/o.

Prep. II. In this case, the preparation was washed with hot water. Hg = 82.99 °/o(*a*), 83.03 °/o(*b*) ; N = 5.6 °/o.

Prep. III. The dry substance was digested with nitric acid, the acid decanted off, and the substance dried once more as above. The colour was found to change from pale yellow to perfectly white. Hg = 83.2 °/o ; N = 5.9 °/o.

The identity of all the above preparations, as far as analysis goes, seems to be established.

Behaviour.—All the above samples when heated in a bulb-tube decomposed with a sudden puff, giving off nitrous fumes, and yielding a mirror of mercury, the residue mostly of mercuric oxide. It was, however, distinctly noticed that moisture was on the stem of the tube.

Conclusion.

The identity of the so-called mercuroxy-ammonium nitrate with dimercurammonium nitrate is at once apparent.[1] The formation of the "mercuroxy" compound in the presence of strong nitric acid would seem to favour the view already put forward, namely, that the dimercurammonium compounds are non-oxylic in constitution. Pesci found that when the preparation was washed with hot water, the anhydrous salt, NHg_2NO_3 was obtained. This, as will be seen, is not, however, borne out by my own experiments.

[1] There is, however, this difference that when the compound is obtained by precipitation of mercuric nitrate with ammonia, the colour is faintly yellow.

The Function of the Vasiform Orifice of the Aleurodidæ.—*By* H. W. Peal, F.E.S.

The vasiform orifice of the *Aleurodidæ* is a small oval organ always present on the posterior surface of the dorsum of both the larval and adult insects. This organ consists of three parts: The vasiform orifice, which is a more or less oval pit or depression. The operculum, which is a flat shield-like organ which covers the vasiform orifice to a greater or less extent. It is hinged on to the anterior margin of the orifice. The lingula and a narrow tube-like organ, which lies beneath, and sometimes projects beyond the operculum. The lingula is usually two jointed. It is continued within the body as a transparent tube, which expands and opens into the body cavity of the insect.

So far the exact function of the vasiform orifice has received little or no attention and the exact use to which it is put has up to the present been a matter of conjecture. While observers like Maskell have surmised that this organ is concerned in the secretion of honey dew, no one as yet has been able to definitely state that such is really the case.

Some time back, while I was examining an aleurodid which in its earlier stages is remarkably flat and transparent, I was fortunate enough to observe the lingula in motion. This organ was shot out beyond the vasiform orifice with extreme rapidity, it being protruded some four or five times a second.

When the lingula was shot out the vasiform orifice moved in unison, the upper edge being bent inwards while the whole organ moved candad. The internal opening of the lingula lies directly in the path of the rudimentary circulatory system, and when the organ is in motion it throws the circulatory fluid into a pulsating motion for some distance within the body cavity. I have been unable so far to detect the actual formation of the globules of honey dew, but as soon as the lingula comes to rest after a series of protrusions a small globule may be seen just within the lower end of the lingula. This globule advances slowly, being apparently forced forward by the movement of the lingula, and after awhile reaches the tip of that organ. I have never observed these globules within the lingula of an adult insect, but once on examining an adult male of *Aleurodes simula*, I perceived a globule of honey dew emerging from the lingula.

There is no doubt that the function of the organ is the secretion of honey dew and the operculum may be regarded as a protective covering to this organ.

It would appear that but little honey dew is formed by these insects compared with the majority of the coccids, aphids, or psyllids.

The "Green Bug" and other Jassids as food for Birds.—
By H. W. PEAL, F.E.S.

In 1897, a very interesting paper by Mr. F. Finn, the Deputy Superintendent of the Indian Museum, appeared on this subject in *Indian Museum Notes.*

Mr. Finn, however, confined his attention to the "green bug" (*Nezara viridula*, Linn.), which periodically at the beginning of every cold weather appears in swarms in Calcutta. Fortunately this little intruder contents itself with a merely temporary visit, as during the period of its stay it is a source of no little discomfort. This, on the other hand, is the true reason why the suggestion put forward by Mr. Finn has not up to now, at any rate to my knowledge, received the notice it really deserves. The period of its stay is far too short to make its collection profitable.

Some time back, while investigating the operations of the mango jassid (*Ideocerus niveosparsus*, Leitherry), it struck me that it would be an excellent addition to the "green bug" as a bird food. This jassid may in most years be found in swarms in mango topes in February, March, and April. It subsists by sucking out the juices from the young flower shoots of the mango. This insect is one of the most serious of our mango pests. Still later in June and July I found another jassid exceedingly plentiful in the various plots around Calcutta devoted to the cultivation of the Bhindi (*Hibiscus esculentus*). This insect is clothed in a uniform coat of green, is far softer than the two jassids just referred to, and would, if anything, prove an even more palatable addition to the above two species as a bird food. These three species taken together would, I am sure, make it worth one's while to take the matter up. (There are in addition several other species of jassids occurring in abundance on various plants which could also be systematically collected).

It will be seen from Mr. Finn's paper that 'ants' eggs' sell from about 1*s.* to 1*s.* 6*d.* per lb. retail in the English market. Presumably about 4 to 6*d.* would be about the correct wholesale rate it could be sold at. I have no data to hand which would give one an idea as to how much each lantern trap could be counted on to catch in a night during the season. As a matter of fact, it must be admitted that it would vary enormously with the state of the weather, the wind, and to a certain degree the type of lantern used. I have myself gathered considerably over a pound of the green fly from off an ordinary lamp in about two hours' time.

A suitable lantern trap would consume about an anna's worth of oil per night and it would require to catch some two or three pounds of insects per night to make it pay.

Last year the insects were plentiful from the 27th October to the 5th November. Giving an estimate of two pounds of dried insects off each lantern trap, the total catch for a hundred lamps would be nearly 2 cwt. per night or a ton for the ten days' work.

As for the mango jassid I did not know at first if it would prefer immolation in a lantern trap to the allurements of the mango shoots. I find, however, that like the rest of its family it has a strong fascination for light.

One can count on ten days or a fortnight for the "green bug," a period of nearly three months for the mango jassid, and two months on the "bhindi" jassid. This would mean at least 150 working days for each lamp and the total catch for each lamp would be almost 3 cwt. of insects. This on 200 lamps would represent an outturn of about 30 tons. On a basis of 4*d.* a pound, this would mean some £1,120.

For drying the insects Mr. Finn's idea of cheap coarse cloth stretched on frames is both inexpensive and efficient. The frames should be double to prevent the insects while drying being eaten up by other birds, like the crows. If, however, the work was taken up on an extensive scale, it would pay to use a dryer, such as is used for drying fruit in the United States or tea in India.

I could never understand before where the insect hid itself during the day. This year while searching for insects on peepul seedlings, I found this jassid packed away in large numbers under the leaves. Possibly the peepul is its food plant. Peepul seedlings spring up in enormous numbers during the rains in all sorts of likely and unlikely places. For various causes most of these seedlings die out about the beginning of the cold season, but during the time of their growth they would afford an unlimited supply of food for the bug.

Note on the occurrence of Motacilla taivana (Swinhoe) near Calcutta.—By CAPT. H. J. WALTON, I.M.S.

In the Fauna of British India, Birds, Vol. II, p. 296, under the heading of *Motacilla flava*, Mr. Oates remarks: "An allied species, *M. taivana*, Swinhoe, from China and the Malay Peninsula, is extremely likely to be found in Burma.............A specimen of a wagtail in the Hume collection killed at Howrah, Calcutta, would appear to belong to this species, but unless supported by other specimens, it would be premature to pronounce it such."

With the exception of the specimen mentioned above, I can find no reference to the occurrence of *M. taivana* in India.

On January 7th, 1900, amongst a number of live small birds in a coop in the New Market, Calcutta, I noticed a wagtail that I was unfamiliar with. I bought the bird and skinned it. I labelled it at the time "*? M. taivana.*" For various reasons, I have only lately been able to re-examine the skin and to compare it with the wagtails in the Indian Museum. In doing this, I had the great advantage of the assistance of Mr. Frank Finn. My bird differs from all the Indian wagtails in the Museum collection, and except that it is of a slightly duller yellow on the under parts, agrees perfectly with a specimen of *M. taivana*, from Foochow. Mr. Finn agrees with me that my bird is undoubtedly *M. taivana.*

The distribution of this species, given by Mr. Bowdler Sharpe, in the Catalogue of Birds in the British Museum, Vol. X, is "Kurile Islands, Eastern Siberia, Dauria, Amoorland, throughout China and Formosa, wintering in the Malayan Peninsula."

The fact of my specimen being exposed for sale in the market in the same coop as a miscellaneous lot of common small birds, "ortolans" in the language of the market—completely negatives the idea that it may have been imported. All these small birds are obtained in the immediate neighbourhood of Calcutta, and there can be no doubt that the wagtail came from the same locality. It is curious that Hume's specimen should have been killed at Howrah.

My bird is a hen. The following measurements were taken in the flesh :—

Length—			
Total	...	...	6·8″
wing	...	...	3·1
tail	...	...	3·0
bill from gape	...	...	0·65
tarsus	...	...	0·95

Iris ; dark brown.
Bill ; upper mandible black : lower mandible pale horny.
Legs and feet ; black.
Ovary ; very small.

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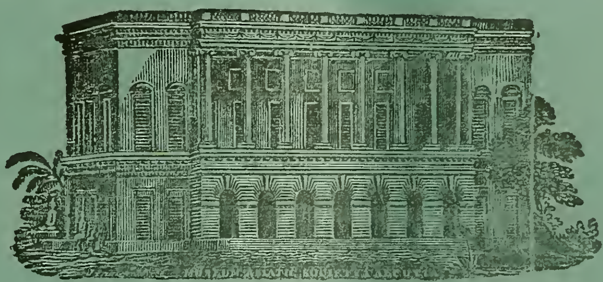

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Noviciæ Indicæ XX. *Some Additional* Scrophularineæ.—*By* D. Prain.

[Received 24th March 1903. Read 1st April 1903.]

Having had occasion to assort the material of the natural order *Scrophularineæ*, preserved in the Herbarium attached to the Royal Botanic Garden at Shibpur, the writer finds, as is usually the case, that there are a number of species belongiug to the order which are new to India in the sense that they are not included in the account of the family published by Sir J. D. Hooker in the *Flora of British India*, vol. iv. (1884). In almost every case the new record is the result of the extension of the territories of the Indian Empire along its north-western and its north-eastern frontiers. Following the practice, commenced now fifteen years ago, of providing diagnoses of species thus found to be new to the Indian flora, arranged according to the method of the *Flora of British India*, for the benefit of members of the Society who may be botanising near the Indian frontiers, the writer now presents the necessary supplement to this particular natural family. Having regard, however, to the needs of those who may be working in the field elsewhere than on the frontiers, new localities for species already accounted for in the *Flora of British India* are duly noted.

1. ANTICHARIS Endl.

1. Anticharis linearis *Hochst.*

Add to localities :—Rajputana ; Bikanir, where it is known as "Dhunnya," *Major Roberts !*

The capsules, in all the Indian specimens at Calcutta, are pubescent.

2. VERBASCUM Linn.

3. Verbascum erianthum *Benth., DC. Prodr.* x. 236; *Boiss. Flor. Orient.* iv. 319 ; thinly ashy-pubescent, lower leaves oblong narrowed to a petiole, upper auricled cordate obtuse or subacute, flowers panicled.

British Beluchistan ; Ziarat, *Lace !* Harnai and Lakkahana, *Duthie's Collectors !* Chitral ; near Drosh, *Hamilton !* Kala Drosh, *Harriss !* between Mirga and Dir, *Harriss !* Distrib. Afghanistan ; W. Beluchistan.

Biennial ; stem 3-4 feet, blackish, paniculately branched upwards. *Leaves* crenate, radical up to 18 in. long, cauline 4-8 in. *Flowers* in distant tomentose fascicles on the 6-8 in. long branches of the terminal panicle ; pedicels unequal, rather shorter than the calyx, ·25 in. long. *Calyx*-lobes triangular, partite to the middle. *Corolla* ·5 in. across. *Stamens* 5, filaments woolly. *Capsule* ovate, twice as long as calyx.

4. LINARIA Juss.

2. Linaria incana *Wall. Pl. As. Rar.* ii. 43; *Benth., DC. Prodr.* x. 270. L. cabulica *Hook. f., Flor. Brit. Ind.* iv. 251, *quoad descript.* L. ramosissima var. pubescens *Stocks Mss., Flor. Brit. Ind.* iv. 251.

Deccan : *Perrottet !* C. India : Jubbulpore, *Beddome !* Goona, *King !* Nepal : Rambun, *Wallich* 3910 ! N.W. Himalaya : Sirmore, *Vicary !* Jaunsar, *Gamble !* Fagu, *Gamble !* Hazara, *Stewart !* Kangra, *Stoliczka !* Chumba, *Clarke* 23566 in part, mixed with *L. ramosissima !* Rawal Pindi, *Aitchison* 213 in part, mixed with *L. ramosissima !* Rajputana : Abu, *King !* N. India : Etawah, *Hume !* Chitral, near Drosh, *Harris !*

The above are the Herb. Calcutta localities for this plant, which the writer is inclined to agree with Clarke and Aitchison in uniting with *L. ramosissima*. This is the species with softly hirsute leaves and echinate or, as Bentham expresses it "muricate-tubercular" seeds, exactly like those of *L. ramosissima.*

3. Linaria cabulica *Benth., DC. Prodr.* x. 270. L. incana *Hook. f., Flor. Brit. Ind.* iv. 252.

Afghanistan : *Griffith* K.D. 3859, named by Bentham ! Kashmir : Srinagar, *Clarke* 29124 ! *Gammie ! Falconer* 763 !

The above are the localities of the specimens in Herb. Calcutta of this species, which is, as an authentic sheet named by Bentham shows, the one with flowers, capsules, and seeds larger than in *L. ramosissima* and *L. incana ;* in this plant the seeds have a closely roughly pitted testa, not echinate or "muricate-tubercular."

5. Linaria Griffithii *Benth., DC. Prodr.* x. 272 (*Griffithsii*); *Boiss. Flor. Orient.* iv. 370; perennial, erect, glabrous, leafy, leaves alternate glaucous, oblong, flowers shortly pedicelled, spur rather shorter than the corolla-tube; seeds discoid marginate.

British Beluchistan: Shelabagh, 6,000 ft., *Lace!* Distrib. Afghanistan.

Stem 1·5-2 ft., branches short ascending. *Leaves* 1·5-2 in. long; ·5-·75 in. wide, semi-amplexicaul, acute, 5-7-nerved from the base. *Flowers* in long rather lax spiciform racemes; bracts and calyx-segments lanceolate acute, pubescent; *calyx* ·25 in long; *corolla* yellow, ·6 in. long, spur slender subincurved. *Capsule* subglobose, ·3 in. in diameter, pale brown.

6. Linaria odora *M. Bieb. Flor. Taur.-Cauc.* ii. 76; *Benth., DC. Prodr.* x. 274; *Boiss. Flor. Orient.* iv. 373. L. venosa *Lindl.*; *Benth. l.c.*; perennial, erect, much branched, glabrous, glaucous, leaves alternate, linear, pedicels short, spur shorter than corolla-tube; capsule globose, seeds smooth wide-margined.

W. Himalaya: Chitral, *Harriss! Younghusband!* Gilgit, *Giles!* British Beluchistan: Kanozai, *Duthie's Collector!* Distrib. Northward to Siberia, westward to Central Europe.

Stem 2-2·5 ft. high, branches strict, numerous from the base. *Leaves* linear-subulate rather distant, entire, semi-terete, canaliculate, 1·25-1·75 in. long. *Flowers* few laxly shortly racemed; *calyx* small, glabrous or faintly puberulous, segments elliptic subobtuse or slightly acute, ·15 in. long; *corolla* yellow, ·75 in. long, throat bearded, spur straight or slightly incurved short. *Capsule* globose, ·25 in. in diam.

5. SCHWEINFURTHIA A. Braun.

1. Schweinfurthia sphaerocarpa A. Br.

Add to localities:—British Beluchistan; Sibi, *Lace!* Kaloo-killa, *Duthie's Collector!*

7. SCROPHULARIA Linn.

11. Scrophularia variegata *M. Bieb.*

Add to localities:—E. Himalaya; Phari, *King's Collector!*

14. Scrophularia cabulica *Benth., DC. Prodr.* x. 316; *Boiss. Flor. Orient.* iv. 420; glabrous, glaucescent, leaves small oblong-lanceolate, repandly toothed, cymes few-flowered, divaricate, flowers small distant sessile; sepals oblong, hardly margined; staminode linear.

N.W. Himalaya: Chitral, *Harriss!* British Beluchistan: Torkhan, etc., *Duthie's Collector! Lace!*

Stems much branched from the base upwards, 1-1·5 ft. high; branches rigid sparsely leafy below, passing above into long strict thyrsoid panicles. *Leaves* ·5 in. long, oblong-lanceolate, teeth very faint. *Cymes* 5-7-flowered divaricately divided, the lower peduncled, the upper nearly or quite sessile.

9. WIGHTIA Wall.

1. Wightia gigantea *Wall.*

For Western read Eastern Himalaya; and add to localities of *F. B. I.*:—Assam; Khasia, *Hooker and Thomson! Simons!* Jaintea, *Wallich! King's Collector!* Manipur, *Watt!* Burma: Bithoko Range, *Brandis!* Ruby Mines District, *King's Collector!* Shan Hills, *Alpin!*

A large epiphytic climber.

11. MIMULUS Linn.

1. Mimulus nepalensis Wall.

Add to localities of *F. B. I.*:—Burma: N. Shan States, at Najong, 4,500 ft. *Gatacre!*

3. Mimulus gracilis R. Br.

Add to localities of *F. B. I.*:—Rajputana: Aboo, *King!* Central India: Goona, *King!* Betul, *Duthie!* Assam: Naga Hills at Kohima, *Clarke!* Manipur, *Watt!* Burma: Shan Hills, *Calcutta Collectors!*

14. LINDENBERGIA Lehm.

1. Lindenbergia grandiflora Benth.

Add to localities of *F. B. I.*:—Northern Circars: Ganjam, on Mahendragiri, at 4,500 ft., *Gamble* 13954!

A very interesting extension of distribution, especially since the species has not yet been met with on Parasnath or on the other subtemperate hills of Chota Nagpur.

2. Lindenbergia Hookeri Clarke.

Add to localities of *F. B. I.*:—Assam: Dikri Hills, *Simons!* Brahmakund, *Masters!*

3. Lindenbergia philippinensis *Benth.*

Add to synonyms of the *F. B. I.*:—L. siamensis *Teijsm. & Binn.*, *Nat. Tijds. Ned. Ind.* xxv. 411 (1863); *Miq. in Herb.*, *ex Hook. f.*, *Flor. Brit. Ind.* iv. 262 (1884). Adenosma cuspidatum *Benth. in Wall. Cat.* 3852 (1829). A. macrophyllum *Benth. in Wall. Cat.* 3853 (1829). Pterostigma macrophyllum *Benth. Scroph. Ind.* 21 (1835); *DC. Prodr.* x. 380 (1846).

Add to localities of *F. B. I.*:—Assam; Naga Hills, Zamba, *Collett!* and Pherima, *Prain's Collector!* Banks of Brahmaputra near Dibrugarh, weak plants on sand-banks apparently from seed washed down from higher elevations, *Prain's Collectors!*

4. Lindenbergia macrostachya *Benth.*

Delete synonyms of the *F. B. I.*:—L. siamensis *Miq. in Herb.* Adenosma cuspidatum *Benth. in Wall. Cat.* 3852.

Delete the localities:—Martaban, Siam, China.

Some confusion has grown up regarding the identity and the distribution as well as the synonymy of *Lindenbergia philippinensis* and *Lindenbergia macrostachya;* this requires to be definitely settled, if for no other reason than that, as the *Flora of British India* truly says, the one may prove only a variety of the other.

The species *Lindenbergia philippinensis* was first described as such in *DC. Prodr.* x. 377 (1846), the basis of the species being *Stemodia philippinensis* Cham. & Schlecht. *Linnea* iii. 5. (1828), and the Philippines being then its only known locality. Hooker in *Flor. Brit. Ind.* iv. 261, also describes the species but gives it as occurring in Chittagong, Burma, Pegu, Tenasserim, and as extending to China and the Philippines.

The species *Lindenbergia macrostachya*, which is admitted by Bentham, as well as by Hooker, to be very nearly related to *L. philippinensis*, was first described by Bentham in *Scroph. Ind.* 22 (1835), and is again described in the *Prodromus* x. 376. It is thus, *as a* Lindenbergia *at all events*, older than *L. philippinensis*. But, since the basis of *L. macrostachya* is Bentham's own *Stemodia macrostachya* in *Wall. Cat.* 3925 (1829), the epithet *philippinensis* has priority over the epithet *macrostachya*. Bentham gives the distribution of *L. macrostachya* as from the N.-W. Himalaya as far as to Martaban and Moulmein. This, however, he only manages to do by including in the species his own *Adenosma cuspidatum* in *Wall. Cat.* 3852 (1829) which is a Burmese plant. Hooker does not put the distribution in this way. He says that *L. macrostachya* occurs in the N.-W. Himalaya and in Martaban; a somewhat different statement from Bentham's. But it seems clear, from the way in which the citations are made, that the species is considered Burmese solely on the strength of *Wall. Cat.* 3852. The further distribution Siam is clearly on the strength of *Lindenbergia siamensis* Miq. in Herb.; that of China is probably on the strength of specimens from China named *Lindenbergia macrostachya* by Hance and by Maximowiz.

The only tangible character in the various diagnoses of these two species is that the style in *Lindenbergia macrostachya* is glabrous, whereas in *L. philippensis* it is hirsute at the base. The character of glabrous and pubescent leaves is unreliable; Hance's "*L. macrostachya*," for example, is undoubtedly *L. philippinensis* with nearly glabrous leaves; on the other hand Griffith and King have both collected in North-West India examples of undoubted *L. macrostachya* with leaves as pubescent as those of *L. philippinensis*.

As a rule the calyx is distinctive but even at best the difference does not amount to much and there are some Burmese examples of *L. philippinensis*, *i.e.*, of the plant with a very hairy base to the style, that have calyx-teeth quite like those of *L. macrostachya* which always has a glabrous style. The corolla of *L. macrostachya* is smaller than that of *L. philippinensis*, but the character, being a relative one, is hardly sufficient for absolute diagnosis, and the corolla of *L. philippinensis* itself varies too much in size to make the character of more than subsidiary value.

By the only crucial character, "style hairy at the base," *Adenosma cuspidatum* Benth. is certainly *Lindenbergia philippinensis!* So also is "*L. siamensis* Miq." which is only *L. siamensis* Teijsm. & Binn., of which I have seen an authentic example and of which there is a drawing made from the living plant in the Calcutta Herbarium. By this test too the *Lindenbergia macrostachya*, from China, of Hance and Maximowicz, is *L. philippinensis*.

In short *Lindenbergia macrostachya* is a species strictly confined to Northern India; *L. philippinensis* is a species that extends from Central China, throughout the whole of Indo-China from the Brahmaputra river eastward to Upper Tenasserim and to the Philippines. It has not, however, as stated in the *Index Kewensis*, been yet collected in any part of Malaya.

Whether the two plants deserve to be considered specifically distinct is rather an open question. They are easily distinguished in most cases and in any case are certainly very distinct varieties.

15. ADENOSMA R. Br.

1.* ADENOSMA INOPINATUM *Prain;* hirsute, leaves ovate-acute, serrate; flowers axillary sessile, 3 outer sepals in fruit very large, rounded at base, about twice as long as broad, 2 inner very small lanceolate. A. ovatum *Flor. Brit. Ind.* iv. 263 *as to the Malay Peninsula locality, not of Benth.*

MALAY PENINSULA; Malacca, *Griffith!* Singapore, *Anderson! Kunstler!*

Branching from the base, black when dry; branches 2-3 ft long, often rooting below, prostrate or ascending. *Leaves* 1·5-1·75 in., base cuneate, tapering to a very short petiole. *Fruiting sepals* nearly ·5 in. long, membranous reticulate pubescent outer twice as long as broad. *Flowers* blue.

This is very near *A. ovatum* from which it differs by its narrower fruiting sepals and still nearer *A. subrepens* from which it differs by its rather larger, serrate not crenate and acute not obtuse leaves.

9. ADENOSMA HIRSUTUM *Kurz, Journ. As. Soc. Beng.* xlv. 2. 143 (1873). Pterostigma hirsutum *Miq. Flor. Ind. Bat. Suppl.* 562 (1860). P. villosum *Miq. Flor. Ind. Bat. Suppl.* 562 (1860) *not of Benth.;* stout, erect, densely tawny-tomentose, leaves very short-petioled, ovate ovate-lanceolate or lanceolate, acute or subobtuse, crenate-serrate, flowers in dense cylindric villous bracteate spikes, corolla blue; capsule ovate abruptly beaked.

NICOBARS: Kamorta, *Kurz!* MALAY PENINSULA, Prov. Wellesley, at Kuleang Ulu, *Curtis* 2238! DISTRIB. Sumatra, at Rau (*Teijsmann* 1157)! Bangka, near Djebus (*Teijsmann* 3429)!

Stems 2-4 ft., and leaves on both sides densely villous with tawny hairs, as are the leafy bracts ·75 in. long at base of spikes, but gradually decreasing upwards. *Spikes* 2-3·5 in. long, very dense. *Calyx*-teeth lanceolate, the uppermost largest. *Capsule* straw-coloured.

The bracts of the Nicobar specimens are rather larger than these of the original Sumatra plant but the leaves are identical. The leaves of the Malayan Peninsula plant are rather narrower, but the bracts are exactly as in the Sumatra plant. The Bangka plant is rather more slender, but has the same compact heads with leafy bracts and tawny pubescence, and is very different from *Pterostigma villosum* Benth. (*Adenosma cæruleum*) to which Miquel has referred it. The nearest ally of the species is *Adenosma capitatum* from which, however, it is very distinct.

8. ADENOSMA MACROPHYLLUM *Benth.*

This plant, founded on *Wall. Cat.* 3853, as represented in Herb. Calcutta, is only *Lindenbergia philippinensis.*

17. LIMNOPHILA R. Br.

2. Limnophila balsamea *Benth.*

Add to localities of *F. B. I.* :—Malay Peninsula; Perak, *Kunstler* 1027!

Leaves rather dark green, flowers blue (*Kunstler*).

5. Limnophila micrantha *Benth.*

Add to localities of *F. B. I.* :—Malay Peninsula; Pahang, *Ridley!*

6. Limnophila erecta *Benth.*

Add to localities of *F. B. I.* :—Malay Peninsula; Perak, *Wray! Kunstler!* Pahang, *Ridley!*

The stems are sometimes 12 in. long, and the leaves sometimes 1·5 in. long.

8. Limnophila villosa *Bl. Bijdr.* 750. L. javanica *A. DC. Prodr.* x. 594. L. pulcherrima *Hook. f.*, *Flor. Brit. Ind.* iv. 267.

11. Limnophila hirsuta *Benth.*

Add to localities of *F. B. I.* :—Malay Peninsula; Perak, *Kunstler! Scortechini!*

17. Limnophila sessiliflora *Bl.*

Add to localities of the *F. B. I.* :—Burma; Hotha, *J. Anderson!* Kachin Hills, *Shaik Mokim!* Andamans; Port Blair, *King's Collector!*

The Burmese localities are very far north; the species may however occur elsewhere but have been overlooked. At Port Blair it is to be suspected that the species has been accidentally introduced with seed of rice from India.

21. Limnophila gratioloides *R. Br.*

Add to localities of *F. B. I.* :—Chittagong; Puttea, *Clarke!* Burma; Rangoon, *Kurz!* Tenasserim, *Helfer!*

The great rarity of this species to the east of India Proper leads to the suspicion of introduction.

22. Limnophila Griffithii *Hook. f.*

This interesting little species has also been collected in Perak by Kunstler, who reports the flowers as pure white, so that the plant from Nigeria referred to by Hooker may be actually the same.

18. HERPESTIS Gærtn.

4. Herpestis chamædryoides *H. B. & K.*, *Nov. Gen. & Sp.* ii. 369; *Benth.*, *DC. Prodr.* x. 393; decumbent, leaves short-petioled, ovate, toothed; pedicels solitary, ebracteate; upper sepal ovate, 2 lower ovate or oblong; capsule ovate.

Lower Bengal: Shibpur, plentiful.

Quite glabrous, not at all succulent; branches 3-6 in. long. *Leaves* ·5-·75 in. long, narrowed to the distinct petiole. *Pedicels* as long as or longer than the leaves. *Fruiting calyx* ·3 in. long. *Corolla* yellow, rather longer than calyx.

This small American weed has, of late years, become quite naturalized on paths and in waste corners in the neighbourhood of Calcutta.

22. CURANGA Juss.

1. CURANGA AMARA *Juss.*

Add to localities of *F. B. I.* :—MALAY PENINSULA ; Perak, *Scortechini !* Pahang, *Ridley !*

23. TORENIA Linn.

3. TORENIA CORDIFOLIA *Roxb.*

In all the specimens examined by the writer the lower filaments are distinctly toothed.

5. TORENIA ASIATICA *Linn.*

Add to localities of *F. B. I.* :—MALAY PENINSULA : Perak, *Scortechini ! Curtis !*

Add to distribution :—Sumatra.

6.* TORENIA RUBENS *Benth., DC. Prodr.* x. 410.

This is included under *T. vagans* in the F. B. I., and may, as Hooker suggests, be but a form of that species. The two are, however, very easily distinguished in the Herbarium by the smaller, often minute, teeth on the longer filaments of *T. rubens.* They are still more easily distinguished in the field by the colour of the flowers : *T. vagans* has a fairly uniform blueish-purple or dull-violet corolla ; *T. rubens* has a corolla with a pale lilac or nearly white tube with three bright violet-purple spots.

10. TORENIA FLAVA *Ham.*

Add to localities of *F. B. I.* :—MALAY PENINSULA : Perak, *Kunstler !*

Kunstler describes the corolla of this as bright yellow.

11. TORENIA CILIATA *Sm.*

Add to synonyms of *F. B. I.* :—T. flava *Miq. Flor. Ind. Bat. Suppl.* 237.

Add to localities of *F. B. I.* :—MALAY PENINSULA : Perak, *Scortechini ! Kunstler !* DISTRIB. Sumatra (*Teijsmann* 1182) !

Teijsmann's original specimens of "*T. flava* Miq. non Ham." are marked *corolla cœrulea.* Two species of *Torenia* collected by Teijsmann and described by Miquel I have not seen. One of these is *T. lamponga* which from Miquel's description ought certainly to be *T. peduncularis ;* the other is *T. cœrulea* and it ought equally certainly to be *T. ciliata.*

12. TORENIA BENTHAMIANA *Hance, Ann. Sc. Nat.* Ser. 4. xviii. 226 (1862) ; decumbent diffuse rooting at the nodes, finely tawny-tomentose ; leaves petioled deltoid-ovate acute, serrate ; pedicels axillary larger than the calyx or the leaves ; fruiting calyx oblong, subclavate, 5-angled, keeled and chanelled, not winged ; lower filaments with a very long slender tooth.

MALAY PENINSULA: Johore, *Ridley* 4160! DISTRIB. China (*Hance* 5901)! Cochin-China.

Stems slender, up to a foot long; *leaves* ·75-1 in. long including the petiole ·2-·25 in. long, base rounded truncate. *Calyx* in fruit ·5 in. long, peduncle ·75-1·5 in. long. *Corolla* ·6 in. long, yellow with purple eye.

This seems to be the *T. flava* Bot. Mag. t. 6,700 not of Ham.

24. VANDELLIA LINN.

3. VANDELLIA STEMONOIDES *Miq. Flor. Ind. Bat. Suppl.* 563 (1860). V. Hookeri *Clarke Flor. Brit. Ind.* iv. 280 (1884). DISTRIB. Bangka, (*Teijsmann* 3242)!

6. VANDELLIA HIRSUTA *Benth.*

Add to localities of *F. B. I.*:—MALAY PENINSULA: Perak, *Kunstler!* Pahang, *Ridley!*

7. VANDELLIA SCABRA *Benth.*

Add to localities of *F. B. I.*:—MALAY PENINSULA: Prov. Wellesley, at Butterworth, *King!* Singapore, *Kunstler!*

8. VANDELLIA MOLLIS *Benth.*

Add to localities of *F. B. I.*:—BURMA: Chin Hills, *Abdul Huq!* Add to DISTRIB.:—Sumatra, (*Forbes* 1981)! Java, (*Kurz* 555)!

8*. VANDELLIA PUNCTATA *Prain;* procumbent, quite glabrous; leaves shortly petioled orbicular-ovate, succulent, crenate-serrate, distinctly punctate; pedicels in axillary and terminal racemes much longer than the calyx; sepels lanceolate glabrous not quite so long as the ovate capsule.

SHAN HILLS: Fort Stedman and Taungyi, *King's Collectors!*

Stem creeping below 12-18 in. long, somewhat succulent. *Leaves* ·5-·75 in. long, quite glabrous. *Racemes* up to 2·5 in. long, distantly 10-12-flowered; pedicels very slender ·4 in. long. *Sepals* ·15 in. long, lanceolate glabrous except for the finely ciliate-serrate margins. *Corolla* ·3 in. long, pale purple. *Filaments* glabrous. *Capsule* ·2 in. long.

This species is most nearly related to *V. scabra* and *V. mollis*, the flowers and capsules much resembling those of the former, the influence being exactly that of the latter. From both it differs in its quite glabrous leaves which are thicker than in either and are very distinctly punctuate.

12. VANDELLIA PEDUNCULATA *Benth.*

Add to synonyms of *F. B. I.*:—V. cerastioides *Coll. & Hemsl., Journ. Linn. Soc.* xxviii. 100.

Add to localities of *F. B. I.*:—BURMA: Tagaung, *J. Anderson!* Poneshee, *J. Anderson!* Pegu, *Kurz!* Shan Hills, *Collett!* MALAY PENINSULA: Malacca, *Harvey!* Singapore, *Kunstler!* Add to DISTRIB.:—Sumatra (*Beccari* 873)!

25. ILYSANTHES Rafin.

1. Ilysanthes hyssopoides *Benth.*

Add to localities of *F. B. I.*:—Chota Nagpur: Sirguja, *J. J. Wood!*

26. BONNAYA Link & Otto.

2. Bonnaya reptans *Spreng.*

Add to localities of *F. B. I.*:—Malay Peninsula: Perak, *Scortechini! Wray!* Singapore, *Hullett! Ridley!* Pahang, *Ridley!*

This species appears to be common in the Eastern Peninsula, *B. brachiata*, on the other hand, being rare. The latter was collected at Singapore by Wallich in 1822, but had been recorded by no one else till recently when it was collected by Ridley in Pahang. The two are very similar and perhaps *B. brachiata* may have been overlooked.

4. Bonnaya peduncularis *Benth.*

This species is based on *Wall. Cat.* 3865, and, so far as the Calcutta example of that number is concerned, is simply typical *Vandellia angustifolia*, because it has 4 perfect stamens.

32. SIBTHORPIA Linn.

1. Sibthorpia pinnata *Benth.*

Add to localities of the *F. B. I.*:—Sikkim: Tongloo, 10,000 ft. *Lister! Clarke! Gamble! King's Collectors!*

33. HEMIPHRAGMA Wall.

1. Hemiphragma heterophyllum *Wall.*

Add to localities of *F. B. I.*:—Naga Hills: Japvo, *Clarke!* Manipur, *Watt!* Burma: Kachin Hills, *Prain's Collectors!* North Shan States, Hantong Stream, 5,200 ft., *Gatacre!*

39. VERONICA Linn.

13. Veronica cana *Wall.*

Var. robusta *Prain; stems* stoutish, up to 2 ft. high; *leaves* larger over 2 in. long; more densely tomentose everywhere; *calyx*-segments acute; *fruit* less deeply 2-lobed than in the type.

Sikkim: Phallut, Tongloo, Kalipokri, Tassijour and elsewhere in Western Sikkim, common.

Larger in all its parts and more robust than the typical plant.

15. Veronica javanica *Bl.*

Add to localities of *F. B. I.*:—Nilgiris: *Gamble!*

40. ALECTRA Thunb.

2. Alectra Thomsoni *Hook. f.*

Add to localities of *F. B. I.*:—Noada in Singbhum, *Clarke!* Rajmahal Hills near Sahibganj, *Kurz!* Chanda District, C. Provinces, at Pátal Páni, near Alapilli, *Duthie!*

42. STRIGA Lour.

3. Striga lutea *Lour.*

Add to localities of *F. B. I.*:—Andamans: Port Blair, *Prain! King!* Malay Peninsula: Pahang, *Ridley* (the yellow-flowered form)! Singapore, *Kurz* (the pink-flowered form)!

44. CENTRANTHERA *R. Br.*

1. Centranthera grandiflora *Benth.*

Add to localities of *F. B. I.*:—Assam: Manipur, *Watt!* Burma; Chindwin Valley, *Prazer!*

45. SOPUBIA Ham.

2. Sopubia trifida *Ham.*

Add to localities of *F. B. I.*:—Naga Hills; common, *Prain!* Manipur, *Watt!* Burma; Chin Hills, *Prazer!* Shan Hills, *King's Collectors!* Distrib. Bali (*Zollinger*)!

A specimen of this species, n. 3,889 *Zollinger*, is in Herb. Calcutta, with the MSS. name *Sopubia sulphurea* Kurz. It was collected among the volcanic ash of Mt. Bator, in Bali, at 4-5,000 ft. in Sept. 1837. Of *Sopubia stricta*, which was already recorded from Java, there is also a specimen from Madura, collected by Teijsmann.

47. LEPTORHABDOS Schrenk.

2. Leptorhabdos linifolia *Walp.*

Add to localities of *F. B. I.*:—Hazára; Kagán Valley, *Duthie's Collector!* Gilgit, 8,000-9,000 ft., *Giles*! Lahul, *Jaeschke!*

This form, which Duthie's collectors have also collected more than once in Baltistan, differs both from *L. parviflora* and from *L. virgata* in the points noted by Hooker, but it hardly differs more from either of these forms than they do from each other, and the *Flora of British India* is almost certainly right in suggesting that there is but one species in the genus.

48. PHTHEIROSPERMUM Bunge.

3. Phtheirospermum tenuisectum *Bur. & Franch. Journ. de Bot.* v. 129 (1891); *Prain in Hook. Icon. Pl.* t. 2211 (1894); glandular-pubescent; leaves ovate-acute 2-3-pinnatisectly dissected, segments linear; calyx-lobes subequal; corolla-tube nearly twice as long as calyx.

Eastern Himalaya: Chumbi Valley at Tassi-chen-doom, *King's Collector!* Distrib. Tibet, W. China.

Stems slender from a perennial woody rootstock, many, simple or sparingly branched. *Leaves* ·75 in. long, nearly 1 in. wide. *Flowers* axillary, shortly pedicelled. *Calyx* ·3 in. long. *Corolla* ·5 in. long, ·2 in. wide. *Capsule* compressed beaked. *Seeds* with reticulate testa.

52. PEDICULARIS Linn.

11.* Pedicularis diffusa *Prain, Journ. As. Soc. Beng.* lxii. 2, 7, t. 1 (1893); glabrescent, stems erect or ascending, cauline leaves 4-nately whorled petioled ovate-oblong pinnatisect, segments oblong-obtuse, incised-serrate; flowers whorled, whorls numerous distinct; corolla-tube twice as long as calyx, upper lip slightly curved, apex somewhat incurved not beaked; lower lip 3-lobed, lobes oblong-ovate with sinuate margins the lateral one-half larger than the central; stamens inserted opposite top of ovary, anterior filaments bearded above.

Eastern Himalaya: Sikkim, Mt. Tankra, *Gammie!*

Stems 1·5-2 ft. long; cauline *leaves* ·75-1 in. long, petioles ·25-·4 in. long, radical leaves evanescent. *Flowers* in rather distant whorls, except the uppermost; bracts leafy. *Calyx* ·25 in. long; lobes rather large, unequal; the anterior and lateral ovate, incised-serrate, the upper deltoid entire, small; lateral twice as large as anterior 4 times as large as upper. *Corolla* rose; tube widened upwards, 4 in. long; limb ·2 in. wide; lip ·3 in. wide. *Capsule* narrowly lanceolate, acute, twice as long as calyx, ·5 in. long. *Seeds* ovoid, testa black, finely reticulate.

Most nearly related to *P. verticillata* Linn. and *P. refracta* Maxim., but while differing considerably from both in habit and foliage, it further differs from *P. verticillata* in having a calyx with large teeth and with the tube reticulated throughout, and further differs from *P. refracta* in having the anterior and lateral calyx-teeth serrate instead of entire. In habit it most resembles *P. flexuosa*, but is glabrescent, where that species is hirsute, or still more *P. gracilis* var. *macrocarpa*, from which it is hardly distinguishable in fruit. The flowers of these two last species have, however, long-beaked corollas.

30. Pedicularis flagellaris *Benth.*

Add to synonyms of *F. B. I.*:—P. Gammieana *Prain, Journ. As. Soc. Beng.* lviii. 2. 260; *Ann. Roy. Bot. Gard.* iii. 162.

32. Pedicularis curvipes *Hook. f.; Bot. Mag.* t. 7735.

Add to description of *F. B. I.*:—Corolla-tube not longer than the calyx; lower lip sessile, ·6 in. wide, pale rose-coloured, white towards the mouth, 3-lobed, glabrous, lateral lobes obliquely rounded, median much smaller, orbicular, emarginate or obcordate; upper lip puberulous, bright rose-red erect and inflated, arcuate, ending in a decurved slender beak.

53. LATHRÆA Linn.

2. Lathræa purpurea *Cummins, Journ. As. Soc. Beng.* lxiv. 2. 137 (1895); calyx cylindric campanulate, hirsute, 10-ribbed, slightly 2-lipped.

Eastern Himalaya: Bhutan, Dichu Valley, 12,000 ft. *Cummins!* Sikkim, Singalelah, 13,000 ft., *King's Collector!*

Diffusely branched; *stems* short, 3-4 in., purple, slender; *scales* purple, orbicular, obtuse, opposite, short-petioled; *flowers* racemed rather long-pedicelled, erect; bracts subsessile like the stem-scales. *Calyx* purple. *Corolla*-tube purple, about twice as long as calyx, ·75 in. long; upper lip purple hooded, subacutely toothed below the apex on both sides; lower lip 3-lobed, purplish-white with dark purple veins. *Stamens* didynamous, included; anterior filaments pubescent throughout and one-third shorter than the posterior which are only pubescent towards the apex. *Ovary* 2-lobed, purplish; style simple; stigma very small, subexserted; each chamber 10-15-ovuled.

Nearest to *L. clandestina* Linn., but differing in its nearly uniform purple colour, its subentire calyx, and its smaller corolla with subacute not rounded subapical teeth.

On two remarkable rain-bursts in Bengal; and some of the more prominent features of the monsoon season in Northern India in 1902.—*By* C. Little.

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Part I.

The south-west monsoon is a subject of enduring interest to many, not only to those who are continuous residents in the plains of India, or to those who are interested in raw products, but to all professional meteorologists, and to many other scientific men, whose work dovetails in with meteorological investigations. I make no claim to belong to any of these classes except the first, but my official duty as storm-warning officer for ports in the Bay of Bengal, has made it necessary for me to try and follow others in their advances in the direction of explaining complicated atmospheric changes. Any attempt by me to go beyond the *rôle* of follower has been either with the purpose of educating myself or merely as a pastime, and in either case it is not likely that it will be much, or any advantage to others to know what I have been studying, or what conclusions I have come to.

In my position of follower I have one strong belief which is, of course, a not uncommon belief, and it is that much of the weather in Northern India during the monsoon season depends on storms, which develop in the Bay of Bengal, or to be on the safe side, which enter India from the Bay. I have another belief which may not be so common, *viz.*, that, in one important respect intimately connected with the character of the monsoon, the behaviour of these storms is as yet a mystery. My main object in offering this brief paper for publication is that, by showing my ignorance others may be induced to supply the necessary information, or that if that information is not available, the collection of meteorological statistics may be more specially directed so as to meet a most important demand.

The difficulty I have felt is, how to account for the line of advance of storms (the word here meaning any cyclonic disturbance, slight or severe), while moving over the Bay, or the part of the country, which they may devastate or enrich. The past few years appear to me to have cast into strong relief the importance of having this matter placed, if possible, beyond question, so that the direction of advance may not only be accountable for after the event, but may be capable of exact forecast several days before. The importance of what is called the recurving of cyclonic storms was shown in 1899, when not a single depression entered India from the Bay but recurved over Central India, and as every one will remmember the general distribution of rainfall in that year was great scarcity in the west and abundance in the east. The past monsoon season has been even more rich in evidence, in favour of the enquiry, which I here suggest, being one of first class importance.

The recurving of cyclonic disturbances, is not the only important matter of enquiry which a discussion of the past monsoon season brings to the surface. The disturbed weather which extended along the Himalayas on two occasions appears to me to indicate the direction in which the enquiry as to recurving should be made. These disturbances were the immediate cause of the two rain-bursts in Bengal, and I have on that account used them as a title for this paper. In what follows I have given small tables containing the more important meteorological statistics collected at the time of their occurrence and I have endeavoured to show how they serve to divide the monsoon season into periods which have important characteristics as regards the recurving of storms from the Bay and of the rainfall distribution in Northern India. No one who gives any consideration to such matters can have forgotten the famine cloud that was hanging over North-Western and Central India, in the early part of August, and the rapidity with which that foreboding vanished, when the storms from the Bay moved towards the area of drought.

Some Calcutta people may remember the change that occurred in the weather here on the 30th June. On that date a very trying period of hot muggy weather came to an end, and there began, at last, what had all the appearance of the south-west monsoon.

If there should be any doubt in the minds of my Calcutta friends as to what happened here on that date, I am sure residents of Benares will remember the relief they must have experienced, not on the 30th June, but on the 2nd July, that is, two days later, when their excessive temperature gave place to the comparative coolness of the south-west monsoon. The interval of two days between these occurrences shows one of the points which I wish to make out, *viz.*, that the change progressed from east to west. No one, I think will be likely to challenge that statement because it is accepted by everyone that south-west monsoon conditions gradually extend from the head of the Bay north-westward into Northern India. The other point which I wish to make, and which may not be readily accepted, is that the disturbance to which that change of weather was due, began in the north-east of India, and while progressing westward also extended southward over Bengal Proper in the first instance, then over Orissa and on to the Circars. It was even felt in Arakan and Madras though not very noticeably.

Of the occurrences accompanying this wave of change, which passed over Bengal, one of the most noticeable on the meteorological record of the time is the heavy rainfall in Bengal Proper, between 8 A.M. on the 29th, and 8 A.M. on the 30th June. It appears in the record as rainfall of the 30th June.

I may, perhaps, be allowed to digress here for a moment to point out the difficulty, which I shall refer to later on, in establishing the sequence of events in atmospheric matters. The only record of such events is what the observers note at certain fixed hours—mostly 8 A.M., supplemented at a few places by observations at 4 P.M. If any change passes so rapidly over the land that it is completed within the 24 hours, between 8 A.M. of one day, and 8 A.M. of the next, it appears, as a simultaneous change and at times, an important part of the change is lost altogether. For instance, when a cyclone of small extent passes over an observatory the rapid fall of pressure during the approach of the central area and the rapid rise, after its passage, may occur in a few hours, and neither will be shown by the 8 A.M. record of that station, unless the passage occurs about that hour. For that reason, the pressure record of a disturbance, with a high rate of progress, is of less value in a historical survey than are those for temperature and rainfall. It would be a very awkward circumstance if the rain which falls, say in the afternoon, were to evaporate before it could be measured next morning. But the rainfall remains and though some rise of temperature occurs after the passage of a disturbance the recovery is slower than that of pressure, more especially if there should be a good deal of cloud at the time. Because of this difficulty as regards the record of pressure changes I rely more on the rainfall and temperature changes to prove the progressive motion from north to south for the disturbance which accompanied and no doubt caused the rainfall of the 30th June.

The second disturbance with which the rain-burst of the 11th August was associated was no less remarkable than the first, but it was less striking to the ordinary observer because there was not the same reversal of temperature. In one respect it was even more noticeable and that was as regards the pressure changes which in this case, strongly support the view that the disturbance entered India from Thibet. A reference to the Indian Daily Weather Report, will show that the fall of pressure preceding the June rainfall, occurred almost simultaneously over the whole of India so that pressure changes alone would not be sufficient to prove that the disturbance did not come from some other direction, from the Bay of Bengal for example, but the pressure changes preceding the August rainfall leave no room for doubt that that disturbance did not originate over the Bay. The fall of pressure began in the north-eastern Himalayas and from there, extended westward and southward. The southerly element in this progressive movement was less marked in the second than in the first disturbance, as shown by both pressure and temperature changes.

The explanation of the weather changes for the periods represented for the purpose of this paper by the 30th June and the 11th August appears to be that just previous to these dates, depressions were crossing Thibet towards the Himalayan range, the first moving in a south-westerly, and the second in an almost due westerly direction. These depressions on reaching the Himalayas became to a certain extent broken up, more especially the former whose direction of motion had been almost perpendicular to the range of high hills. Owing to the comparatively small height of the hills to the north of Assam, a disturbance of some intensity entered that province and moving south-westward caused the rainfall in Assam and Bengal. The higher hills in Nepal, formed a more serious obstacle to the progress of the general disturbance, and that may be the reason why on both occasions the changes appear to have been delayed in Bihar and the United Provinces. The fact that the depressions had to pass over a range of hills extending in places to between twenty and thirty thousand feet, adds greatly to the difficulty of establishing continuity in the changes that occurred. What adds still further to the difficulty is that when a cyclonic storm encounters a range of hills of height sufficient to cause disintegration of the cyclonic system of air motion, local storms with large irregular changes of pressure and temperature and with irregular rainfall generally occur. In almost every case where a cyclonic storm moves northwards from the Bay of Bengal towards the Himalayas the storm breaks up very suddenly on reaching the hills, and instead of a well defined depression with cyclonic winds we find in a few hours a uniform distribution of pressure with numerous thunderstorms, it may be along the whole line of the Himalayas. Judging by what one observes of these storms, from the southern side of the range of hills it is very improbable that weather becomes disturbed in Thibet after a storm from the Bay of Bengal disappears amongst the hills. But that is not a sufficient reason for arguing that a cyclonic storm may not cross the Himalayas from Thibet into India. In the first place the Thibetan storm is at a high altitude, because of the Central Asian plateau, and a second reason is that the obstacle which the hills present, to the progress of a storm, from the Thibetan side is not nearly so serious as to storms from the south. There would be more or less isolated peaks to pass, instead of the solid wall, formed by the lower ranges up to 10,000 feet, surmounted by the peaks.

Among the general conclusions given in the *Monthly Weather*

Review for June, 1902, issued by the Meteorological Reporter to the Government of India, and Director-General of Indian Observatories, and suggested by the discussion of the atmospheric conditions in June in Europe, Asia, Africa, Australia, and the adjoining seas, the following occur:—

(1) "That conditions in India may be sometimes largely conditioned by actions taking place in the Central Asian areas, and that occasionally these actions extend over the greater part of Europe and Asia."

(3) "That these actions are largely modified by the barrier of the Himalayas and seem to spread more readily southwards through the gaps in the range."

These conclusions may I think be interpreted, as giving general support to my assumption that it is possible for a storm to cross the Himalayas into India from Thibet; but as regards my statement, that the depression moved towards India from a north-easterly direction, the *Monthly Weather Review* takes up an entirely different position. Discussing the changes of the 28th June it is there stated that "Large and important changes occurred on this day" and subsequently "It hence seems probable that the main centre of the action was near Gilgit, and that it extended almost up to Lake Balkash on the north, to Chitral on the west (where pressure was steady) and on the south over the greater part of India. It is impossible to further define the scope of the action for no data are available for the regions to the east of Gilgit. The fact, however, that the fall in Upper Assam was only moderate seems to indicate that the action did not extend far eastwards into Thibet."

What the comparatively small readings on that date in Assam appear to me to indicate is, that the wave of change had passed rapidly over Thibet, that the 8 A.M. pressure readings on the 28th in the north-east included some part of the recovery which had, by that time, commenced in the east; and that it had not reached the neighbourhood of Gilgit, etc. The great rapidity with which that change of pressure occurred is shown by the almost uniform fall over India, as given by the pressure readings at 8 A.M. of the 28th. The main result is that the pressure changes on that occasion give little or no indication of the direction of advance of the disturbance and that if there were no confirmatory evidence in favour of a westerly movement from other sources reliance would have to be placed on temperature and rainfall only. But the storm of the 11th August and adjoining days shows beyond all question, that that depression moved from east to west, and as in all other respects there was a striking resemblance between the two storms it appears to me to be an established fact that the depression accompanying the rainfall of the 11th June passed over Thibet in a westerly or south-westerly direction, and that at 8 A.M. on the morning of the 28th, the region of Gilgit was near the front of the advancing wave.

Before commenting separately on the information regarding these storms preserved in the meteorological records, I will again point out that from whatever direction the storms entered Northern India, it was not from the Bay of Bengal. For several days before and after the two dates, mentioned above, weather was unusually quiet over the Bay, and in one respect was in striking contrast to what is usual in disturbed weather. At Diamond Island the most exposed of the observatories on the sea coast easterly winds of greater or less strength are an invariable accompaniment of disturbance. During the two periods of disturbance the direction was westerly day after day, which would indicate that weather was more probably disturbed over the south of Burma, than over the Bay, that is, if there were any disturbance in that region. The unusually low wind velocity at Diamond Island is sufficient in itself to prove that there was disturbance, neither over the Bay nor in Burma, until some days after the events under discussion.

Part II.

The following tables give in the form which appears to me most convenient for purposes of comparison, the data for the storms in succession. When weather is unsettled changes at different observatories are often very irregular more especially when local storms are frequent as appears to have been the case on both of these occasions. I have therefore given the average change for divisions containing four to six observatories or even more. The number of stations for each province or division is given in the rainfall tables.

Storm of June 30th.

The following tables I (*a*) and II (*a*) give the pressure changes from June 27th to July 5th, and the variation from the normal in Assam, Bengal Proper, and on the northern coasts of the Bay, arranged with the view of showing the southerly movement of the disturbance. As I have already stated the pressure change is practically useless for this purpose in the case of the June storm because it extended over India with great rapidity. The fall on the 28th was general and it continued in the north on the 29th. The recovery began on the 30th and extended from Assam and Bengal Proper to Orissa on the 1st July, practically the only evidence of south-westerly movement, afforded by the table. Table II (*a*) shows that pressure was relatively high on the 27th June, and that there was continued excess, over the area represented, throughout the period except in Bengal Proper and Assam on the 29th June, and the Burma coast on the 2nd July. If the smallest excess or largest defect be selected for these divisions it will be found in the column of the 29th for Assam and Bengal Proper, of the 30th for Orissa, and of later dates for the Circars, Akyab, and Diamond Island. The relatively small excess on the 5th in the Circars and at Diamond Island is due to a cyclonic storm which began in the south of the Bay about that time.

TABLE I (*a*).

Giving the pressure change daily from June 27th to July 5th, arranged to show the southward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	−·012″	−·080″	−·026″	+·041″	+·006″	−·013″	+·038″	+·053″	+·024″
North Bengal	−·009	−·073	−·083	+·096	−·006	−·009	+·027	+·040	+·029
East Bengal...	+·003	−·075	−·032	+·060	−·025	−·021	+·005	+·087	+·018
South-West Bengal ..	+·002	−·081	−·042	+·037	+·027	−·024	+·012	+·075	+·004
Orissa ...	+·014	−·045	−·032	−·006	+·027	−·028	+·005	+·032	+·028
Circars ...	+·031	−·028	−·008	+·002	−·019	+·002	−·024	+·003	−·004
Akyab ...	−·001	−·043	000	+·005	−·023	−·012	+·017	+·073	−·019
Diamond Island	+·038	−·025	−·012	−·015	+·011	−·044	+·024	+·008	+·004

TABLE II (*a*).

Giving the pressure variation from the normal from June 27th to July 5th, arranged to show the southward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	+·111″	+·034″	−·002	+·045″	+·047″	+·029″	+·055″	+·112″	+·139″
N. Bengal ...	+·115	+·04	−·041	+·049	+·047	+·036	+·064	+·108	+·133
East Bengal...	+·116	+·039	−·001	+·063	+·040	+·016	+·025	+·109	+·127
South-West Bengal ...	+·123	+·050	+·010	+·041	+·058	+·031	+·045	+·124	+·126

TABLE II (*a*).—*Contd.*

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Orissa ...	+·130	+·082	+·043	+·035	+·064	+·038	+·044	+·081	+·110
Circars ...	+·100	+·070	+·061	+·062	+·042	+·041	+·018	+·020	+ 015
Akyab ...	+·085	+·041	+·040	+·044	+·020	+·007	+·023	+·096	+·077
Diamond Island	+·071	+·044	+·031	+·015	+·025	−·020	+·003	+·010	+·013

Tables III (*a*) and IV (*a*) give the temperature change and variation from the normal for the same provinces and divisions as tables I (*a*) and II (*a*), prepared in the same way and with the same purpose, *viz.*, to show the southward movement of the wave of disturbance. To assist the eye I have had the larger changes and the larger variations printed in bolder type. It will be readily seen that the rapid fall of temperature began in Assam and North Bengal on the 29th June, in East Bengal on the 30th, in South-West Bengal and Orissa on July 1st, and in the Circars on the 2nd. There is here clear evidence that a wave of falling temperature proceeded from North-East India in a southerly direction beginning about the 29th June, and reaching the more southern districts three days later. Akyab and Diamond Island felt the change later and not to the same extent, as might be expected from there being a westerly element in the movement indicated by subsequent tables.

From Table IV (*a*) it will be seen that mean defect in Assam was 5°·7 on June 30th, about 5° over the whole of Bengal Proper on July 1st, 4°·3 in Orissa on the 2nd, 3°·1 in the Circars on the 3rd, and 4° 6 at Akyab on the 4th, while at Diamond Island there was a moderate to large excess throughout the period.

It is impossible to say whether the fall of 1°·5 at Diamond Island on the 5th is connected with the wave of falling temperature so clearly indicated as proceeding from the north-east or with the cyclonic disturbance which began over the south of the Bay about that date.

TABLE III (*a*).

Giving the temperature change daily from June 27th to July 5th, arranged to show the southward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam... ...	+2·4°	−0·2°	**−2·7°**	−3·2°	**+3·3°**	+1·3°	+0·8°	+0·5°	−1·6°
North Bengal ...	+2·5	−1·2	−1·8	**−2·3**	−1·6	**+4·4**	−0·2	−1·5	+1·8
East Bengal ...	+0·2	+1·0	−0·7	**−4·2**	−2.2	**+4·1**	+0·3	−1·6	+0·8
South-West Bengal	−1·1	+1·5	+0·6	−1·3	**−7·3**	**+3·6**	+1·8	−2·0	−2·6
Orissa	+2·2	−0·7	+0·9	+0·3	**−5·6**	−3·5	**+6·6**	+0·6	−3·6
Circars ...	−0·5	−3·2	+1·2	−1·0	+1·0	**−4·4**	−0·4	**+4·1**	+0·1
Akyab... ...	−0·8	+1·0	−0·2	−2·3	0·0	+0·8	**−2·3**	−2·3	**+3·8**
Diamond Island ..	+1·8	+0·5	+0·5	+0·2	+0·5	0·0	−0·1	+0·7	−1·5

TABLE IV (*a*).

Giving the temperature variation from the normal from June 27th to July 5th, arranged to show the southward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	+0·8°	+0·3°	−2·0°	**−5·7°**	−2·9°	−0·5°	+0·7°	+0·4°	−0·9°
North Bengal ...	+2·2	+1·2	−0·8	−3·1	**−5·5**	−0·7	−1·3	−2·7	−0·4
East Bengal ...	+1·2	+2·2	+1·5	−2·7	**−5·0**	−0·9	−0·5	−2·1	−1·2
South-West Bengal	+2·2	+3·8	+4·5	+3·3	−4·0	−0·2	+1·7	−0·2	−2·7
Orissa... ...	+4·3	+3·3	+4·7	+5·1	−0·4	**−4·3**	+2·6	+2·7	−1·3
Circars ...	+3·8	+0·6	+1·7	+0·6	+1·6	−2·8	**−3·1**	+1·2	+1·5
Akyab ...	+0·8	+1·9	+1·6	−0·8	−0·8	0·0	−2·3	**−4·6**	−0·8
Diamond Island ...	+1·6	+2·1	+2·6	+2·9	+3·4	+3·4	+3·2	+4·0	**+2·5**

Tables V (*a*) to VIII (*a*) are arranged to show the westerly movement of the disturbance and give the pressure and temperature changes and variations for Northern India from Assam on the east to the Punjab and Kashmir on the west.

Table V (*a*) shows that the fall of pressure was general over Northern India on the 28th and on the 29th, and that the changes on those days give no indication of progressive movement; but on the 30th the recovery is shown as almost complete in Assam and North Bengal; partly complete in Bihar, beginning in the United Provinces and not yet begun in the Punjab. That is the only clear indication, of the westerly progressive movement given by the pressure changes.

TABLE V (*a*).

Giving the pressure change daily from June 27th to July 5th, arranged to show the westward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	−·012″	−·080″	−·026″	+·041″	+·006″	−·013″	+·038″	+·053″	+·024″
North Bengal	−·009	−·073	−·083	+·096	−.006	−·009	+·027	+·040	+·029
Bihar ...	−·020	−·085	−·064	+·069	+·041	+·032	−·009	+·032	−·021
United Provinces ...	−·026	−·096	−·055	+·015	+·082	−·013	+·019	+·031	−·031
Punjab ...	−·022	−·117	−·061	−·008	+·028	−·030	+·091	+·051	−·017
Srinagar, etc.	−·006	−·093	−·045	+·026	−·004	−·057	+·024	+·021	+·005

TABLE VI (*a*).

Giving the pressure variation from the normal from June 27th to July 5th, arranged to show the westward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	+·111″	+·034″	−·002″	+·045″	+·047″	+·029″	+·055″	+·112″	+·139″
North Bengal	+·115	+·040	−·041	+·049	+·047	+·036	+·064	+·108	+·133
Bihar ...	+·097	+·010	−·049	+·008	+·046	+·071	+·065	+·101	+·082
United Provinces	+·138	+·043	−·009	+·005	+·079	+·062	+·076	+·106	+·075
Punjab ...	+·182	+·074	+·019	+·012	+·036	(?) −·005	(?) +·077	+·123	+·107
Srinagar	+·172	+·074	−·002	+·045	+·041	−·003	+·015	+·065	+·046
Leh ...	+·153	+·073	+·053	+·070	+·059	+·007	+·017	+·017	000

Table VI (*a*) shows that on the 27th there was a large excess in pressure over the whole of Northern India and that the excess was greatest in the Punjab and Kashmir. During the two following days this excess disappeared except at Leh and before the end of the period covered by the table the old excess pressures were restored except at the high level stations. Leh which is the highest of all the hill stations given in the Indian Daily Weather Report was the only station on the 4th and 5th July, for which pressure was not in moderate to large excess.

The westward progress of the temperature change is clearly shown by tables VII (*a*) and VIII (*a*). The rapid fall of temperature, which began on June 29th in Assam is most marked in North Bengal on the 30th, in Bihar on July 1st, in the United Provinces on the 2nd and 3rd, in the Punjab on the 2nd to 4th, and in Kashmir on the 5th.

TABLE VII (*a*).

Giving the temperature change daily from June 27th to July 5th, arranged to show the westward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	+2·4°	−0·2°	**−2·7°**	−3 2°	**+3·3°**	+1·3°	+0·8°	+0·5°	**−1·6°**
North Bengal ...	+2·5	−1·2	−1 8	**−2·3**	−1·6	**+4·4**	−0·2	−1·5	+1·8
Bihar	−0·6	+0 6	−0·3	−0·5	**−5·2**	−1·3	−2 6	**+1·7**	−0·3
United Provinces	+1·2	+1·9	+0·6	+2·4	−1 7	**−4·0**	−5 3	**+0·6**	−0·8
Punjab ...	+2·5	+3·3	+2 2	+3·2	+1·0	**−6·4**	−3·1	−4·9	**+2·9**
Srinagar, etc. ...	+0·5	+4·5	+3·0	+0 7	+0 4	0·0	−1·6	−1·5	−4·7

TABLE VIII (*a*).

Giving the temperature variation from the normal from June 27th to July 5th, arranged to show the westward movement of the disturbance.

	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4	July 5
Assam ...	+0·8°	+0·3°	−2·0°	**−5·7°**	−2 9°	−0 5°	+0·7°	+0·4°	−0·9°
North Bengal ...	+ 2 2	+1·2	−0·8	− 3·1	**−5·5**	−0 7	−1·3	−2·7	−0·4
Bihar ...	+ 6·9	+7·8	+7 8	+ 7·3	+2·6	+1·4	**−1·2**	+0 5	+0·4
United Provinces	+ 4·6	+6·9	+7 8	+10·4	+8·8	+4·9	**−0·2**	+0 5	−0·3
Punjab ...	− 2 9	+0·7	+3·2	+ 6·7	+8·0	+1·8	−1·2	**−5·9**	−3·1
Srinagar ...	− 6·5	−1·9	+2·1	+ 1·2	+1·9	−1·3	**−4·4**	**−2·0**	**−5·1**
Leh ...	−11 0	−3·6	−0·6	− 0·0	−1·0	−1·4	+1·1	**−2·1**	**−5·7**

From Table VIII (*a*) it can be seen that the lowest temperature in Assam was on June 30th, in North Bengal on July 1st, in Bihar and the United Provinces on the 3rd, in the Punjab on the 4th, and in Kashmir on the 5th. The very low temperatures which are shown at Srinagar and Leh on the 27th were connected with conditions, then prevailing in Western India, and have no connection with the disturbance or series of disturbances which I have been discussing.

A very striking feature of Table VIII (*a*) is the large fall of temperature in Northern India between June 30th and July 4th. In the United Provinces the change was from an excess of 10° on the 30th to a small defect on the 3rd, and in the Punjab from excess of 8° on July 1st to defect of 5°·9 on the 4th.

TABLE IX (*a*).

Rainfall. (June 27th to July 4th).

	No. of Stations.	June 27	June 28	June 29	June 30	July 1	July 2	July 3	July 4
Assam ...	5	3·10	2·47	**6·28**	**8·06**	0·89	5·59	0·04	3·91
North Bengal ...	7	2·12	6·54	**10·68**	**14·28**	2·20	0·10	3·85	3·77
East Bengal ...	7	7·37	0·14	1·60	**26·41**	3·92	9·46	2·10	6·70
South-West Bengal	9	0·93	0·36	0·37	**2·51**	**1·72**	0·01	2·09	16·31
Bihar	13	0·64	...	...	2·02	0·67	**8·85**	2·78	2·24
United Provinces...	12	...	...	...	...	0·79	**3·14**	**4·46**	**7·01**
Punjab ...	6	...	...	...	...	1·81	0·47	**3·12**	1·56
Simla Hills ...	5	0·04	...	...	...	0·17	0·85	**6·49**	**5·92**
Kashmir ...	6	0·07	...	...	0·62	0·49	0·35	0·46	0·91
Darjeeling ...	...	0·04	0·85	0·26	1·69	0·02	0·35	1·49	...
Cherrapoonjee ...	...	...	0·51	3·68	4·66	0·15	0·05	1·22	5·61
Orissa ...	4	...	...	...	...	**8·76**	1·12	0·07	0·46
Circars ...	4	0·35	0·44	...	...	1·60	**7·01**	...	...

TABLE X (*a*).

Rainfall.

	No. of Stations.	Before 30th June.	30th June.	After 30th June.	Total.
Assam ...	5	11·85	8·06	10·43	30·34
North Bengal ...	7	19·34	14·28	9·92	43·54
East Bengal ...	7	9·11	26·41	22·18	57·70
South-West Bengal	9	1·66	2·51	20·13	24·30
Bihar ...	13	0·64	2·02	14·54	17·20
United Provinces	12	......	......	15·40	15·40
Punjab ...	6	......	......	6·96	6·96
Simla Hills ...	5	0·04	......	13·43	13·47
Kashmir ...	6	0·07	0·62	2·21	2·90
Darjeeling ...	...	1·15	1·69	1·86	4·70
Cherrapoonjee ...	...	4·19	4·66	7·03	15·88
Orissa ...	4	......	......	10·41	10·41
Circars ...	4	0·79	......	8·61	9·40

In Tables IX (*a*) and X (*a*), I have given the rainfall in Northern India, for the period June 27th to July 4th. They are similar, to those which precede as to divisions of the country. The figures I have obtained by merely adding up the rainfall recorded at the various stations in each division and the stations which I have taken, are those given in the *Indian Daily Weather Report*. In the first column of each of these Tables the number of stations is given so that the average rainfall for each day or for a group of days so far as it depends on the records of the stations selected can be obtained by dividing by that number. The heavy rainfall in East Bengal on the 27th June, has no connection, so far as I can see with the general disturbance which culminated in the down-pour in East and North Bengal on the 30th. Setting that item aside it will be seen that in Assam and North Bengal, the rainfall steadily increased between the 27th and the 30th, and that the dates of heaviest rainfall were the 29th and 30th. Proceeding southward from North Bengal the dates of heaviest rainfall are East Bengal June 30th, South-West Bengal June 30th and July 1st, Orissa July 1st, and the

Circars July 2nd. Going westward we see that before June 30th, Bihar was practically rainless, and that there was no rain in the United Provinces, Punjab, and the Simla Hills, until July 1st. The dates of heaviest falls are July 2nd in Bihar, the 2nd and 3rd in the United Provinces, the 3rd in the Punjab, and the 3rd and 4th in the Simla Hills.

In Table X (*a*) I have merely added together the columns for the days 27th, 28th, and 29th, with the heading "before 30th June" and the columns for the days July 1st to 4th with the heading "after 30th June." It will be seen that the heaviest falls occurred before the 30th June in Assam and Bengal, and after the 30th June in Lower Bengal, Orissa, the Circars and over the whole of North-Western India.

In addition to the provinces and divisions in the Table, I have given the rainfall at Darjeeling and Cherrapoonjee. The rainfall at these two stations agrees only partially with what is given for the plains of Bengal and Assam; and there is a striking difference between the falls at these places for the two disturbances. With the June storm, rainfall was comparatively light at both Darjeeling and Cherrapoonjee, while in August it was very heavy at both.

There appears to me to be no want of evidence, in the above Tables, in favour of the view that an atmospheric disturbance invaded India from the north-east, at the end of June. I may, however, give one or two further items of information showing the south-westward direction of progress over Bengal. They are only stray items, but they will indicate to some extent how the meteorological record might be improved, if there were some fore-knowledge of coming events and of the direction from which change should be looked for.

As the disturbance advanced over Bengal, thunderstorms probably occurred at places in succession. If so the fact has not been recorded. But I saw in the newspapers that a local storm of great severity had occurred between Nalhati and Rampur Hât, on June 29th, and I have ascertained that the hour when it overturned a train on that part of the E.I. Railway was between 3 and 4 o'clock in the afternoon. I personally observed the changes, as the wave passed over Calcutta, on the morning of the 30th and the traces of the self-recording apparatus, at the Alipore Observatory, show that it began about 4 A.M. on that date and was practically over by 10 A.M. When the weather was becoming more settled at Calcutta, that is about 10 A.M. I received a telegram from the observer at Saugor Island that weather was very unsettled there, that the barometer had fallen two-tenths of an inch, and that the wind was blowing 44 miles an hour. The following day I heard from a Calcutta resident who had just arrived from Madras that while the train on the East Coast Railway was passing through Orissa on the night of the 30th, they had experienced very severe thunderstorms, with most vivid lightning. Though these are only stray facts, they indicate very clearly how the disturbance was advancing.

TABLE.

Place.	Hour and date of local storm.
Rampur Hât	3-30 P.M., June 29th.
Calcutta	6-0 A.M. to 8 A.M., June 30th.
Saugor Island	About 10 A.M., June 30th.
Orissa	About midnight, June 30th.

The following Table gives the hourly changes of pressure from the barograph at Alipore Observatory, on June 30th. Hourly pressure at Alipore corrected for instrumental errors and reduced to 32° Fah.

June 30th.	Actual pressure.	Approximate normal.	Change.
4 A.M.	29·539″	29·548″	−·009″
5 „	·563	·549	+·014
6 „	·588	·560	+·028
7 „	·633	·576	+·057
8 „	·597	·592	+·005
9 „	·646	·602	+·044
10 „	·658	·613	+·045
11 „	·697	·598	+·001
12 „	·678	·585	−·007

The Table shows that at 4 A.M. pressure was normal, that considerable oscillations occurred between that hour and 11 A.M. (a rise followed by a fall) and that at noon the difference from the normal was the same as it had been at 4 A.M. The general appearance of the part of the trace from which the above measurements were taken is irregular and jagged without any marked sign of a depression, that is, the trace is of the kind characteristic of the passage of nor'westers in the hot season.

The temperature changes show a steady decline from 4 A.M. until noon. The change, though not quite regular, is not of the sudden character of the fall accompanying thunderstorms. It was continuously falling throughout the period and that at a time, it may be observed, when in ordinary weather temperature is rising with the advancing day.

Table giving temperature changes at Alipore observatory in degrees Fahrenheit.

	On June 30th.	Approximate normal.	Difference.
4 A.M.	85°·2	80°·7	+4°·5
6 "	83·0	81·1	+1·9
8 "	82·8	83·5	−0·7
10 "	79·5	86·2	−6·7
12 "	78·5	87·5	−9·0

The last column of the Table shows the large change of temperature which occurred between 4 A.M. and noon on the 30th June at Calcutta. It also shows indirectly how scanty, comparatively, would have been the information if the record had been limited to what is usually noted at 8 A.M. The temperature at that hour was practically normal.

Storm of August 11th.

The Tables containing the information for the August disturbance have been prepared in the same way as those for the preceding storm and are given below in the same serial order for purposes of comparison. I stated in discussing the earlier storm that the pressure changes give an imperfect indication of the line of advance of the wave of change. From Tables I (*b*), II (*b*), V (*b*) and VI (*b*) it will be seen that the fall of pressure began in North Bengal on August 9th, that it extended southward over Bengal Proper and Orissa and westward as far as the Punjab on the 10th; and that while pressure was beginning to recover in North-East India on the 11th it was still falling in the United Provinces, the Punjab and Kashmir. The fall on the 11th, was very rapid at Teheran (·175″) and Ispahan (·150″), showing that the centre of the wave had passed westward beyond the Indian region. The rapidity of this westerly movement is very little less than that of the earlier disturbance, and would probably have eluded observation if it had not been for the larger fall. The fall is first shown on the 9th in the north-east, and within 48 hours has passed far beyond the western boundary of India. The movement is also shown by the recovery which began on the 11th in Assam, and North Bengal, was rapid in North-Western India on the 12th and at Jask, Quetta, etc., on the 13th.

TABLE I (*b*).

Giving the pressure changes daily from August 8th to 14th, arranged to show the southward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	+·040″	+·004″	−·043″	+·019″	+·022″	−·019″	−·019″
North Bengal ...	+·057	−·025	−·087	+·037	+·059	−·018	−·010
East Bengal ...	+·067	+·003	−·061	−·003	+·052	−·020	−·025
South-West Bengal	+·050	+·006	−·065	+·050	+·039	−·025	−·018
Orissa ...	+·051	+·044	−·043	+·013	+·052	−·024	−·043
Circars ...	+·049	+·054	−·009	−·017	+·049	−·022	−·051
Akyab ...	+·062	+·028	−·021	−·043	+·008	+·011	−·062
Diamond Island...	+·055	+·014	−·016	−·051	+·019	−·003	−·057

Winds at Diamond Island varied between south-west and west-north-west and showed no signs of becoming easterly.

TABLE II (*b*).

Giving the pressure variation from the normal from August 8th to 14th, arranged to show the southward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	+·056″	+·052″	−·007″	+·004″	+·028″	+·010″	−·013″
North Bengal ...	+·075	+·040	−·051	−·019	+·034	+·016	+·006
East Bengal ...	+·079	+·075	+·006	000	+·053	+·027	+·003
South-West Bengal	+·066	+·071	000	+·043	+·080	+·049	+·028
Orissa ...	+·060	+·104	+·053	+·069	+·114	+·087	+·041
Circars ..	+·032	+·085	+·072	+·054	+·102	+·078	+·024
Akyab ...	+·066	+·091	+·066	+·020	+·025	+·032	−·034
Diamond Island...	+·055	+·066	+·047	−·007	+·010	+·004	−·055

TABLE III (*b*).

Giving the temperature changes daily from August 8th to 14th, arranged to show the southward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	−3·3°	−0·7°	**−2·8°**	**−2·9°**	−0·6°	+3·5°	+2·8°
North Bengal ...	−0·6	−1·9	−0·4	**−3·4**	−1·1	+3·3	+1·5
East Bengal ...	−1·6	+0·2	+0·6	**−3·9**	−0·7	+3·9	+0·7
South-West Bengal	−0·3	−0·6	+0·5	**−5·6**	+1·1	+4·5	+0·2
Orissa ...	−1·4	+0·2	+0·9	**−1·8**	−0·3	+1·8	+1·3
Circars ...	+1·8	−0·4	−1·4	+1·0	0·0	−0·1	+1·2
Akyab ...	+1·0	+2·5	+0·8	+0·2	−0·7	−2·8	+1·5

TABLE IV (*b*).

Giving the temperature variation from the normal from August 8th to 14th, arranged to show the southward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	−0·7°	−0·8°	−3·7°	**−6·4°**	**−6·8°**	−3·4°	−1·3°
North Bengal ...	+2·1	+0·4	+0·1	**−3·2**	**−4·0**	−0·9	+0·2
East Bengal ...	+0·5	+0·7	+1·3	**−2·5**	**−3·2**	+0·6	+1·2
South-West Bengal	+2·4	+2·0	+2·5	**−3·1**	**−2·1**	+2·3	+2·6
Orissa ...	+0·8	+1·1	+2·2	+0·5	+0·2	+1·4	+3·6
Circars ...	+3·7	+3·3	+1·9	+3·0	+2·9	+2·9	+4·1
Akyab ...	−0·2	+2·4	+3·2	+3·5	+2·7	−0·1	+1·5

TABLE V (*b*).

Giving the pressure change daily from August 8th to 14th, arranged to show the westward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	+·040″	+·004″	−·043″	+·019″	+·022″	−·019″	−·019″
North Bengal ...	+·057	−·025	−·087	+·037	+·059	−·018	−·010
Bihar ...	+·036	+·012	−·078	−·009	+·102	− 022	−·017
United Provinces	+·004	+·060	−·101	−·077	+·144	+·024	−·036
Punjab ...	−·025	+·056	−·085	−·103	+·212	+·041	−·040
Srinagar, etc. ...	−·007	−·008	−·084	−·087	+·130	+·089	+·002

TABLE VI (*b*).

Giving the pressure variation from the normal from August 8th to 14th, arranged to show the westward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	+·056″	+·052″	−·007″	+·004″	+·028″	+·010″	−·013″
North Bengal ...	+·075	+·010	−·051	−·019	+·034	+·016	+·006
Bihar ...	+ 045	+·048	−·038	−·041	+·050	+·029	+·010
United Provinces	+ 027	+·080	−·022	−·100	+·035	+·054	+·015
Punjab ...	000	+·046	−·041	−·153	+·035	+·078	+·040
Srinagar ...	+·054	+·025	−·031	−·130	+·055	+·137	+·106
Leh	+·059	+·038	−·047	−·145	−·052	+·049	+·045

It is not a matter of much importance in connection with this paper, whether local variations occurred while the above changes were in progress. What I have attempted is to establish the general progress of the disturbance, pointing out that the part of India first affected was the north or north-east and that from the place of first contact the line of advance was southward and westward. The Tables for the second disturbance are very similar to those of the earlier one and I propose commenting very briefly on the figures they contain. Tables III (*b*) and IV (*b*) give the temperature changes, and variation indicating the southward movement, and VII (*b*) and VIII (*b*) are similar Tables for the westward movement.

TABLE VII (*b*).

Giving the temperature changes daily from August 8th to 14th, arranged to show the westward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	−3·3°	−0·7°	−2·8°	−2·9°	−0·6°	+3·5°	+2·8°
North Bengal ...	−0·6	−1·9	−0·4	−3·4	−1·1	+3·3	+1·5
Bihar ...	+0·7	−1·0	−0·7	−2·8	−0·2	+3·0	+0·1
United Provinces	+1·8	−2·5	−0·4	+2·0	−1·4	+1·0	+1·5
Panjab ...	+3·1	+0·2	−1·9	−0·9	−5·6	−2·6	+3·3
Srinagar, etc. ..	+2·5	+1·1	+0·3	−3·0	−7·8	−5·4	−0·2

TABLE VIII (*b*).

Giving the temperature variation from the normal from August 8th to 14th, arranged to show the westward movement of the disturbance.

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	−0·7°	−0·8°	−3·7°	−6·4°	−6·8°	−3·4°	−1·3°
North Bengal ...	+2·1	+0·4	+0·1	−3·2	−4·0	−0·9	+0·2
Bihar ...	+2·9	+1·9	+1·3	−1·4	−1·2	+1·8	+1·8
United Provinces	+2·4	−0·1	−0·6	+1·5	+0·2	+1·2	+2·8
Punjab ...	+7·0	+7·2	+5·5	+4·9	−1·0	−3·5	−0·1
Srinagar ...	+4·1	+4·9	+4·9	+5·2	−3·4	−10·5	−10·7
Leh ...	+0·9	+2·3	+2·0	−1·4	−7·5	−14·9	−9·7

The southerly movement is less marked than was the case in June. The fall of temperature began in Assam on the 10th, it extended to Bengal Proper on the 11th, and there was a slight fall in Orissa also on that date. But unlike the earlier disturbance, mean temperature did not fall below the normal in Orissa, and in the Circars temperature continued high throughout the period.

From Tables VII (*b*) and VIII (*b*) it may be seen that the fall of temperature which began in Assam on the 10th, and North Bengal on the 11th, occurred in Bihar on the 11th, and in the United Provinces, Punjab, and Kashmir on the 12th. From Table VIII (*b*) in which the variation from the normal is given it may be seen that there was a very large defect in Assam on the 11th and 12th, and at Srinagar and Leh on the 13th and 14th.

The rainfall Tables IX (*b*) and X (*b*) show as before the heavy rainfall in Bengal Proper on the 11th, the heavy rain in Assam on the previous day the 10th, and that the days of heavy rainfall in the west of India were the 12th and 13th.

TABLE IX (*b*).

Rainfall (August 8th to 14th).

	August 8	August 9	August 10	August 11	August 12	August 13	August 14
Assam ...	3·28	7·07	**18·73**	**12·40**	**13·38**	1·97	0·70
North Bengal ...	2·09	3·24	**15·53**	**29·43**	9·38	2·19	4·26
East Bengal ...	2·63	6·79	1·62	**28·71**	9·03	4·04	1·15
South-west Bengal	1·17	0·55	3·33	**15·11**	2·28	0·93	0·25
Bihar ...	1·80	6·55	5·19	**12·94**	3·10	4·44	0·92
United Provinces	7·77	1·38	5·24	1·32	—	0·32	0·01
Punjaub ...	—	—	0·05	**1·31**	**1·81**	0·32	—
Simla Hills ...	0·16	7·21	1·09	2·06	**8·62**	**3·59**	0·16
Kashmir ...	0·43	—	0·03	1·05	**2·49**	1·02	0·52
Darjeeling ...	0·79	0·12	1·01	**7·91**	1·35	0·17	0·11
Cherrapoonjee ...	2·09	4·08	**28·69**	**22·71**	4·25	1·69	0·18

TABLE X (*b*)

Rainfall.

	No. of Stations.	Before 11th August.	11th August.	After 11th August.
Assam	5	29·08	12·40	16·05
North Bengal	7	20·86	29·43	15·83
East Bengal	7	11·04	28·71	14·22
South-west Bengal	9	5·05	15·11	3·46
Bihar	13	13·54	12·94	8·46
United Provinces	12	14·39	1·32	0·33
Punjaub	6	0·05	1·31	2·13
Simla Hills	5	8·46	2·06	12·37
Kashmir	6	0·46	1·05	4·03
Darjeeling	—	1·92	7·91	1·63
Cherrapoonjee	—	34·86	22·71	6·12
Orissa	4	—	—	—
Circars	4	—	—	—

It may also be seen that the rainfall was much more heavy at Darjeeling and Shillong than in June. At Darjeeling on the 11th nearly 8 inches fell, more than double the total fall for the three preceding and the three following days put together. At Cherrapoonjee 50 inches fell on the 10th and 11th taken together.

The only sensational incidents I have heard of in connection with this later storm were landslips in the Hills and heavy flooding of the rivers as the rainfall extended westward along the Himalayas.

If a comparison be made of the two sets of Tables, it will be seen that in many important respects the resemblance is as striking as two sets of meteorological Tables could almost be expected to be. The wave of pressure change in each case passed very rapidly, so much so that it is difficult to show the line of advance by the sequence of changes. The fall and the recovery were much greater in Western India in the latter than in the former. In each case the fall of temperature can be traced from East to West, but in the June storm the sequence is more complete because of the change from intense hot weather in Bihar, the United Provinces and the Punjaub, to the cooler weather of the monsoon season. Though the intermediate changes of temperature are less marked in August, there is abundant evidence of the line of advance of the wave of change; and the low temperature in Assam on the 11th and 12th, followed after an interval of two days by what may be called wintry weather in Kashmir, affords a succession of events which it would be difficult to account for, except on the supposition of a westward-moving atmospheric disturbance. But in my opinion the most striking similarity in connection with these two disturbances is afforded by the heavy general rainfall in Bengal Proper on the 30th June and the 11th August. In the latter case particularly, it is obvious that no disturbance entered Bengal from the Bay, which had been singularly calm throughout the week from the 8th to the 14th August. The wind direction at Diamond Island was westerly throughout the period, and velocity day by day was below the average for the season. In both cases, as shown by the following Table, there was considerable increase of wind force at Saugor Island; but the direction continued south-westerly, showing that the change was due to some influence to the north, and the record of the Pilot Brig shows that the strong winds extended to no great distance southward from the Bengal coast.

Table giving the wind force and direction at Saugor Island during the two periods of disturbed weather.

June.	Daily velocity in miles.	Wind direction at 8 a.m.	August.	Daily velocity in miles.	Wind direction at 8 a.m.
27	312	S.S.W.	8	360	S.W.
28	408	S.S.W.	9	504	S.S.W.
29	576	S.S.W.	10	768	S.
30	840	S.S.W.	11	394	W.S.W.
July. 1	360	W.S.W.	12	288	S.W.
2	456	S.W.	13	384	W.S.W.
3	384	S.W.	14	120	W.N.W.

One difference which may be noted, as shown by the above Table, is that the highest velocity in the earlier disturbance occurred at Saugor

Island between the 10th and 11th, that is along with the heavy rainfall in Bengal Proper, whereas in the later disturbance it was between the 9th and 10th, or before the heavy rainfall. In other respects the resemblance is very striking, and the Table shows that with the fall of pressure in the north, the south-westerly wind increased and continued to increase until the recovery of pressure was complete. There is no sign with either disturbance of the northerly winds which invariably accompany a disturbance over the Bay.

Mr. C. C. Collingwood who was in command of the P.V. "Alice" at the Sandheads informs me that, from the 29th June to the 1st July, the brig was under way all the time, and that work went on as usual; also that there was very little sea-set. The weather was bright and clear, except from 8 A.M. of the 30th June to 10 A.M. of the 1st July. The following extract from the log for June 30th is given in full, because it shows the time at which the disturbance which passed over Bengal south-westward commenced at the Pilot Brig.

Extract from the log of the P.V. "Alice" stationed at the Sandheads June 30th.

Hour.	Pressure.	Temperature.	Wind direction.	Wind force.	Weather.
2	29·66″	88°	S.W.	3	bc
4	·63	88	S.W. × W.	4	bc
6	·67	88	S.W.	3·4	bc
8	·73	89	S.W.	3	oc
10	·78	82	S.W.	1·2	ocqlt
12	·76	80	W.N.W.	3·4	oc
14	·74	81	E.S.E.	1	o
16	·66	84	S.S.E.	1	o
18	·66	84	S.	3	ocqlt
20	·68	83	W.	3·5	ocl
22	·72	83	S.W.	2·3	ocl
24	·68	83	S.W. × W.	1·2	ocd

The change of temperature shows that the disturbance which had begun at 4 A.M. in Calcutta, reached the Pilot Brig between 8 and 10 A.M., and the column giving wind force shows that nothing more than a moderate breeze was experienced. The increase of cloud began about 8 A.M., and the sky was more or less overcast during the day.

Part III.

In the preceding, which I have called Part II, I have considered only the weather changes, as they are indicated chiefly by the 8 A.M. observations from day to day during the period of disturbance. These are of sufficient interest to justify their separate consideration. But the two storms, which in what follows I shall represent by the dates June 30th and August 11th, appear to me to have caused a change so striking in the atmospheric conditions over Northern India, that those dates become punctuation marks in the monsoon season of 1902. The expression " punctuation marks " inadequately conveys my full meaning, and I would perhaps indicate more clearly the importance of the changes which then took place if I say that new chapters begin with those dates. It is impossible in the space which I now have at my disposal to go fully into the wider question which I am attempting to open out, even if I had the material ready. But I will indicate briefly the general run of the argument in order to form a line of connection with some future effort in this direction.

A study of the monsoon season of 1902 falls naturally into four periods :—

A—From the beginning up to the end of June, that is until the first Himalayan storm occurred.

B—From the 30th June to the 11th August, that is, from the first Himalayan storm up to the beginning of the second.

C—The three to four weeks which follow the 11th August, and during which the 'remarkable series of storms' moved from the Bay of Bengal north-westward to the extreme west of India.

D—The remaining part of the season, which I consider began with the storm which early in September broke up over the south-west of the Province instead of moving westward as the various members of the 'remarkable series' did.

During each of these periods we have a well-defined behaviour of the cyclonic storms, and a well-defined distribution of rainfall. Also the connection between the line of advance of the storms and the prevalence of monsoon conditions is so striking that the study of the monsoon is reduced to an enquiry why a cyclonic storm should move from the Bay of Bengal in one direction at one time of the year, and in another direction a week or two later; why it may be for several weeks at a time the prominent features of these storms are, more especially as regards the line of advance, repeated with but little variation; and why there should come without warning by ground level instruments a marked change in the line of advance.

In ordinary years cyclonic storms move westward, or slightly to the north of west [1] from the beginning of the monsoon season, and while they follow the usual direction there is no want of rain in any part of Northern India. During the past five years cyclonic storms have been very far from following the usual course, that is the course which the previous fifteen or twenty years' experience had shown to be the usual course. For instance, in 1899 the recurving was very marked, especially in August and September; and there being no 'remarkable series of storms' such as occurred during the past year, the crops failed over wide areas in Western and Central India. Several storms developed in 1899 over the Bay at the most critical time, that is August, and began to move westward; but in every case their advance was checked over the Central Provinces, and they recurved towards Bengal, where in consequence rain fell in abundance. Contrast the past year with 1899, and the main difference will be found in the behaviour of the cyclonic storms in the latter part of August and the early part of September. No one who is interested in crops and rainfall can have forgotten how critical the condition had become in the west of India in August 1902; and how it was a question of days whether or not there would be a repetition of the disasters of 1899; and that just when it was not too late the change came, and came with the first of that 'remarkable series of storms' which was in the west of the Bay on the 19th of August and over the north-west dry area and Guzerat on the 22nd. Two more storms followed the same course at intervals of about a week, crossing the area of drought and giving plentiful rainfall where it was most needed.

The difference between the years 1899 and 1902 is that the storms of the second-half of August and first part of September in former

[1] In page 173 of the Hand-Book of Cyclonic Storms in the Bay of Bengal, Second Edition, Sir John Eliot says regarding cyclonic storms in July :—"The charts shew that all the 39 storms which formed in the Bay during this month, in the period 1877-99, marched in west or west-north-west directions across the north-west angle of the Bay; and the centres of all with about six exceptions crossed the coast between Saugor Island and Gopalpur. In the great majority of cases they afterwards advanced across the head of the Peninsula into Sind, Guzerat or Rajputana.

year recurved over Central India and in the latter year they did not.

And so it appears to me that this matter of the motion of cyclonic storms over Northern India is one urgently requiring explanation, and that so long as it is unknown in what direction a storm will move in the immediate future so long will the distribution of rainfall be a subject of speculation only. So great a difference as we find between the directions of motion of storms in the four periods of the past monsoon season must be due to well-defined causes which it must be possible to determine. The only point on which I feel any certainty is that these causes will not be determined by ground level observations. To me it appears much more likely that they are connected with overhead conditions, and the past season indicates that the cause may be found in an overhead current from the west, that is in its height and strength. This current is the main current over Northern India during the cold season and the early part of the hot season. It retreats upwards with the approach of the monsoon season and my opinion is that monsoon conditions cannot be established in Northern India so long as its strength is unimpaired.

The only effects which I am aware of as giving some indication of the strength of that current late in the season are the occurrence of late snowfall in the hills, and of late nor'westers in Bengal such as were experienced in June of last year. It is well known that for some years late snowfall in the hills has been put forward as indicating the late arrival of the monsoon, but I am not aware that there has been any connection established between the snowfall and the strength of the westerly overhead current. The reason for this doubtless is the great difficulty always experienced in any attempt to investigate the higher levels of the atmosphere—a difficulty which is not to any extent removed by the establishment of observatories on ranges of high hills. It has come to be recognised by meteorologists that a high level observatory must be placed on the top of an isolated peak; otherwise the local irregularities of the ground, such as the spurs and valleys of the Himalayas, cause deviations in the record and the result is misleading.

I have divided the monsoon season of 1902 into four periods—June 30th being the division between the first and second and August 11th between the second and third of these periods—and I will now state generally the line of advance of depressions from the Bay of Bengal during these periods.

Period A.

In May a depression entered Burma, moving in a north-easterly direction, the usual one at that time of the year. In June there was at times a tendency to the formation of depressions over the north of the Bay, but it was temporary except about the 11th June, when the slight depression which then formed moved northwards into Bengal proper. The usual direction in which depressions advance in the middle of June is north-westward, and it is a fact worth noting that last year the depression which in ordinary years would have been followed by monsoon conditions over north-western India, moved into North Bengal instead, and that the monsoon weather was confined to Bengal Proper and Assam.

Period B.

Two storms occurred during this period. They followed an almost identical course into Central India and then recurved towards the Kumaon Hills.

The following extracts from the *Indian Daily Weather Report* give the opinions recorded at the time regarding the change of motion and the place where it occurred.

1st storm of Period B.	July 17th.	"The cyclonic storm will probably continue to advance in a west-north-westerly direction."
	July 18th.	"The cyclonic storm from the Bay instead of continuing a westerly course has been almost stationary, and is apparently recurving to the north."
	July 19th.	"The storm is apparently advancing towards the Kumaon Himalayas."

It may be noted that the change of direction which occurred between the 17th and 18th was not anticipated, showing that the information supplied by the ground level observations was not sufficient to settle the direction beforehand.

2nd storm of Period B.	July 30th.	"The cyclonic storm has continued to advance slowly in a west-north-westerly direction and is now apparently central near Nowgong."
	July 31st.	"The cyclonic storm in the Central India Plateau has been almost stationary during the past day, which may be an indication that it is about to change its direction of advance.
	Aug. 1st.	"The cyclonic storm is apparently advancing to the Kumaon Himalayas."

The course is shown by the above extracts to be the same as in the preceding storm and it is also seen that the experience gained from the earlier storm made it possible on July 31st to anticipate to some extent the change of direction.

PERIOD C.

A single extract from the *Indian Daily Weather Report*, of September 4th, will give the necessary information regarding the storms of this period.

"The present storm is the third of a remarkable series of storms which have formed in the Bay since the 19th August and have followed an almost identical course."

The first storm was over Guzerat or the north-west dry area, on August 22nd, the second on August 28th, and the third on September 3rd.

PERIOD D.

What appeared to be a fourth in the above series was over the north-west of the Bay, on September 5th, and was expected to advance into the east of the Central Provinces during the next thirty-six hours, but it moved northwards, and on September 8th and 9th became diffused over West Bengal and the adjacent part of Central India. The following extracts are taken from the *Indian Daily Weather Report* because they support my contention already expressed, that recurving or in fact the direction of motion at any time is not directly indicated by the ground level observations of the day.

September 6th.—"The storm at the head of the Bay is likely to advance into the east of the Central Provinces during the next thirty-six hours and will probably give moderate to heavy rain to Orissa, Chota Nagpur, West Bengal, and the east of the Central Provinces. Weather may become feebly unsettled in Kashmir within the next day or two."

(Sd.) J. MURRAY,

Offg. Meteorological Reporter to the Govt. of India and Director-General of Indian Observatories.

September 7th.—"The storm at the head of the Bay has hardly changed in position during the past twenty-four hours and now shows a tendency to advance northwards into Bengal in which case rainfall will increase in Lower Bengal."

September 8th.—"The cyclonic storm in Bengal will probably continue to advance in the same general northerly direction and give moderate to heavy rain in East and North Bengal and Assam."

The next storm in the Bay began towards the end of the third week of September and was well defined over the north-west angle on the 24th. From there it moved north-westward into Chota Nagpur, then northwards, and on the morning of the 26th was recurving towards the Darjeeling Hills. It broke up on reaching the Himalayas, causing heavy rainfall in the eastern part of the range. A slight residual depression moved eastward into Assam.

It will be seen from the above extracts and remarks that the storms from the Bay during the monsoon season fall clearly into the four classes I have formed. Two in period (*A*) moved northwards; two in period (*B*) moved in the usual west-north-westerly course, but recurved over Central India towards the Kumaon Himalayas; three in period (*C*) moved west-north-westward, and without recurving passed over Guzerat and other parts of Western India where rain was much needed; and that the two storms in period (*D*) moved into Bengal; thus showing that, whatever the determining cause of the line of advance of these storms may be, it was in September becoming similar to what obtained in period (*A*) that is at the beginning of the season.

The question therefore is what cause would be sufficient to account for the change of motion in its various degrees shown by these storms of the past monsoon season. I know of only one, and that is the westerly wind overhead which is believed to cease before the monsoon commences, but which may continue in the higher levels after it has ceased near the ground. I was watching this wind very carefully last year, and believe it still existed over Lower Bengal as late as the last week of June, because typical nor'westers occurred about that time. I believe also that the north-westerly wind returned earlier than usual at the end of the season, and was stronger than usual or in some other way differed from what it is in ordinary years, and my reason for thinking so is that nor'westers occurred in October in Western Bengal, a most unusual event.

Another question is, why should the two storms from Central Asia, which I have discussed in the second part of this paper, influence that westerly current. I am unable to say why it should be so, but I think there can be no doubt, but that seasonal currents are often materially altered by what for want of a better word I will call the shock of a storm. The Rangoon cyclone early in May supplies an example of such a change. An examination of weather charts for April and May last year will show that the wind directions on the Burma coast were northerly up to the occurrence of that storm and that afterwards they had generally the south-westerly direction usual in the monsoon season.

The permanent change in the wind system on the Burma coast then produced is none the less instructive, because the north-westerly winds in April and May are believed to be a continuation of the very current which appears to me to have so much to do with the advent of the monsoon in different parts of Northern India, and in reasoning that the storms from Thibet influence the overhead current so as to render the advent of the monsoon possible in the first case as far west as Central India and the Kumaon Himalayas, and in the second case to the extreme west of the empire I am making an assumption in support of which I believe numerous examples such as the Rangoon cyclone of 1902 can be cited. The influence of these storms from Thibet was in all probability greater in the upper reaches of the atmosphere than is shown by the ground level observations, because in the first place the storms were at a high level to begin with, owing to the Central Asian plateau, and in the second place the Himalayan range was an obstacle to their progress so serious that none but disturbances extending to a great height could have passed over them without complete disintegration.

Before closing I will refer very briefly to the storms which occurred in the Arabian Sea during 1902. They were only three in number. Two occurred in period (*A*), *viz.*, the two Karachi cyclones and they moved in much the same direction as the two storms in that period from the Bay, that is, northward or north-eastward. The third occurred in July and was therefore in period (*B*). That storm appears to me to be very suggestive as to the circumstances in which monsoon conditions may be produced by a cyclonic storm. It entered Guzerat and the part of India which was most in need of rainfall. It, however, ceased to be a well-defined cyclonic disturbance, while still over Guzerat and though, a steep pressure gradient developed shortly afterwards over the whole of North-Western India and there were all the appearances which would suggest a strong inrush of monsoon winds with general rainfall, only a few showers fell and those near the coast. The weather produced by that depression, which was quite as deep as any one of the "remarkable series" in the third period, was dry hot weather, rather than monsoon weather.

The following extracts from the *Indian Daily Weather Report*, during the time of that disturbance will show that what I have stated above is borne out by the daily observations and also that it was difficult if not impossible to forecast the behaviour of the depression as regards the line of advance.

July 6th.—"The low pressure area in the Arabian Sea is apparently still an ill-defined disturbance, and has not yet developed into a cyclonic storm."

July 7th.—"The cyclonic storm in the Arabian Sea is apparently advancing towards the Kathiawar Coast."

July 8th.—"The cyclonic storm in the Arabian Sea crossed the Kathiawar Coast yesterday afternoon and has apparently been almost stationary during the past eighteen hours. Its future course is uncertain, but the character of the isobars and of the pressure changes, would appear to indicate the possibility of its advancing in a north-westerly direction."

July 9th.—"The cyclonic storm in Guzerat has been almost stationary during the past twenty-four hours."

July 10th.—"The storm in Kathiawar is filling up but will probably continue to give rain in Guzerat, during the next twenty-four hours."

On July 11th no reference is made to the storm which was no longer shown by the ground observations and rainfall in India was confined to restricted areas.

The following Table, gives the rainfall in Guzerat, between the 6th and 11th July, and the amount which from the normal Tables was likely to fall during those days:—

	Actual rainfall between 6th and 11th July.	Normal rainfall between 6th and 11th July.
Surat	2·17	3·11
Ahmednagar	0·70	1·91
Bhavnagar	0·65	0·71
Veraval	6·05	0·76
Rajkot	0·70	2·28
Bhuj	1·00	1·18
Deesa	0·32	1·35

It will be seen that Veraval alone received excess rainfall, and that at three other stations, Ahmednagar, Rajkot, and Deesa, rainfall was much in defect.

I have pointed out that the two storms from the Bay in period (*B*) recurved towards the Kumaon Hills, and that the storm from the Arabian Sea filled up in Guzerat after causing rainfall near the coast. In fact, that storm was very similar in its behaviour, to the first storm in period (*D*), which filled up in south-west Bengal, and it is not unlikely, that the filling up was due to similar causes, if these were only known. It may, therefore, be assumed that throughout period (*B*) there was some influence which prevented the advance of cyclonic storms, whether from the Bay of Bengal or from the Arabian Sea, into the north-west dry area. What change took place, before period (*C*), with its "remarkable series" of storms began, can be matter of surmise only, but I think it is fair to assume that it was not shown by the ground level observations, and that it may have been caused by the disturbance of August 11th, which entered India from Thibet, and which was so clearly shown in its advance along the Himalayan Range.

I may be allowed to explain that I make no claim to have thrown, by this discussion, any light upon the complicated problem of the distribution of monsoon rainfall in Northern India. The connection between cyclonic storms and rainfall has for years been a matter of enquiry. I shall be satisfied if I have even partially succeeded in making out a *primâ facie* case for an extension of meteorological observations to the upper atmosphere, feeling sure as I do that further information in that direction will meet requirements which ground level observations have hitherto failed to satisfy.

On the acquisition of alar appendages by the Spruce form of Chermes abietis-piceæ MS. in the N.-W. Himalayas.—By E. P. Stebbing, F.L.S., F.E.S.

[Received 27th March 1903—Read 1st April 1903.]

In July 1893, Mr. Smythies, late Conservator of Forests, Central Provinces discoverd the winged form of a species of *Chermes* issuing from galls or pseudo-cones (see fig. *d*) on spruce (*Picea Morinda*) trees at Deoban in the Jaunsar Forests of the N.-W. Himalayas (elevation 9,200 ft.) Mr. Smythies stated that only immature forms were to be found in the galls in May and June, the first winged individuals observed issuing on July 21st. These insects were identified by Mr. E. B. Buckton, F.R.S., as the species *Chermes abietis* of Linnæus and Kaltenbach.

The above facts are recorded in Indian Museum Notes, Vol. III, No. 5, the species being noted as new to the fauna of India. I can find no further mention or data about this insect.

In May, June, and a portion of July, in 1901, and the latter part of May, all June, and half of July, in 1902, the writer toured through the Jaunsar and Simla Hill Forests, and whilst observations were noted on the habits of other insects, many quite new to science, a careful study was made of the *Chermes.* The notes then recorded are still far from complete, but the important and interesting discovery was made that whereas, as in Europe, the insect spends one generation of its life in pseudo-cones upon the spruce (*Picea Morinda*), the individuals of the alternative generation of the parallel series live, not upon the larch as in Europe, since the tree is not to be found in the N.-W. Himalayan Forests, but upon the silver fir (*Abies Webbiana*). Owing to this habit I call the insect *Chermes abietis-piceæ*, MS., to distinguish it from the *Chermes abietis-laricis* of Europe. We shall here only concern ourselves with the acquisition of alar appendages and method of escape of the winged individuals from the galls found on the Spruce, leaving for a future paper full descriptions of the forms and habits of the other individuals of the parallel series of this most interesting insect.

As noted by Mr. Smythies, throughout June only small immature larvæ are to be found within the false cones. In the first week of May I have found the eggs, laid in patches on the bark of the twigs and main stem of the tree by the winter female, to be abundant. Little purple larvæ (see plate, fig. *a*) hatch out from these and slowly increase in size throughout the rest of May, June, and early days of July, by which date they become full-grown. An examination of the cone shows that even whilst still quite small it is partitioned off into chambers, figs. *e*, *f*, each containing a number of the immature aphids. It differs, however, from the European one in the fact that it never has long portions of needles growing out of the centre of the diamond-shaped external portion of the covering of each chamber. It would appear as if the gall arising from the attacks of the larvæ of the *Chermes abietis-piceæ* was almost a stem growth and not a leaf one. And yet this is in all probability not the case. In the European form the formation of the gall is attributed to the young larvæ feeding at the bases of the young needles causing them to swell up at this point and coalesce, the upper part of the needle still continuing its growth. Thus the external covering of each chamber has the upper portion of a spruce needle, perhaps half an inch or more in length, growing out of its centre. No such long upper growth of needle is found in the Himalaya gall; but at times the centre of each diamond-shaped cover bears a tiny green spike which appears undoubtedly to be the upper extremity of the needle and thus proves that the gall arises in a similar manner to the European one. This point will be dealt with more fully in a subsequent paper. In fig. *d* a branch is shown bearing a typical set of the pseudo-cones containing nearly mature larvæ as they are invariably found in the N.-W. Himalayas. Fig. *f*, shows an old last year's cone from which all the insects have escaped.

The year 1902 was a dry warm one up in the Himalayan region and therefore favourable to insect growth and development. Galls in sunny warm spots were found to be opening on the 10th July. The gall or false cone, in the process of what may perhaps be termed 'ripening,' changes from green to pale crimson; this takes place first on one side, after the manner of a ripening apple, and then all over, the cone often becoming bright crimson for a time, finally turning, when the insects are ready to emerge, a dull purple with the exception of a small patch or point in the centre of each of the diamond-shaped covers (where the needle would arise from in the European Spruce gall) which remains bright green.

The cone does not necessarily commence opening at the top: the small chambers may open anywhere all over it. The portions more exposed to the sun and in direct contact with warm air currents ripen first. An examination of the insects within the galls, just before the latter begin to open, will show them to be little thickish, puffy, wingless aphids, dull purple in colour and much ridged dorsally with greatly enlarged globose anterior coxæ. Beneath the skin at each side of the mesothorax a small dull yellow excrescence can be seen and posterior to this, on the metathorax, also at either side, a dark longish, flatter protuberance. Legs and antennæ are yellowish-green. Antennæ are six-jointed. Length 2·35 mm. Fig. *b*, shows this fully grown larva.

This is the last stage of development of the insect within the gall, no functional alar appendages being present.

In opening the upper two edges or sides of the diamond-shaped outer covering of the chamber become detached at their points of juncture with the two lower sides of the cover of the chamber next above, thus forming a kind of lip, which can be forced open with forceps. The external surfaces of the diamond-shaped coverings then contract slightly, thus causing the aperture to permanently gape, the opening becoming wider and wider as the surface dries and consequently contracts (fig. *f*). The slit is at first quite narrow, but as soon as it appears the insects commence to crawl out. On reaching the outside of the false cone the fat purple larva at once undergoes its last moult. In doing this, the skin splits down a median line, both dorsally and ventrally; as far as the mesothorax dorsally, and the first or second pair of coxæ ventrally; the insect then slowly crawls out leaving the white papery cast skin, to which are attached the dark-coloured leg and antennal cases, behind it.

After this last moult it will be seen that the Chermes has undergone a great change.

It now appears as a small gorgeously-coloured aphid, with black shining head and prothorax, dark orange-brown shining meso- and metathorax, both dorsally and ventrally, and with a shining black abdomen. Legs and antennæ bright canary yellow. On either side of the thorax two little bright-coloured bundles are visible, a bright naples yellow anteriorly and vivid apple-green posteriorly. The whole insect, in fact, is very highly coloured and looks at this stage as if it had just been freshly painted with the very brightest tints in Nature's colour box and then given a coating of varnish. As soon as the Chermes has freed itself from the last attachment of its last skin it begins to crawl actively about on the exterior surface of the gall and the little yellow and green bundles unfold and disclose the fact that they are the rolled-up alar appendages. As far as I could perceive, the insects themselves take no active part in unfolding these wings. They do not hang themselves up to get them unrolled as is the case with Lepidoptera, but simply walk about and under the influence of the sun and heat, the wings rapidly spread out, stiffen, and become functional. I noted that in many cases, even before the insect has entirely freed itself from the last larval skin, the little bundles had so far unrolled as to be quite distinct from one another. Within half an hour from the time of leaving the cone, the wings are fully unrolled, being held at an angle on the side of, but not meeting in a roof-shaped manner over, the abdomen. These wings are pale apple-green in colour with yellow nervures except at their juncture with the thorax where they are chrome-yellow.

Total length of insect with wings is 4·68 mm. The wings project beyond the posterior end of the body about $1\frac{1}{4}$ times the total length of the aphid. The *Chermes* is short, thickish, almost squarish in build and appears somewhat flatter after its final moult. The head is small; antennæ six-jointed, the first joint very small, second and third small, fourth longest; prothorax broad and much channelled; the rest of thorax also broad the metathorax being sessile upon the abdomen. Fig. *e*, shows a dorsal and side view of the winged form.

Within one and a half hours of shedding the last skin, patches of white setæ begin to appear upon the aphid, and the meso- and meta-thorax turn from orange to shining black. These hirsute white patches appear on the head, upon each division of the thorax, and two little tufts, set side by side on each segment, run medianly down the dorsal surface of the abdomen. On the prothorax these white setæ are in a transverse ridge; on the meso- and meta-thorax they are in two large patches as on the abdomen. The wings become a paler green, the costal and median nervures being strongly marked and orange in colour, the transverse intersecting ones being silvery.

The insect by now, *i.e.*, within three hours of its last moult, has lost all its brilliant colouring and has become dull and inconspicuous. It only differs from the winged form to be found at this period on the needles of the silver fir in having a green tinge in the wings, those of the silver fir fly being colourless but irridescent in certain lights.

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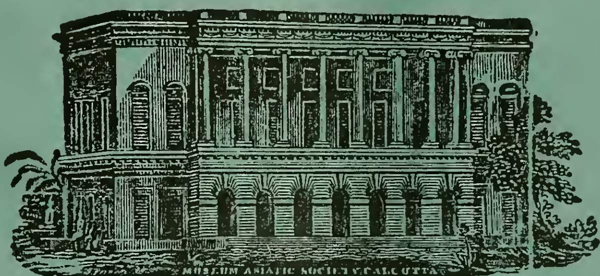

"The bounds of its investigation will be the geographical limits of Asia: and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."—SIR WILLIAM JONES.

*** *Communications should be sent under cover to the Secretaries, Asiat. Soc., to whom all orders for the work are to be addressed in India; or care of Messrs. Luzac & Co., 46, Great Russell Street, London, W. C., or Mr. Otto Harrassowitz, Leipzig, Germany.*

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ERRATA

IN

Journal, Asiatic Society of Bengal, Vol. LXXII, Part II, 1903.

p. 6, lines 18 *and* 19, from top: *for* "orifice. The lingula and a narrow" *read* "Orifice; and the lingula a narrow."

,, 8 ,, 38 *and* 39 *for* "by other birds, like the crows" *read* "by crows and other birds."

JOURNAL

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No. 3.—1903.

Contributions toward a Monograph of the Oriental Aleurodidæ.—Part I.—
By H. W. Peal, F.E.S.

[Received 28th January, 1903. Read 4th February, 1903.]

CHAPTER I.

Introductory.

The Aleurodidæ are a family of the Homoptera which are allied to the well-known Coccidæ or Scale Insects. Owing to their similarity to this family they are usually mistaken for such by Agriculturists and such mistakes can easily be excused owing to this family being so little known.

The Aleurodidæ, like all the bugs, are sucking insects and derive their nourishment from plants by pumping up the sap by means of a proboscis formed of three fine setæ. In the Coccidæ the winged males (the females are unwinged) are destitute of mouth parts, but in the Aleurodidæ the males and females both possess wings and the mouth parts and digestive organs are present. It is however in the immature and stationary stages that the greatest damage is done by these insects. In a country like India where there is practically a perpetual summer, these insects are present in great abundance and they are more destructive than in colder climates. This is due to there being a continuous succession of generations uninterrupted by winter, which in colder latitudes not only puts an end to their depredations for a season, but also seriously thins their numbers, thus acting as a very efficient check on an abnormal increase. Fortunately however for us the members of this family have not proved so prominently destructive as some of the Scale Insects, and probably this is the reason why hitherto they have been but little studied. Although not of pressing importance it must be admitted that their potential power for expansion and destruction is possibly even greater than that of the Coccidæ. Although not possessing limbs in the early and more destructive stages [1] as in some Coccids (like the Monophlebinæ) still their power of dissemination is greater as, owing to the females being winged and capable of prolonged flight, they can be more easily spread. Thus in a plantation their spread would take place quicker than Scale Insects. As a matter of fact it is rare, when several plants of the same species are grouped together, to find only one or two showing traces of this pest; as a rule the entire clump is affected.

So far only six species belonging to the family Aleurodidæ have been described from India. This it must be admitted is a poor record. When we turn to the Coccidæ we see however that even this important family had been till only recently entirely neglected. Now, thanks to the admirable work of Mr. E. E. Green, the number of our recorded Indian Species of the Coccidæ has risen from seven in 1886 to fifty-two in 1901, and this even is only a tithe of those which will be discovered in time and worked up. The case of the Aleurodidæ is similar or even worse; as latterly, after the death of Mr. Maskell of New Zealand, no one has done any work on the Indian forms. India in reality is exceedingly rich in members belonging to this family. In the short space of time that I have been working up the Aleurodidæ I have examined nearly fifty species. Mr. Green has sent me twenty-eight species from Ceylon, one species from Java and two species from Victoria for determination.

CHAPTER II.

Collection and Preparation.

As the habits of members of this family are so similar to those in the Scale Insects the method of collection and preparation is identical or almost so in the case of both. The only disappointment one may meet in collecting is the far larger number of scale insects one is inveigled into examining. It is impossible to give any definite instructions as to the method of searching for these insects, but the few following notes as to

[1] Except the very first stage and then their power of movement is not very great, the larvæ usually moving but a short distance from the egg.

my method of collecting may be of use. I carry a large number, a dozen suffices, of fairly long and narrow envelopes. These envelopes are all that is required for the collection of larvæ and pupæ.

One soon gets quite expert in noticing the signs which betray the presence of these insects. A spotted yellow leaf, a black deposit of fungus on the upper surface of the leaf, a procession of ants, these and many other little signs are soon picked up. Always search the older and more mature leaves rather than the young foliage, nor should one overlook the dead and withered leaves which lie on the ground. The insects are almost invariably attached to the under-surface of the leaves.

For collecting the adults use small phials. The insects themselves must be picked up with a fine camel hair brush the tip of which has been previously moistened.

After collecting as many larvæ and pupæ as are required, make what notes you wish on the envelope itself. The following at least should be entered. Name of tree, colour of insect, character of fluff if any, the comparative abundance of the insect, locality and date. If the tree cannot be recognised carry away some of the leaves and if possible flowers for identification by a botanist.

As soon as possible after reaching home the insects should be examined and sorted, and if possible mounted. When the insects are dry it is impossible to examine the first larval stage satisfactorily as the legs and antennæ shrivel up.

For examination one will find that powers of $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{6}$ are usually sufficient. A camera-lucida for making the drawings is almost indispensable. After cleaning a microscope slide, drop some dilute Canada balsam on it; examine the leaves with a hand lens, and with a fine pin moistened if necessary with turpentine, pick up a few eggs and transfer them to the slide. Next search for larvæ of the first stage. This is somewhat difficult as they are usually only about ·2 mm. in length. Do not be content with one or two specimens, mount several. Pick up the other larval stages present and also some of the pupæ. If the insects are very dark one will have to boil them in caustic potash before mounting. The following is the method. Half fill a fairly long test-tube or watch glass with an almost saturated solution of caustic potash, drop in *one* insect and boil over a spirit lamp or gas jet. When sufficiently transparent remove the specimen with a piece of wire or a hair spring into a small dish of water. After soaking out the caustic potash mount the specimen in a drop of glycerine. I however find that with black species, if one mounts specimens in dilute Canada balsam, and the slide is put away for some time, the insects as a rule become transparent enough to be examined for fine details. Those species which have the dorsum covered with spines should be mounted under a cover glass raised above the slide by a cork or metal ring. The cover glass is thus kept some distance from the insect itself. It is impossible however in this case to examine with very high powers. The winged insect should be mounted as soon as possible, as it is impossible to make out the details in a shrivelled specimen. I find Canada balsam excellent for mounting them, but it is advisable to stain some of the insects first. It will be found somewhat difficult to mount the adult so as to show the wings to advantage. I find that by placing the insect on the slide, when the balsam is somewhat hardened, gentle pressure on the head with a fine pin will cause the body to slip backwards and leave the wings spread out evenly. If this is found difficult, an alternative method is to carefully cut off the wings with a fine scalpel, the operation meanwhile being watched with a hand lens. As a rule it will be found that Canada balsam is not suited for those species in which the wings are banded, as the bands show but faintly. In this case mount dry by making a ring of balsam and after placing the wing in the centre, pressing on a small cover glass. Keep a fairly large number of the insects in situ on the dry leaves and also some of the winged insects in empty phials or if preferred in spirit.

CHAPTER III.

Preventive Measures.

I do not think it will be out of place to describe shortly such preventive measures as are useful in eradicating or at any rate keeping down these pests. These insects cannot be killed by means of any of the poisons ordinarily used against mandibulate insects, as they exist by pumping up sap from within the leaves by means of their setæ. The most convenient all-round remedy is the well-known kerosine emulsion which when sprayed on the plants kills the insect by closing up the spiracles. It is true that these insects are extensively parasitized by chalcids and their numbers thus kept down ; but despite this check these pests often get out of hand and do extensive damage. The causes which lead to this result are varied. It may be that as in the case of most cultivated plants, their natural food-plant may be largely increased and thus sufficient pabulum be provided ; or seasons may be favourable. In this case the pests' increase would be short-lived, as the parasite being provided with plenty of food, would soon increase and reduce the pest to something like its old numbers. If, however, the pest is unwittingly imported with its food-plant into a new country and its natural parasite or parasites be left behind at home, it is possible that the pest may increase amazingly and do extensive damage. In this case its natural parasite being absent, the most suitable remedial measure would naturally be a search for and importation of the parasite. Care would have to be taken of course that no hyperparasites were imported as well. In my opinion I think it may be taken for granted that in its native habitat and under the check of its parasites, a pest cannot ordinarily, without other assistance, be eradicated by means of these natural parasites, as the balance has been adjusted after many generations of struggle between the parasite and its victim.[1] In the case however of an imported parasite the case is quite different; the environment, climatic conditions, abundance of food and the like will be different from that in its native habitat and the pest will take some time to settle down in its new home. While in this as it were transitory stage the parasite (imported without its own parasites) will probably have a far greater power to check the pest.

I have never observed lady birds feeding on any of these insects but it is possible that they do so.

CHAPTER IV.

Characters and Classification.

The Aleurodidæ are a family of insects belonging to the Order Hemiptera, Suborder Homoptera.

Characteristics of the family :—

Adult. Furnished with four wings in both sexes. Sucking and digestive organs present. Eyes usually constricted or reniform, sometimes completely divided. An ocellus above each eye. Antennæ seven jointed. Tarsi dimerous and furnished with three claws. Fore wings with one median and one basal vein (in the genus *Aleurodicus* there is also a terminal vein). The wings usually white, sometimes spotted or banded with red or grey. The surface of the wings mealy.

Puparium. Scale-like. Brown, black or yellow in colour. The dorsum sometimes covered with a waxy secretion. The most important characteristic is the vasiform orifice described below.

Larva 1st stage. Shape elliptical. Furnished with short stout legs and antennæ. The other larval stages similar to the puparium or last quiescent stage.

Egg. The eggs are bean shaped, curved and are attached to the leaf by a short peduncle or stalk.

In the adult stage these insects can be distinguished from the

[1] It cannot, we think, be said that there is ever a 'struggle' between the parasite and its host; the lessened food supply available for the former is entirely brought about by its own actions. Hon. Edit.

Coccids by their possessing four wings to the latter's two, and from the Pysllids by the venation of the wings. The fore wings of the latter family are supplied with several veins while in the Aleurodidæ there are only two (or in some cases three). In the larval and pupal stages they can be distinguished from both the Coccidæ and Psyllidæ by the presence on the dorsal surface of the last segment of the abdomen of a triangular or subelliptical opening (also present in the adult) known as the vasiform orifice. This orifice has hinged to it anteriorly a plate or flap known as the operculum. This operculum projects and covers to some extent the opening of the vasiform orifice. There is besides in nearly every case a narrow tongue-like organ which lies within the vasiform orifice and which projects caudad more or less into or beyond the vasiform orifice. This is the organ which produces the honey-dew.

The family is divided into two genera: *Aleurodes* and *Aleurodicus.* The species belonging to the genus *Aleurodicus* have with one exception been all described from the warmer parts of America.

Genus *Aleurodes.*

Adults with only one branch (basal) from vein of forewing. Hind wing with a single vein.

Genus *Aleurodicus.*

Adults having the vein in both wings with a distal and basal branch.

In a recent work by Mr. T. D. A. Cockerell (Proc. Acad. Philadelphia, May 1902, p. 279), these two genera are divided into several subgenera. I will deal with these subgenera later on when classifying our Indian species. As regards the bibliography, the principal works dealing with this family are Dr. V. Signoret's papers in the Journal of the Entomological Society of France, 1867 and 1883; Mr. W. M. Maskell's papers in the Transactions of the New Zealand Institute 1889, 1890, and 1895; and Mr. A. L. Quaintance's "Contributions toward a study of the American Aleurodidæ," (U.S. Dept. Agri. Technical Series No. 8). From these works the complete bibliography can be obtained.

Both Mr. Maskell and Mr. Quaintance have put forward a plea for describing species belonging to the family, not only from the adult insect, but also from the larva and pupa. However objectionable such a practice is in the case of other insects it is perfectly valid in the case of the Aleurodidæ. Though in some cases it is true that the perfect insects do differ in some small particulars, such as the occasional presence of spots and bands on the wings, it is practically impossible in most cases to differentiate species from this stage alone. In the larval and pupal stages on the other hand there is a considerable diversity of form and colour and in the character of the waxy secretion. It also happens that generally when these insects are collected, only the larvæ and pupæ are sent for examination, as these are the stages in which damage is done to plants. If however the adult "flies" are obtained, they should always be described, particularly the colour of the wings, as although in most cases they are white some species have the wings more or less spotted with brown or red.

I have gone somewhat into detail in describing the different larval stages. It is difficult except in some few cases to be absolutely sure as to the number of moults. I have however but little doubt that the normal number is four excluding the pupal stage. This I have made certain of in some species but it is of course impossible to find out the number in many cases as material sent usually consists of only one or two of the stages.

CHAPTER V.

Description of 7 new species of *Aleurodes.*

Aleurodes religiosa n. sp. Plate V, figs. 6–9.

Signoret in his "Essai Monographique sur les *Aleurodes*" (Ann. Soc. Ent. France Ser. 4, VIII, 1868), describes and figures an Aleurodid he obtained from *Rubus fruticosus* and which he named *A. rubi.* This species is distinguished from *A. longiceræ*, Walk. by minute differences in the adult insect, the larval (really pupal) state, which he figures being identical except that as he says " sur la ligne mediane on observe sur chaque segment abdominal une impression plus visible a la base qu'au sommet." In allied species the differences in the adult stage are extremely minute and it is hardly safe to rely on these differences alone in defining a species.

A. religiosa is undoubtedly closely allied to these two species possessing as it does the same series of spines on the dorsum. It however differs in having in addition another pair of spines placed fairly close together on the cephalic region, caudad of the outer and longer pair on cephalic region. It also has two yellow ridges one on each side of the vasiform orifice. The caudal half of the dorsum is narrower than the cephalic half and the margin caudad is slightly incurved. The cephalo-thoracic margins are also incurved the surrounding area being suffused with yellow. The indentures also bear a short fragmentary fringe of wax.

I have described this species in detail as Signoret gives no detailed description of the vasiform orifice. His drawing shows that it is probably identical or almost identical (but smaller in proportion) to that in *A. religiosa ;* he does not deal with the earlier stages at all, nor does he give any measurement. I have found *A. religiosa* fairly common on some pepul and banyan plants in Calcutta. So far however I have been able to obtain it from only one locality. The larvæ and pupæ are usually to be found on the same leaves as *A. quaintancei.*

All stages can be obtained at the same time and from off the same leaf, but one or two stages always largely predominate. In the middle of November pupæ, adults and eggs can be obtained in abundance but the larval stages are scarce.

Egg. Size ·16 mm. × ·06 mm.

Light yellow when first laid turning light-brown afterwards. Peduncle short about ·025 mm. in length; surface minutely sculptured with hexagons. The adult female when laying eggs moves in the segment of a circle, the leaf being whitened by the white meal from the undersurface of the abdomen.

Larva 1st stage. Size ·18 mm. × ·1 mm.

Elliptical, narrow for its length. Colour light yellow, eyes maroon. Legs and antennæ present. One long seta on centre of each tibia of second and third pair of legs. One long seta on tarsi of all legs. Antennæ apparently six-jointed the last joint short and slender. Two long caudal setæ and two short setæ caudo-laterally on margin. There is a narrow fringe of wax around the margin.

Larva 2nd stage. Size ·16 mm. × ·09. mm.

Elliptical, narrow for its length. Colour light yellow. Two darker yellow pigment patches on abdominal region. Eyes maroon, fairly broad waxy fringe right around margin. Dorsum slightly elevated especially along centre of abdominal region. Abdominal segments distinct along dorsum. Two long setæ on second segment of abdomen. Two long setæ caudad on margin. Length of latter pair ·1 mm. Two shorter setæ on caudo-lateral margin. Region round vasiform orifice slightly tinged with yellow. Vasiform orifice relatively large in this stage, shape conical, apex pointing caudad. Anterior edge flat, posterior edge slightly flattened; lateral margins upper edge convex lower edge concave. Operculum brown: anterior and posterior margins flat, lateral margins convex. Length not quite half that of the vasiform orifice. Colour brown, surface covered with fine hairs. Lingula two jointed the first joint short and broad, the second joint narrow broadening out to a conical tip: the surface covered with fine hairs. The lingula projects almost half its length beyond the operculum, the tip extending almost to the lower edge of the vasiform orifice. Legs present but short and rudimentary; antennæ obsolete. The marginal fringe of wax rises from a series of pores just above and within the dorsum. At each segment of the abdomen and about the same distances apart on the cephalothoracic region there are two larger pores which produce larger filaments of wax and so more or less break up the otherwise uniform stretch of fringe.

Larva 3rd stage. Size ·35 mm. × ·21 mm.

Shape elliptical, broadest cephalad tapering gradually caudad. Cephalothoracic margins incurved. Colour light yellow: two yellow pigment patches on abdomen. Area around indentures on cephalothoracic margins and around vasiform orifice suffused with yellow. Eyes maroon. Dorsum slightly elevated, especially along the abdominal region. Segments of abdomen very distinct along centre of dorsum; they cannot be distinguished near margin. A short fringe of wax all around margin. It is relatively narrower than that in the preceding stage. There are two setæ on the second segment of the abdomen: two extremely fine long setæ ·2 mm. in length, just within the margin at incurved cephalothoracic areas and two sightly shorter setæ caudad on margin. All these setæ spring from small tubercles. Vasiform orifice and its appendages similar to that in the preceding stage. There are, however, two fairly long setæ near end of lingula.

Larva 4th stage. Size ·44 mm. × ·3 mm.

Caudal extremity of vasiform orifice flat. There is a narrow marginal fringe of wax. The rest substantially as in puparium. The lateral margins of the operculum in this stage and in the pupa are flat, angled inwards to meet posterior margin: upper edges curved to meet anterior margin: they are not convex as in the other stages of the larva. There is a series of small pores along ventral surface of margin. These produce a small quantity of wax. The margin is fairly broad.

Puparium. Size ·56 mm. × ·35 mm.

Shape elliptical, broadest cephalad. Lateral cephalothoracic and caudal margins incurved. Colour yellowish, semi-transparent under the microscope. Two yellow pigment patches on abdomen: light yellow-brown areas around cephalothoracic and caudal indentures. There is an extremely short scanty fringe of wax at indentures; no trace of a fringe elsewhere on margin. Dorsum elevated, surface granular, abdominal segments fairly distinct. Dorsum covered with several long setæ which spring from small tubercles. They are situated one pair cephalad some distance from the margin; slightly caudad of these a second shorter pair in which the setæ are placed rather close together; one pair on prothorax at inner edge of yellow-brown areas running from the incurved thoracic margins; a pair on metathorax; a pair fairly close together on first segment of abdomen; a pair on fourth segment of abdomen; a pair one on each side of the vasiform orifice, and a pair caudad just within the margin.

Vasiform orifice long, in the shape of a narrow cone ; apex pointing caudad. Cephalic margin flat, corners rounded. Connecting the vasiform orifice to the incurved area on caudal margin is a narrow groove or channel. This channel and the sides of the vasiform orifice are bounded by two yellow, rounded fleshy ridges which run from the upper corners of vasiform orifice caudad to margin. On the end of these ridges are the two tubercles from which the caudal setæ spring. Edge of vasiform orifice light brown. Operculum similar to that in previous stages but lateral margins flatter ; but little more than $\frac{1}{3}$rd. length of vasiform orifice. Colour light-brown, caudal margin darkest; surface covered with fine hairs. There are near the tip two fairly long hairs which project caudad.

Parasited pupæ become very convex, dark coloured and in some cases turn quite black.

Adult female. Length ·8 mm. Wing ·85 mm. × ·31 mm.

Colour light-yellow; dorsal surface of thorax tinged with brown. Legs light-yellow; eyes maroon, almost divided, lower half larger. Wing immaculate powdered with white meal. Length of antennæ ·22 mm. Formula 3, 2, 7, 5, 6, 1, 4. Joint 1 short, broad for its length ; joint 2 subpyriform, nearly twice the length of joint 1; joint 3 twice the length of joint 2 ; joint 4 one-fourth length of joint 3 ; joint 5 one-and-a-half times the length of joint 4 ; joint 6 slightly shorter than joint 5 ; joint 7 nearly one-and-a-half times the length of joint 6. Vasiform orifice cordate, anterior edge flat. Rim of vasiform orifice tinged with yellow. Operculum in the form of a narrow neck which broadens out into a wide bilobed tip. The posterior margin incurved. Operculum faintly tinged with yellow. Lingula long, fairly stout, conical at tip; setose, the end extends almost to the inferior edge of the vasiform orifice ; colour yellow.

Adult male. Length ·72 mm. Wing ·74 mm. × ·25 mm. Antennæ ·2 mm. Formula of antennæ, shape of vasiform orifice, etc., as in female.

Aleurodes bengalensis n. sp. Plate II, Figs. 10–16.

Egg. ·2 mm. × ·1 mm.

Colour reddish-brown under the microscope, dark claret colour under a hand lens. Surface covered with meal. The eggs are usually laid in a more or less perfect ring.

For want of material the first, second, and third larval stages have been described from empty skins and in some cases dead and dried individuals. I will describe them later on in detail when these stages can be obtained. Just now, Nov. 20th, pupæ and adults are fairly plentiful and larvæ 4th stage scarce, no living examples of any of the other larval stages being obtainable. Large quantities of the cast off skins can however be obtained, which is rather unusual amongst these insects.

The insects are present on the leaves in colonies of from half a dozen to several hundred individuals. The location of a colony can be easily ascertained owing to the peculiarly whitened appearance of the leaf wherever a colony has planted itself. This white is the meal from off the adults. I observed no parasited pupæ.

Larva 1st stage. Size ·2 mm. × ·1 mm.

Shape elliptical. Yellow pigment patch on centre of abdomen. A fairly broad marginal fringe of wax. There are 26 spines on dorsum, all around and some distance from the margin. Two series of pores around the margin; difficult to make out but apparently as in later stages. Two long setæ caudad on margin. Two short setæ caudolaterally on margin. The vasiform orifice opens directly on the surface of the dorsum. Shape cordate; anterior edge flattish; edge tinged with yellow. Operculum yellow, similar in shape to the vasiform orifice only narrower being broader than long. Anterior and posterior margins flattish. The operculum extends only a little further than centre of vasiform orifice. Lingula short, broad, constricted in the middle to form a flat broad basal end and a spatulate tip. About half the lingula projects beyond the operculum. Colour of lingula brownish yellow. There appear to be no pores placed centrally on the abdominal segments as in later stages.

Larva 2nd stage. Size ·65 mm. × ·43 mm.

Shape elliptical. A large brown patch on abdomen extending from the first to the sixth segment. Area around vasiform orifice tinged with brown. There are 26 setæ around and slightly within the margin. Caudad on margin 2 setæ. Two shorter setæ caudolaterally on margin. These 4 setæ are placed on a lower plane than the marginal ring of setæ. There is a fairly broad marginal fringe of wax. There are two marginal series of pores situated apparently as in pupa. Of the central double row of abdominal pores present in the pupa only the pair on the first and second segments present. There are rows of extremely minute pores on each segment of the abdomen placed centrally and extending about one-third the width of the dorsum. These pores tend to be disposed in rows but are very irregularly placed. The fourth, fifth, and sixth segments have the largest number.

Vasiform orifice placed in a depressed pit. The pit proportionately far smaller than that in the pupa, the vasiform orifice nearly filling it. Anterior and posterior edges of pit flat, sides convex. The lateral and posterior edges slope inwards. The vasiform orifice situated in a clear space, the edges of the space being demarcated by a dark line; rest of pit yellowish brown. Vasiform orifice similar in shape to pit, edges dark brown. Operculum broader than long, anterior edge flat, posterior edge concave, sides convex; colour brown. It extends to a little beyond centre of vasiform orifice. Lingula broad for its length, dumb-bell-shaped, being constricted in centre, tip spatulate. It projects for about half its length beyond operculum; colour brown.

Larva 3rd stage. Size ·76 mm. × ·46 mm.

Apparently similar to the 4th stage.

Larva 4th stage. Size ·85 mm. × ·5 mm.

Shape as in pupa. A short marginal fringe of wax. Vertical fringe short. Dorsum much blotched with black. Rest apparently as in pupa.

Puparium. Size 1·1 mm. × ·68 mm.

Shape elliptical, narrower cephalad, the margin being rather abruptly incurved at thorax. Margin caudad flattish. Cephalothoracic area lemon yellow, later turning to orange. Last three segments of the abdomen up to vasiform orifice orange. There is a clear space between these two patches. Two irregular longitudinal grey bands on anterior segments of the abdomen just without the central double row of pores. A broad edging of black around cephalothoracic margin. This is in some cases interrupted so as to form three separate patches, one cephalic and two thoracic. The cephalic patch is divided into two by a narrow yellow band which connects the cephalic margin to central yellow area. A black edging on margin caudad. Caudolateral margins more or less blotched with black. Rest of body of a cream white colour. The grey edging on margin is not at all constant, it varying a good deal. As the insect within develops the markings gradually disappear. They disappear very irregularly, in many cases blotches disappearing from one side before the other. The caudolateral marginal blotches disappear first. The suture between thorax and abdomen sometimes apparent as a fairly broad transparent band. There are 26 setæ right around dorsum; they are set just within the margin. The upper end of each seta for about one-third of its length surrounded with a quantity of fluffy wax. Of these setæ 14 are situated on the abdominal and 12 on the cephalothoracic region. The spines are comparatively short; colour light brown. Two long setæ caudad on margin on a slightly lower plane than the marginal fringe of spines. Mesad of the marginal spines there are present on the dorsum two series of large pores an inner and an outer series. There are in all 28 pores in the outer series, 12 on the abdominal and 16 on the cephalothoracic region. The pores on the abdominal segments are situated, one on each side near margin of 3rd, 4th, 5th, and 6th segments and two on 7th. There are 26 pores in the inner series, 14 on the abdominal and 12 on the cephalothoracic region. The abdominal pores are situated two on each side near margin of the 3rd segment, one on each side near margin of 4th, 5th, and 6th segments and two similarly placed on the 7th segment. There are also two rows of similar pores down centre of dorsum on the abdominal segments. The rows are placed fairly close together. There are in all 6 pores in each row, 1 pore of each row being placed on abdominal segments 1 to 6. The pores are large, rims slightly elevated above dorsum. All the pores secrete globules of liquid. Ventrally on margin a series of fine pores which secrete a quantity of wax. This fringe of wax is vertical and about ·15 mm. in length. It elevates the pupa off the leaf. The vasiform orifice is prominent and is extremely characteristic. It is situated in a large depressed pit. The pit is conical apex pointing caudad. Apical and basal margins flat, the apical margin being if anything a trifle incurved. Lateral margins rounded, basal ends being curved to meet basal margin. Sides from centre to near apical margin flat, then sharply incurved to meet apical margin. Edges dark brown, an outer edge of light brown. The sides slope inwards. Apical end of pit shallow, the floor sloping down to the anterior end at which point the pit is deepest. Floor of pit highly rugose, with seven dark wavy brown lines forming the demarcations of the ridges. These ridges vary in different individuals. A clear light yellow area around vasiform orifice. Vasiform orifice oval, posterior margin slightly incurved. Anteriorly the margin projects beyond and can be seen below basal edge of pit, showing that the pit's basal edge overhangs at the top. Edge of vasiform orifice tinged with brown. Operculum two-thirds the length of the vasiform orifice. Anterior margin flat, posterior margin slightly concave, sides convex, the curve being somewhat angular. Colour light brown. Lingula spatulate at tip. Only the tip projects beyond the operculum, it is the only part which can be distinguished. Colour brown. Legs of adult can be distinguished through ventral surface. Appearance much the same as that shown in the description of *A. citri.* When the adult is emerging from the pupal case its thorax is of a bright deep orange colour.

Adult female. Length 1 mm. Wing 1·15 mm. × ·42 mm.

Colour light orange; surface of the body dusted with a large quantity of white meal. Eyes maroon, almost divided. Wings immaculate, covered with white meal. Legs and antennæ white, tinged with yellow, dusted with white meal. Antennæ ·3 mm. in length. Formula 4, (2, 3,) 5, 7 (1, 6). Joint 1 short, flat: joint 2 stout, subpyriform: joint 3 thin, cylindrical, equal in length to joint 2: joint 4 slightly longer than joint 3, joint 5 short, only two-thirds length of joint 4: joint 6 short, little more than one-third length of joint 5: joint 7 twice the length of joint six. Vasiform orifice somewhat square, broader than long, posterior edge widest, anterior edge flattish, posterior edge slightly convex: lateral edges flat and angled outwards. Margin of vasiform orifice slightly tinged with brown: inner area semitransparent. Operculum flattish, broader than long: only about one-third length of vasiform orifice. Anterior and posterior margins concave, lateral margins convex. The upper corners are the only parts of the operculum which touch the vasiform orifice. Colour brown. Lingula long, cylindrical, two jointed, first joint shortest. The lingula projects nearly half its length beyond the vasiform orifice.

Adult male. Length ·9 mm. Wing ·85 mm. × ·31 mm. Antennæ ·25 mm.

Long silky fluff on abdomen as in *A. citri.* This is only present in recently emerged individuals.

Aleurodes alcocki n. sp. Plate II, Figs. 1-9.

Egg. Size ·2 mm. × ·1 mm.

Colour light yellow brown. It stands upright on leaf to which it is attached by a peduncle about ·04 mm. in length. The egg is curved, surface sculptured with minute hexagons.

Larva 1st stage. Size ·27 mm. × ·16 mm.

Shape elliptical, extremely narrow for its length. Provided with antennæ and legs. Colour whitish, semitransparent under the microscope. Margin minutely crenulated. There is a series of closely apposed marginal pores which secrete a short regular fringe of wax. Four fairly long setæ caudad on margin. Caudolaterally on margin eight extremely short setæ (four a side) placed equidistant and forming a regular continuation of the four long caudal setæ. Cephalad there are marginally twelve (six a side) setæ which extend around the cephalothoracic margin. Vasiform orifice slightly elevated, conical, apex pointing caudad. Operculum semicircular, flat anteriorly, almost filling up vasiform orifice. Colour brown, surface covered with fine hairs. Lingula extremely short, cylindrical, about half the length of the operculum beneath which it is hidden. Legs stout; tibiæ of second and third pair of legs furnished each with a long curved hair placed about the centre of the joint. The tarsi of all the legs provided with a long hair just above claw (or claws). Tarsi with apparently only one claw each. Antennæ ·06 mm. (Formula 5, 6, 3, (1, 2, 4,) 7), long, seven jointed, covered with fine hairs. 1st joint short: 2nd joint short, stout, about the same length as the first joint: 3rd joint thin, cylindrical, slightly longer than joint two: 4th joint shorter than joint three, about the same length as joint two: 5th joint extremely long, four times the length of joint four: 6th joint short, one and a half times length of joint four: 7th joint extremely thin and short, about one-fourth the length of joint six. It is extremely difficult to make out the different joints distinctly, but there is no doubt that joint 5 consists of only a single joint. Eyes maroon coloured. There are several rows of minute pores on the abdomen there being two rows on each abdominal segment. In the figure the artist has represented the vasiform orifice as seen ventrally by him through the transparent body.

Larva 2nd stage. Size ·7 mm. × ·37 mm.

Margin slightly incurved on sides of cephalothorax and at caudal margin. Colour yellow, almost transparent when seen under the microscope. Yellow, pigment patch in centre of anterior abdominal segments. Eyes maroon coloured. Dorsum slightly elevated. The margin is unusually broad. The abdominal segments clearly discernible on elevated portion of dorsum. There is a narrow ridge running from thorax cephalid to the margin where it sometimes projects to a slight point. A series of closely apposed marginal wax tubes which secrete a very fragmentary fringe. Crenulations of marginal pores distinct right up to edge of elevated portion of dorsum. Edge of margin thickened somewhat, brown in colour. Marginal pores on incurved thoracic and caudal margins slightly larger than the rest. Two fairly long setæ on caudal margin, and a pair placed caudolaterally, slightly anterior to these and in line with the lower edge of the vasiform orifice. Vasiform orifice oval, anterior margin flattish. Edge of orifice tinged with brown. Operculum broader than long, of the same shape as the vasiform orifice. The anterior margin flat so that it only touches the rim of the vasiform orifice at the outer edges. Its lower edge extends some distance beyond centre of vasiform orifice. The free (lower) margin slightly elevated. Surface of operculum covered with fine hairs. Lingula short, cylindrical, difficult to make out as it is shorter than the operculum beneath which it lies.

Larva 3rd stage. Size ·85 mm. × ·5 mm.

Shape elliptical, narrower cephalad. Colour yellow: a bright yellow pigment spot on centre of anterior abdominal segments. Brown medio-dorsal ridge running from the thorax cephalad to margin. At thorax a dark brown bar crosses the median dorsal ridge at right angles. Posterior to this is another line which is angled caudolaterally, then back again cephalolaterally. Thorax suffused with light brown, with a deeply trilobed brown line on each side of mediodorsal ridge demarcating the outlines of the developing insect within. Abdominal segments distinct. Edge of margin set with closely apposed pores which produce a very fragmentary fringe. These pores are situated on a slightly higher plane than the margin. Margin incurved at sides of cephalothorax and at caudal margin. There are eight large and distinct wax tubes on each of these areas. Region around these indentures tinged with brown, which, in the case of the caudal indenture, reaches to the vasiform orifice. Eyes reddish. Two small setæ on the cephalic margin. Two small setæ caudad just within the margin and placed one on each side of the incurved area. They point upwards and outwards. Vasiform orifice similar to that in the larva 2nd stage. In some specimens the orifice is almost circular. In others the anterior margin and the sides are flattened somewhat, giving the vasiform orifice a conical appearance, the apex pointing caudad. The edges of the orifice tinged with brown. The orifice appears to project slightly beyond surface of the dorsum. The operculum similar in shape to that in the larva 2nd stage but is smaller in proportion and does not extend so far caudad. Lingula as in larva 2nd stage. There is but little difference except in size between this stage and the pupa, except that the insect is more transparent, has the median keel on cephalothorax less prominent and the operculum is larger, being intermediate in size between that of the pupa and the larva 2nd stage.

Puparium. Size 1 mm. × ·78 mm.

Shape elliptical, narrower cephalad. Margin at thorax and caudal extremity incurved. Colour yellow. Dorsum elevated. A dark brown elevated median keel running from thorax to cephalic margin beyond which it slightly projects. At thorax a dark brown bar crosses the median dorsal ridge at right angles. Slightly posterior to this is another line which is angled caudolaterally and then back again cephalolaterally. Thorax suffused with brown; centre of abdomen suffused with lighter brown. Segments of abdomen fairly distinct along medio-dorsal line. Vasiform orifice oval: anterior margin slightly flattened. Rim round vasiform orifice dark brown. The lower portion of the orifice covered with fine short hairs. Operculum small, similar in outline to vasiform orifice. The lower edge extends to about the centre of the orifice. Surface covered with fine hairs. Lingula short, cylindrical, difficult to observe as it is shorter than the operculum and does not extend beyond that organ. Incurved areas at thoracic and caudal margins tinged with brown. At these places the marginal pores are eight in number, larger than the other marginal pores and differ in producing fairly long filaments of white wax. A distinct series of pores right around on margin. They secrete a quantity of gelatinous looking wax. Each individual filament is distinct for a certain distance beyond the margin then coalesces to form a gelatinous mass with the others. Dorsum covered with a similar gelatinous secretion. This is secreted from a large number of very minute pores which appear to lie all over the dorsum without any definite grouping. Colour of secretion yellow. Two setæ, one on each side of incurved caudal area. Parasited pupæ are smaller than nonparasited pupæ, are darker in colour and have the dorsum much arched. The developing parasite can be easily distinguished within the body.

Adult female. Length 1 mm. Wing 1·05 mm. × ·45 mm.

Colour yellow: thorax tinged with brown, body and legs dusted with white meal. Eyes reniform, almost divided. Upper half cherry-red lower half maroon. There is a large rectangular brown patch on last segment of abdomen: within it and at the upper end is the vasiform orifice. Vasiform orifice oval. Operculum small, extending only to centre of orifice. Lingula long, cylindrical, extending a short distance beyond vasiform orifice. Forewing patched with bluish grey. These patches lie in the form of three bars which run across the wing being more or less interrupted at median vein. A longitudinal bar connects all the transverse patches. This bar is situated below the median vein but is prolonged above the vein to apical margin of wing. Apex of hindwing tinged with grey. Antennæ yellow; Formula 3, 2, (5, 6, 7,) 1, 4. 1st joint short, stout: 2nd joint subpyriform, almost globular: 3rd joint thin, cylindrical, two-and-a-half times the length of joint two: 4th joint extremely short, half the length of joint two: joints 5, 6, and 7 one-and-a-half times the length of joint four. There is a dark line on each side of the under-surface of the second and third segments of the abdomen. The under-surface of the last segment of the abdomen with a patch of grey.

Adult male. Size ·95 mm. Wing ·9 mm. × ·33 mm.

Colour yellow: dorsally segments of abdomen and thorax tinged with grey. Last segment of abdomen and gentalia uniform grey. Rest as in female.

I first found this Aleurodid on the leaves of a seedling banyan (*Ficus indica*) lodged on the trunk of a mango tree in the vicinity of Calcutta. I was only able to obtain some half a dozen pupæ at the time. I was much struck by the gelatinous looking secretion of the insect. It is the only Aleurodid which I have obtained which produces such a secretion. It is possibly allied to *A. gelatinosus*, Ckll., although when the two insects are compared they appear to be very dissimilar. *A. gelatinosus* is elevated off the surface of the leaf by its lateral fringe, not so in this species. The margin of *A. gelatinosus* is deeply crenulated, while in this species the crenulations are quite difficult to detect. It differs in colour, *A. gelatinosus* being black: but the two species agree in producing an apparently similar substance, and the distinctive feature, the indentures on the cephalo-lateral and caudal margins with the pencils of wax issuing therefrom, are common to both. I have, within the last two years, frequently come across this species; at first only on banyan (*Ficus indica*) seedlings, where I searched for it; but later on also on pepul (*Ficus religiosa*) seedlings as well. I find that especially after the rainy season (about October) the insect simply swarms on the young banyan and pepul plants, which spring up during the rains on buildings, rubbish heaps and the like. In the case of the pepul seedlings it is frequently associated with *A. quaintancei.* One peculiarity, however, is that I have only found this species on young plants, and when the two species are both present on the same plant this aleurodid is always to be found on the lower and older leaves. I have failed so far to find the insect on banyan or pepul trees, though I have frequently searched for it. So far, I have only obtained this species from two localities; at Turkaulia, Champaran district, Behar, and in and around Calcutta. The insect is heavily parasited by a minute yellow chalcid. When parasited the dorsum becomes very convex and when the parasite pupates it can be seen quite easily within the body. Although it is to be often found associated with *A. quaintancei* the chalcid parasiting *A. quaintancei* never to my knowledge attacks this species. It is a pity that the insect should suffer so severely from this parasite, as it undoubtedly does some indirect good by killing off the enormous numbers of pepul and banyan plants which take root on old buildings and the like, and which would otherwise in many cases grow up and do future injury. The aleurodid is usually present in large numbers, several hundred being frequently attached to a single leaf, in the greater number of cases eventually killing off the plant. Most of my material has been obtained from the Museum terrace. I may note that I have failed so far to obtain specimens of the 2nd stage; the stages marked 2nd and 3rd being probably the 3rd and 4th. I have much pleasure in naming this species after Major A. Alcock, F.R.S., C.I.E., Superintendent, Indian Museum, to whom I am much indebted for encouragement in my entomological studies.

4. *Aleurodes quaintancei* n. sp. Plate V, Figs. 10–14.

Egg. Size ·18 mm. × ·09 mm.

Cream coloured when recently laid, changing later to light brown. Peduncle about one-third length of egg. The eggs are usually laid four or five abreast in a curved line.

I take this opportunity of naming this species after Mr. A. L. Quaintance, to whom I am indebted for much valuable assistance in my study of this family.

Larva 1st stage. Size ·28 mm. × ·9 mm.

Shape elliptical, narrow for its length. Colour light yellow. Dorsum flat: segments of abdomen fairly distinct. Four long setæ caudad on margin. They rise from small tubercles. Between each pair is a short seta. Four pairs of short setæ (four a side) placed caudo-laterally on margin and forming a continuation of the caudal setæ. Laterally on margin six pairs of short setæ (six a side) the pair furthest cephalad longest. Six long setæ cephalad on margin (three a side), of these the second pair is longest. The caudo-lateral, lateral and cephalic setæ do not form a continous line, there being a space between each set of setæ. Legs and antennæ present. Vasiform orifice as in the pupa only larger in proportion, and the operculum only extends to about the centre of the vasiform orifice.

Larva 2nd stage. Size ·42 mm. × ·3 mm.

Shape elliptical, broader in proportion than the first stage. Dorsum flat: abdominal segments fairly distinct. Eyes maroon. Two short setæ on cephalic margin, two fairly long setæ caudad on margin and two short setæ caudo-laterally on margin. The setæ caudad on margin spring from small tubercles. Vasiform orifice as in pupa but larger in proportion.

Larva 3rd stage. Size ·7 mm. × ·53 mm.

Shape elliptical, broad for its length. Colour light yellow. Dorsum flat, sometimes slightly rounded. Thoracic and abdominal segments clearly discernible. With the exception of the central area, the surface of the dorsum is covered with coarse granular striations which extend to the margin. Vasiform orifice essentially the same as in later stages. Setæ as in previous stage. In some cases there is a slight line running from thorax cephalad to margin and faint indications of the two radial yellow bands running from thorax to cephalo-lateral margins. The channelled passage running from the posterior extremity of the vasiform orifice caudad to margin and the two ridges situated one on each side of the vasiform orifice and the channelled passage which are present in the pupa, first appear in this stage.

Larva 4th stage. Size 1·05 mm. × ·76 mm.

Characters essentially as in pupa.

Puparium. Size 1·55 mm. × 1·23 mm.

Shape oval. Colour translucent white, with in most cases a tinge of yellow, two yellow pigment spots usually present on the first two segments of the abdomen. As the insect develops within the entire thorax and abdomen become yellow and opaque. Dorsum slightly convex, the surface, with the exception of the central area, covered with granular striations which radiate to the margin. Abdomen and abdominal segments clearly defined. Sides and divisions of thorax apparent, the sides being bounded by a three-lobed line. Three faint lines running from suture between pro and mesothorax, one cephalad and two cephalo-laterally to margin. The cephalo-lateral lines are really more or less clearly defined yellow bands. In some specimens a fairly broad distinct margin can be observed, but in others the margin gradually merges into the central dorsal area, there being no well defined inner edge. In some the margin is extremely pronounced but this is apparently only the case when the insect is parasitized. As in the larvæ of the three preceding stages there are two small setæ cephalad on margin and four (the two inner long and placed on tubercles) on the caudal margin. Vasiform orifice conical, apex pointing caudad; corners rounded. Anterior margin flat. Edge of orifice tinged with brown. Caudad there is a channelled passage extending to margin. Operculum broader than long, nearly filling aperture of vasiform orifice. Anterior margin flat, posterior margin concave, lateral margins convex and angled inwards to posterior margin. Corners rounded. Colour brown, posterior edge darkest. Lingula long, cylindrical, spatulate at tip. It projects about one-third its length beyond the operculum. Colour brown. There are two rounded yellow ridges which lie one on each side of the vasiform orifice. They are prolonged caudad to margin. The channelled passage is situated between them. The two long caudal setæ are situated on the end of these ridges. Small tufts of brown wax are secreted at margin at end of these ridges and also where the cephalo-lateral bands touch the margin. There is an extremely light and narrow marginal fringe of wax. Normally the pupa is semitransparent, flat, and its lower surface adheres closely to the surface of the leaf. The longitudinal cephalic, and radial cephalo-lateral lines are then fairly distinct. As the pupa matures the dorsum becomes convex, the central area becomes yellow and the margin turns an opaque white. The cephalic and cephalo-lateral radial lines are then very distinct. Parasitized pupæ however have an entirely different appearance. The insect is then more or less opaque, the colour ranging from a uniform yellow through shades of brown and red brown to black. Usually however the parasitized pupa has two dark brown blotches one on the thoracic and one on the abdominal region, the rest of the dorsum being of a yellow or cream colour. When the parasite pupates it shows up as a brown and black patch within the central area of the dorsum. The dorsum of a parasitized pupa is invariably highly convex, almost globular in fact. Pupæ from which the parasite has emerged are of a dark yellow or brown colour, while those which develop normally and from which the insects have emerged in due course are of a dull semitransparent white colour. The chalcid parasitising this insect has its head and thorax black, abdomen brown.

Adult female. Size 1·1 mm. Wing 1·16 mm. × ·52 mm.

Head and thorax light brown, abdomen yellow. Ventrally last two segments of abdomen tinged with grey along centre. Legs semitransparent, tinged with grey, joints yellow. Eyes reniform, maroon. Wings white with three faint bands of grey running diagonally across wing. Nervure dark grey where the bands cross it. Hind wing immaculate. Body and legs powdered with white meal. Antennæ ·32 mm. in length. Formula 3, 2, 7, (4, 5, 6,) 1. The first joint is short and flat; the second joint stout, pyriform, about three times the length of joint one; the third joint long, thin, cylindrical, about two-and-a-half times the length of joint two; the fourth, fifth, and sixth joints equal, the three together about equalling joint three in length; the seventh joint thin, slightly longer than joint six.

Vasiform orifice oval, anterior edge flattened. Operculum similar in shape but slightly smaller being only about two-thirds the size of the vasiform orifice. The posterior edge is concave. Lingula long, cylindrical, projecting about one-third of its length beyond operculum.

Adult male. Length ·95 mm. Wing 1·05 mm. × ·48 mm. Antennæ ·25 mm.

Markings of wing similar to that in female. Entire body yellow, legs as in female. Two small tubercles on last segment of abdomen just above forcipate process. I have found this species on pepul (*Ficus religiosa*) in and around Calcutta. It is extremely abundant after the rains (October-November).

5. *Aleurodes simula* n. sp. Plate III, Figs. 1–14.

Egg. Size ·2 mm. × ·09 mm.

Colour light yellow when first laid, afterwards turning brown. Peduncle about one-fourth length of egg. Examined while still within the body of the female the eggs are light yellow. The peduncle is curved inwards and pressed against the egg. Colour of peduncle pink, basal end of egg fairly dark yellow.

Larva 1st stage. Size ·25 mm. × ·15 mm.

Shape elliptical. Colour semitransparent yellow; two yellow pigment patches in centre of abdominal region. There are a series of 34 long hairs right around margin. The four hairs furthest cephalad are grouped in two pairs placed some distance apart. Of the six hairs on caudal margin the inner pair long, the second pair short, and the third pair long. The 24 other setæ are shorter than the long caudal setæ, they are situated at equal distances apart on the lateral margins. Vasiform orifice as in the pupa-case, but the operculum is larger proportionately, and the lateral margins of the orifice are somewhat incurved posteriorly beyond the operculum. Eyes maroon. Abdominal segments distinct. Antennæ and legs present. The artist has drawn the vasiform orifice as seen by him through the transparent body.

Larva 2nd stage. Size ·45 mm. × ·32 mm.

Shape elliptical; colour yellow. Two yellow pigment patches in centre of abdominal region. Two curved hairs caudad on margin. Vasiform orifice as in the pupa-case, but the orifice is situated quite close to the margin. Abdominal segments distinct. Eyes maroon. A marginal fringe of stout, cylindrical, waxy filaments which are placed quite close together.

Larva 3rd stage. Size ·7 mm. × ·5 mm.

Shape elliptical, margin at thorax angled slightly outwards. Dorsum almost flat. Colour yellow. Two setæ caudad, and two setæ placed caudolaterally on margin. A marginal fringe of stout, cylindrical wax filaments. Eyes maroon. Abdominal segments distinct. Dorsum granular near margin. Margin broad, faintly demarcated mesad, and deeply striated radially. There is a distinct yellow band extending from the posterior extremity of the vasiform orifice caudad to margin. There are faint indications of the two radial thoracic bands so conspicuous in the pupa. They end, as also does the band extending caudad to margin, in five separate brown horizontal pores which secrete a small quantity of brown wax. Dorsum covered with a large number of extremely minute circular pores.

Larva 4th stage. Size 1·25 mm. × 1 mm.

Similar to pupa-case except in size, it is also flatter.

Puparium. Size. 1·86 mm. × 1·52 mm.

Shape oval, anteriorly the thoracic margins angled outwards, giving the anterior end a somewhat square appearance. Colour bright yellow. Dorsum at first somewhat flat, later turning fairly convex. Three ridges on dorsum, two radiating from thorax to cephalo-thoracic margins, and one from the posterior end of the vasiform orifice caudad to margin. These ridges are dark yellow, blotched with grey. They end marginally in five stout distinct brown pores which produce a small quantity of brown fluffy wax. Margin broad, demarcated mesad by a fairly broad distinct white band the inner edge of which is dark brown. Margin with strongly marked radial striations, the dorsum also marked around the central area, but the markings are more granular than striated. A small quantity of short stout waxy filaments produced from marginal pores spaced some distance apart. There are also a series of submarginal pores which produce finer and longer wax filaments. They are also spaced some distance apart. There are two small slender setæ on cephalic, and two similar but smaller setæ on lateral margins. Surface of dorsum and especially of the margin covered with a very great number of extremely minute circular pores which tend to form detached groups. These pores are also present over the radial patches, but the grouping does not differ from the rest of the margin, the pores not being arranged in any sort of pattern.

The margin of the pupa-case turns quite white a short time before the adult emerges. Vasiform orifice conical, apex pointing caudad. Anterior margin flat. Lateral margins sloping inwards; the sloping surface with six ridges on each side. Operculum rhomboidal; the posterior margin somewhat incurved. The operculum extends to about or a little beyond the centre of the vasiform orifice. Surface setose, colour light brown. Lingula two-jointed, lower joint short, stout. Upper joint club-shaped. The lingula extends for one-third its length beyond operculum; the surface setose, colour brown. Two long hairs spring from near the tip of the lingula and extend some distance beyond the vasiform orifice.

Pupa extracted from puparium.

Head fairly broad, colour yellow, the ocelli lighter in colour. Thorax rather dark yellow, abdomen light yellow. Eyes dark maroon. Unfolded wings dark grey. Legs almost transparent, well formed, setose. Sides of abdomen flattened and spread out. Abdominal segments fairly distinct but the vasiform orifice cannot be made out. Antennæ not noticeable in the specimen examined. When the adult emerges from the pupa-case the dorsum splits up not only from the cephalic margin to thorax, and across the thorax, but also right round the inner edge of the margin so that in empty pupal cases the anterior portion of the dorsum is usually missing. I have observed no parasites on this species.

Adult female. Length 1·9 mm. Wing. Size 1·9 mm. × ·85 mm.

Body light yellow; antennæ and legs semi-transparent white. Tip of mentum grey. A lateral grey stripe on each side of the first segment of the abdomen, and dorsally a rather broad diagonal grey patch on each side of the same segment. Dorsally each abdominal segment dark grey nearly the entire width of the body. An oval grey plate situated on the dorsal surface of the last segment of the abdomen. It encloses the vasiform orifice. Ventrally the abdomen covered with fine short hairs. Body and legs covered with white meal. Eyes reniform almost divided; colour dark maroon. Wings immaculate. Vasiform orifice broadly conical, the anterior edge somewhat produced and with a flat indenture in the centre. Operculum cordate, apex pointing cephalad. Posterior margin incurved; lateral margins dark and wavy. The operculum extends nearly the whole length of the orifice, but is somewhat narrower. Colour dark grey. Lingula cylindrical; it projects to the posterior edge of the vasiform orifice. End almost flat. Only the part which projects beyond the operculum can be made out. Colour grey. Antennæ length ·5 mm. Formula (3, 6,) (2, 4, 5,) 7, 1. Joint one short, flat; joint two subpyriform, about twice length of joint one; joints three and six equal in length, each about twice the length of joint two; joints four and five each equal in length to joint two; joint seven short, thin, and tapering to a point, about one-third length of joint six.

Adult male. Length 1·7 mm. Wing. 1·5 mm. × ·77 mm.

Colour, etc., much as in the female. The antennæ however are enormously developed, being proportionately about twice as long as those in the female. Length ·9 mm. Formula 5, 3, (6, 7,) 2, 4, 1. Joint five is very long, being nearly equal to all the others together. Joint one short flat; joint two subpyriform, twice length of joint one; joint three fairly long, one-and-a-half times length of joint two; joint four short, less than half the length of joint three; joint five long almost equal to all the other joints together; joints six and seven equal, together about equal to joints three and four. The antennæ are heavily ringed and it is extremely difficult to make out the joints. The under surface of the abdomen covered with a large quantity of white fluff.

This species occurs in great abundance on the Simul tree (*Bombyx malabaricum*) in Calcutta. The leaves are thickly covered with the insect; they become yellow and spotted wherever an insect is attached and are ultimately killed. Superficially the insect somewhat resembles *A. eugeniæ*, Mask. There are the same radiating dorsal patches and the dorsum is similarly striated. They differ however in the shape of the pupa-case, and the shape of the vasiform orifice. *A. simula* has a slight marginal fringe and there are four setæ on the margin. The radiating dorsal patches are quite different in the two insects. In *A. simula* these patches are not formed by closely apposed pores but are yellow bands striated with grey. The thoracic radial patches are also true ridges, being elevated above the surface of the dorsum. All three patches in this species end not in a single aperture or pore opening dorsally, but in five stout brown horizontal pores which secrete a small quantity of fluffy brown wax. The dorsum in this species is covered with a large number of extremely minute circular pores; the margin is also broad and clearly defined.

Mr. Maskell was mistaken in assuming that the three radial patches were sufficient evidence to prove the close relationship of *A. eugeniæ* and *A. eugeniæ* var. *aurantii*. As a matter of fact many of the Indian Aleurodidæ possess this characteristic, however widely different they may otherwise be.

Aleurodes bambusæ n. sp. Plate IV, Figs. 1–9.

Egg. Length ·25 mm. × ·11 mm.

Colour light brown. Surface sculptured with hexagons. Attached in an upright position to leaf by a short peduncle.

Larva 1st stage. Size ·35 mm. × ·2 mm.

Shape elliptical; narrow for its length. Colour deep black; dark brown under the microscope. The dorsum is completely hidden by a quantity of white fluff which is produced by a series of submarginal pores. There is an elevated mesio-dorsal ridge extending anteriorly almost to the margin and posteriorly to the vasiform orifice. Segments of abdomen fairly distinct. Margin crenulated, bearing a series of closely apposed pores which produce a regular but somewhat short horizontal fringe. Ventrally just within the margin a series of pores which produce a scanty white secretion. There are four long setæ on cephalic and four on caudal margins. On the dorsum there are four long stout curved spines which are situated a pair on the cephalic and a pair on the anterior edge of the abdominal region. They are placed on the sides of the medio dorsal ridge. The spines point backwards. Each spine is about half the length of the body, the anterior pair being slightly longer. Two short stout curved spines are situated one on each side of the vasiform orifice. Vasiform orifice large elevated on a tubercle. It is apparently similar to that in the puparium but owing to the colour is difficult to make out.

Larva 2nd stage. Size ·55 mm. × ·3 mm.

Similar except in size to larva 3rd stage.

Larva 3rd stage. Size 1 mm. × ·55 mm.

Shape elliptical, somewhat broader proportionately than in the first stage. Colour dense black. There is a distinct mesio dorsal ridge which is somewhat slighter than in the preceding stage. Abdominal segments distinct. Area surrounding vasiform orifice darker than the rest of the abdomen. Margin broad crenulated. Mesad the margin ends at a broad ridge which separates it from the rest of the dorsum. Along its edge are a series of large closely apposed pores which produce a short but abundant horizontal fringe of wax. The upper surface of the margin bears a large number of extremely minute pores. These pores produce a quantity of white fluffy wax filaments which curve inwards and cover the dorsum. Ventrally a little within the margin there are a series of pores which produce a small quantity of wax. The dorsum is covered with a number of stout spines. There are: a pair on the cephalic region at end of mesio dorsal ridge and nearly on the margin; two pairs placed fairly close together on the cephalic region; a pair placed widely apart on the thoracic region; immediately behind this pair there are two pairs placed fairly close together on the lower edge of the mesio dorsal ridge; a pair of spines on each of the 3rd, 4th, and 5th abdominal segments; and two stout curved spines, one on each side of the vasiform orifice. There are two short setæ, one on each side of the vasiform orifice and two fairly long setæ caudad on margin. The vasiform orifice as in preceding stages, but in some specimens the lingula appears large and dumb-bell shaped.

Larva 4th stage. Size 1·4 mm. × ·9 mm.

Shape elliptical, anterior edge abruptly conical. Colour dense black. Mesio dorsal ridge as in preceding stages. A broad crenulated margin which ends mesad in an elevated ridge which separates it from the rest of the dorsum. The margin ends in a series of large closely apposed pores which produce a short thick marginal fringe of white wax. The upper surface of the margin is covered with a large number of minute pores which produce a quantity of white fluff, which curving inwards covers the dorsum. Segments of abdomen distinct. The dorsum is covered with a large number of stout spines which lie: five pairs on the cephalic region; four pairs on the thoracic region, and five pairs on the abdominal segments. There is also a stout curved pair situated one on each side of the vasiform orifice. There are two short setæ, one on each side of the vasiform orifice and a slightly longer pair caudad on margin. Vasiform orifice large in proportion to its size as compared to the vasiform orifice in the puparium.

Puparium. Size 2·1 mm. × 1·4 mm.

Shape elliptical, broadest caudad. Colour dense black. Distinct mesio dorsal ridge which is narrow and sharp anteriorly, and broad and rounded posteriorly. From this ridge there are a series of five ridges which mark out the abdominal segments. Margin broad, crenulated; bearing on its upper surface a large number of minute pores which produce a quantity of white wax filaments which curling inwards conceal the dorsum. There are a series of closely apposed marginal pores which produce a short but abundant horizontal secretion of wax. There are ventrally on margin a series of pores which produce a small quantity of wax. The dorsum is covered with a large number of short but stout spines. These spines are grouped as follows. There are thirty hooked spines forming a ring around the dorsum just within the margin. The other spines are shorter and are situated as follows. A double row of eight spines across the cephalic region; four spines on the thoracic region; sixteen spines in a row down the mesio dorsal ridge on the abdominal region; two rows of three spines, one row on each side of the mesio dorsal ridge on 1st and 2nd abdominal segments; two rows of two spines placed similarly on third and fourth segments and one spine on each side of the mesio dorsal ridge on the 5th segment. A pair of short stout spines placed, one on each side of the vasiform orifice. Two long setæ caudad and two cephalad on margin. The vasiform orifice is situated on a short tubercle at the posterior end of the mesio dorsal ridge. Shape oval. Operculum similar in shape but somewhat smaller, the lower half apparently slightly ridged. Lingula indistinct, shape rectangular, broader than long. It is completely covered by the operculum.

Adult form unknown.

This Aleurodid occurs plentifully on various species of bamboo in the vicinity of Calcutta. As a rule only a few leaves in a bamboo clump are attacked by the insect. I have, however, sometimes found it occurring in very large numbers in some bamboo clumps. It then undoubtedly is a rather serious pest as frequently most of the leaves are then killed. The insect is kept in check by a parasite, presumably a chalcid, as large numbers of dead insects can always be found which have the minute hole on the dorsum made by the parasite for its exit. I have so far obtained no specimens of the parasite. When this aleurodid is detached from the leaf it will be observed that the portion of the leaf beneath the insect is yellow and discoloured. As a rule the exuviæ of the preceding stages remains attached to the spines on the dorsum.

Aleurodes leakii n. sp. Plate V, Figs. 4–5.

I obtained specimens of this insect off both Natal (*I. arrecta*) and ordinary indigo (*Indigofera tinctoria*) at Dalsing Serai, Behar, in the month of May 1902. As seen with the naked eye the pupæ and larvæ are yellowish in colour. I noticed one peculiarity with regard to this species; the scales invariably occur on the upper surface of the leaves. This is rather an unusual feature. The insect itself was not common enough to constitute a pest. It may possibly however at other times of the year be present in larger numbers and so prove a factor amongst the numerous insect pests indigo has to contend with. I have found it to be far commoner on Natal than on ordinary indigo. Considering that in the future the Natal plant will almost certainly be grown to a large extent owing to its superiority over the ordinary indigo the suppression of this pest may at some time have to be taken in hand. The scales themselves as a rule occur rather sparsely, two or three on each leaflet. I have however occasionally found them in fairly large numbers on single leaflets.

Egg. Size ·2 mm. × ·1 mm.

Colour yellowish brown. The egg is attached to the leaf in an upright position by a short peduncle or stalk.

Larva probably 2nd stage. Size 1·05 mm. × ·76 mm.

Shape elliptical; colour whitish-yellow, a few yellowish-brown marks along the centre of dorsum: dorsum covered with coarse granulations. Segments of body more or less distinct along dorsum. Margin of case broad, crenulated; there is no wax fringe. Dorsum flattish, sometimes slightly convex. Vasiform orifice conical, very much elongated, anterior edge concave, sides emarginate. Abdomen distinctly cleft from the vasiform orifice to the posterior margin, the edge of which is slightly incurved to meet the cleft; the vasiform orifice is over one-half the length of the cleft. Operculum attached anteriorly to vasiform orifice, sub-elliptical, broader than long, Lingula narrow, broadest at tip, narrowest a little above the middle. Tip conical, projecting beyond operculum about one-and-a-half times the length of the operculum. It is slightly shorter than the vasiform orifice within which it lies.

Larva. Last stage. Size 1·1 mm. × ·76 mm.

Shape elliptical. Dorsum almost transparent. Segments more or less distinct along dorsum. Insect itself more or less distinct beneath the dorsum. Colour of maturing insect orange to yellow, eyes maroon. Margin of dorsum broad and transparent, the rest of the body faint greenish-yellow. Vasiform orifice lemon-yellow the operculum slightly darker in shade. Lingula similar in colour. Vasiform orifice operculum and lingula as in preceding stage. No trace of setæ or hairs, either on dorsum or on margin of body. Margin extremely flat, the dorsum rises with a slight curve from margin.

Puparium. Size 1·15 mm. × ·84. mm.

Colour translucent, faintly tinged with yellow. Insect itself clearly discernable beneath the dorsum; colour yellow, eyes dark red. The rest as in larval stages.

Adult female. Length ·85 mm. Wing 1·05 mm. × ·35 mm.

Colour of body brownish-yellow; legs and antennæ yellow. Length of antennæ ·22 mm., seven jointed: joint one short, subpyriform: joint two stout, slightly longer than joint one: joint three two and a half times length of joint two: joint four short, less than one-third joint three in length: joints five and six equal, slightly shorter than joint two: joint seven long and tapering, half the length of joint three. Wings immaculate. Eyes reniform, undivided.

I have been unable to obtain specimens of the adult male.

I have much pleasure in naming this species after Mr. H. M. Leake, who assisted me in collecting specimens and was kind enough to mount examples for the microscope.

Aleurodes hoyæ n. sp. Plate V, Figs. 1–3.

This species is fairly common in and around Calcutta on Hoya sp. I have observed it in the years 1900, 1901, and 1902. Although it is comparatively easy to obtain larvæ and pupæ I had the greatest difficulty in rearing adults as nearly every one of the many hundred pupæ I have examined was parasited; the parasite, a minute hymenopteron (a chalcid) cutting a neat circular hole on the dorsal surface of the puparium when escaping. This species is I believe unique in having the wings of the adult of a uniform plum-blue colour. Owing to this peculiarity it has a remarkably moth-like appearance.

Egg. Size ·25 mm. × ·1 mm.

Light brown, curved, surface sculptured with lines forming irregular hexagons. Peduncle one-sixth length of egg.

Larva first stage. Size ·9 mm. × ·68 mm.

Shape elongate elliptical. Colour light yellowish-brown. At this stage the larva is somewhat dissimilar in appearance to more advanced larvæ, the larva being in some cases comparatively narrow and long. Dorsum flat and minutely granulated. There is a slight dorsal ridge.

Larva 2nd stage. Size 1·4 mm. × 1·2 mm.

Shape elliptical. Colour light-brown. Dorsum flat and granular. There is a delicate series of marginal wax tubes from which a small quantity of wax filaments extrude; filaments short. Vasiform orifice similar in shape to that in the third stage. Operculum darker in colour then the rest of the body. Caudal margin slightly incurved, with two wax tubes which are larger than those on the margin, situated one on each side of the curve. They produce two fairly long wax filaments.

Larva 3rd stage. Size 1·6 mm. × 1·4 mm.

Colour from light to dark-brown; centre of dorsum darkest, there being a wide band lighter than the centre along edge of dorsum. Shape elliptical, flattish. Broad medio dorsal ridge on which the abdominal and thoracic segments are clearly discernible. Dorsum granular in appearance. The centre of dorsum has small circular granulations, those on the outer edge being coarser and oval in shape. A series of minute closely apposed wax tubes along margin. There are sometimes traces of a waxy fringe. Vasiform orifice cordate; anterior margin flattish or slightly incurved. Operculum similar in shape and extending almost to the caudal extremity of the vasiform orifice. Edge of vasiform orifice tinged with brown as also the operculum.

Puparium. Size 1·62 mm. × 1·43 mm.

Colour black. Shape elliptical. Some specimens, however, are almost circular. The dorsum is granular and rounded. The medio-dorsal ridge so conspucuous in the larva is far less prominent though still discernible. Margin flat and extremely narrow. Vasiform orifice cordate, anterior margin flattish. Owing to the extremely dense black colour of the dorsum it is difficult to make out the details of the vasiform orifice even after boiling in caustic potash. It however appears to be similar to that in the larva.

Adult female. Size 1·85 mm. Wing 1·55 mm. × ·67 mm.

Body brown. Legs and antennæ yellowish-brown. Eyes reniform, dark red-brown in colour. Antennæ ·63 mm. Seven jointed. Joint one short subpyriform; joint two stout, one and a half times the length of joint one; joint three long, cylindrical, about twice the length of joint two; joint four short, slightly shorter than joint two; joints five, six, seven equal, each about half the length of joint three. Vasiform orifice obovate, operculum small; anterior and posterior margins flat, lateral margins curving outwards from anterior margin and incurving to meet posterior margin. Lingula V shaped, upper extremity broadest, narrowing in centre and broadening out slightly at tip. The tip itself is conical. It projects slightly beyond vasiform orifice; wing purplish-blue in colour, having a bloom on it like that seen on a plum. Edges of the wing reddish along margin. A series of closely apposed globular projections each bearing two delicate setæ.

I only succeeded in rearing three adult females. I have never obtained the male.

Chapter VI.

Description of Aleurodidæ previously described from the Indian Region.

Only a few species of this family have been described so far from India and Ceylon. For the sake of convenience I have thought it advisable to include the full descriptions.

The following species have so far been described.

Aleurodes eugeniæ Mask.

Aleurodes eugeniæ Mask. var. *aurantii* Mask.

Aleurodes barodensis Mask.

Aleurodes cotesii Mask.

Aleurodes piperis Mask.

Aleurodes nubilans Buckton.

Three other species in all have been described from the Oriental Region. *A. gossypii* Fitch, *A. lactea* Zehnt. and *A. longicornis* Zehnt. Their descriptions will be given in Part II.

Aleurodes eugeniæ Mask.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 430, Indian Museum Notes, Vol. IV, No. 2, p. 52.

Larva dull white or grey, or slightly yellowish; form roundly elliptical, the anterior edge very slightly compressed; dorsum scarcely convex; length about $\frac{1}{40}$ inch. Dorsum marked with very delicate radiating striæ. Margin without either fringe or hairs, and not at all thickened, but finely fluted and minutely crenulated. Three marginal depressions and radiating dorsal patches as described below in the pupa.

Pupa-case very pale yellow, or greyish; dorsum very slightly convex; form roundly elliptical or subcircular; length about one-twentieth in. as a rule, but reaching one-fifteenth in. The enclosed pupa is conspicuous dorsally, dark brown, the segments fairly distinct; on turning over the case the rudimentary feet may be made out rather confusedly, and the antennæ more faintly. Dorsum of the case marked with radiating striæ, more clear than those of the larva: these striæ are most conspicuous near the margin, which is not at all thickened, but marked with narrow but deep channels dividing it into broad segments. At three points in the margin there are small concave depressions, one on each side opposite the rostrum, and one at the abdominal extremity. Corresponding with these, on the dorsum, are three very faint radiating dotted patches: when viewed by transmitted light, these patches are seen to be formed of a lace-like pattern, with small, irregular cells, and at their extremity they end in a circular orifice deeply crenulated; the anterior pair extend from the rostrum to the margin, the posterior one from the vasiform orifice to the margin. Vasiform orifice with straight anterior edge, sides and end regularly convex; operculum nearly covering the orifice, and of similar form; lingula short, almost regularly cylindrical, scarcely extending beyond the operculum. There is no marginal fringe, nor are there any dorsal or marginal hairs.

Adult form unknown.

Hab. In India, on *Eugeniæ jambolana.* My specimens were sent by Dr. Alcock, Superintendent of the Indian Museum, Calcutta. From the great numbers on the leaves it would seem that the insect is injurious. They came from Poona.

A short description of this insect was sent by me to Dr. Alcock for insertion in "Indian Museum Notes;" but I have included it again here in order to note the distinctions which separate it, firstly, from *A. eugeniæ*, var. *aurantii*, next described, and secondly, from *A. citri* (Ashmead), Riley and Howard, *Insect Life*, 1893, p. 219. As to the first my descriptions and figures will suffice. From *A. citri* the species differs in the entire absence of marginal and dorsal hairs in the larva and in the three radiating lace-work patches, of which no mention is made by Riley and Howard, but which are conspicuous characters of *A. eugeniæ*.

This insect and its variety, with *A. citri*, *A. melicyti*, and others, may be placed in a series of which *A. proletella*, Linn., may be taken as the type.

Aleurodes eugeniæ, Maskell, var. *Aurantii*, Maskell.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 431, Ind. Mus. Notes, Vol. IV, No. III, p. 144. Larva very pale-yellow, sometimes almost white; form roundly elliptical, flattish; length about one-fortieth in. Dorsum striated, but the striations are very faint, except near the margin. Margin not at all thickened, finely fluted and crenulated, bearing no hairs or fringe. There are three small marginal depressions and three dorsal patches as in the pupa.

Pupa-case very pale yellow, roundly elliptical or subcircular, flattish and thin; length about one-twenty-fourth in., reaching sometimes as much as one-sixteenth in. The enclosed pupa is only faintly discernible dorsally, rather darker than the case, the abdominal segments moderately distinct; on turning over the case the rudimentary organs are less confused than in *A. eugeniæ*. Dorsum of the case very finely marked with radiating striæ, which are a little more conspicuous near the margin. Margin not thickened, almost entire, divided by deep narrow channels into segments narrower than those of *A. eugeniæ*. There are three marginal depressions, two opposite the rostrum and one at the abdominal extremity, and three radiating patches terminating at these depressions; the patches end (as in the type) in crenulated circular orifices, but are composed of great numbers of very minute circular pores or dots, which do not form a lace-work pattern. Vasiform orifice subtrapezoidal or subelliptical, broader than long; operculum nearly fitting the orifice; lingula very short, cylindrical with a dilated end, sometimes obsolete.

Adult form unknown.

Hab. In India, on *Citrus aurantium.* Mr. Cotes, late of the Indian Museum, Calcutta, sent me some orange leaves from "North-West Himalayas," thickly covered with this insect.

I attach this as a variety to *A. eugeniæ* on account of the similarity in several respects, notably in the dorsal radiating patches, though it differs in some others. It has none of the marginal or dorsal characters of *A. citri*, Riley and Howard.

Aleurodes barodensis, Maskell.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 424, Ind. Mus. Notes, Vol. IV, No. III, p. 143. Eggs orange coloured, rather large, oval, pedunculated, length about one-one-sixtieth in. The eggs and empty shells are found in large numbers on the leaf.

Larva dark-brown, becoming later almost black; elongated elliptical; slightly convex; abdominal segments fairly distinct, length about one-forty-fifth in. Margin minutely crenulated and bearing a short white waxy fringe, which is frequently very fragmentary or absent. Dorsum bearing, within the margin, a row of about thirty-two small simple circular pores; within these is a transverse row of four on the anterior thoracic region, another transverse row of four on the anterior abdominal region, a longitudinal row of four on each side of the abdomen, and one on each side of the vasiform orifice. Vasiform orifice subconical, the posterior extremity slightly produced; operculum short, rounded, subconical; lingula cylindrical at the base, afterwards widened, finally tapering, not quite reaching the edge of the orifice.

Pupa-case very dark-brown or glossy-black; very elongated, elliptical, with sides nearly straight, the width only about one-third of the length. Dorsum sometimes slightly convex, sometimes flat, sometimes slightly concave; abdominal segments indistinct. Vasiform orifice apparently as in the larva, but difficult to make out on account of the very dark colour of the case. Margin crenulated and bearing a very elegant, long, snowy-white fringe of slender waxy cylindrical tubes. There is frequently some white powdery meal on the dorsum, which probably bears pores as in the larva, but it is most difficult to detect them. The ventral surface is flat, brown; the rudimentary organs are not distinct, owing to the dark colour.

Adult form unknown.

Hab. In India, on *Saccharum officinale.* My specimens were sent by Mr. Cotes, late of the Indian Museum, Calcutta, from Baroda. He informed me they were rather damaging to the sugarcane in those parts.

The very elongated form is distinctive, besides the black colour.

Aleurodes cotesii, Maskell.

Transt., N.Z. Inst, Vol. XXVIII, 1895, p. 427, Ind. Mus. Notes, Vol. IV, No. III, p. 145.

Larva yellow, the median region darker than the margin; form elliptical; length about one-fortieth in. In the earliest state only very faint indications of the insect itself appear, and the whole is very thin and flat; later on the enclosed future pupa begins to be visible, and the ventral surface becomes more convex; the eyes also appear. The larval integument becomes too small for the growing insect, and splits longitudinally; and in the early pupal state it may be seen attached along the dorsal edges of the pupa-case. Margins somewhat thickened, the adjacent tubes forming minute crenulations, and within it the dorsum bears numbers of very small circular pores; from these and from the marginal tubes is produced a quantity of white waxy matter, some of which covers the dorsum in scattered patches, and the rest spreads round the larva in a very long fringe of delicate threads, frequently much longer than the insect itself! This waxy matter is very brittle, and, as a rule, the whole surface of a leaf is powdered over with the fragments, making the leaf look as if mildewed.

The pupa-case, in the earliest stage, scarcely distinguishable from the late larva; afterwards as the insect grows, it becomes much thicker. The form remains elliptical; the length reaches about one-thirtieth in. The dorsal disk is slightly convex, flattened towards the margin; it is larger than the ventral disk, and slightly overlaps the sides, which are vertical. The hollow thus formed is covered by a ring of thin white wax, and there is also a plate of wax beneath the ventral surface; portions of this ring and of the plate are frequently seen amongst the long threads of the larva. The pupal margin is crenulated, but bears no fringe, and the dorsum has no pores or wax. The outline of the enclosed pupa may be made out indistinctly on the dorsum, and the rudimentary organs ventrally on turning over the case. Vasiform orifice subconical, with regularly convex sides, the anterior edge concave; operculum subelliptical; lingula very short, not extending beyond the operculum.

Adult form unknown.

Hab. In India, on *Rosa.* My specimens were sent by Mr. Cotes, late of the Indian Museum Calcutta. They came from Quetta, Baluchistan. I have named the species after him.

The overlapping of the sides by the dorsal disk of *A. cotesii* is found also in a New Zealand species, *A. fagi*, Maskell, 1889; but that insect has no fringe, the margin bears twenty-four hairs.

Aleurodes piperis, Maskell.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 438.

Eggs dark-yellow, elongate-elliptical, transversely striated; length about one-one hundred and forty-fifth in.

Larva very dark-brown or black, very slightly convex, elliptical; length about one-fortieth in. Dorsum bearing long, very black spines of which four are on the cephalic, eight on the thoracic, and ten on the abdominal regions. Margin not thickened, but very distinctly crenulated There seems to be no fringe.

Pupa-case intense glossy black, slightly convex, with a median longitudinal ridge; abdominal segments indistinct. Form elliptical; length about one-twenty-fifth in. Dorsum bearing many long black spines, of which one series of from twenty to twenty-four are submarginal, the others scattered (seemingly about twenty, but very difficult to make out on account of the intense black colour); two of the spines, at the posterior extremity, are longer than the others. Margin with very small crenulations; there is a very short fringe of white wax, which in many specimens is not noticeable. Vasiform orifice broadly rhomboidal with rounded angles, anterior edge slightly concave; operculum semi-elliptical, covering about half the orifice; lingula short, roundly clavate. The larval exuviæ are commonly seen attached by the dorsal spines to the pupa-case.

The pupa extracted from its case is reddish-yellow, the rudimentary feet and antennæ yellow, the rudimentary wings yellow with bands of dark brown, the eyes dark-brown.

Adult form with the thorax red, banded with brown; the abdomen red; genitalia brown; feet and antennæ darkish-yellow, tipped with brown. The antennæ and feet are normal. Forewings with three bands of dark-brown, of which the outer one does not quite reach the margin at the extremity. The genitalia do not exhibit any special features.

Hab. In Ceylon, on (*Piper nigrum ?*). My specimens were sent by Mr. E. E. Green, from Punduloya.

I know of no described species in which the larva and pupa have such strong black spines as this. The wings of the adult are not particularly distinctive, for those of *A. sacchari*, Mask., 1889, have quite similar bands. I have found it extremely difficult to correctly distinguish the dorsal spines on the pupa; and the vasiform orifice also presents much difficulty.

Aleurodes nubilans, Buckton.

Indian Museum Notes, Vol. V, No. 2, p. 36.

Legs long and hairy with dimerous tarsi. Antennæ rather long and with seven (?) joints in the female, which is a larger insect than the male. Wings four, rounded at the apices, and fringed with minute hairs. A single unforked central nervure, not continued to the margin. Membrane smoky in patches with a darker blurred spot. The male smaller with a large thorax, taper abdomen, and furcate at the apex and with hinder legs longest.

The larvæ crowd the undersides of the leaves of the betel in the form of small scales very difficult to detach. They appear like scales of some Coccidæ, but these show no distinct organs such as antennæ, legs, or eyes. Their outer surfaces were more or less spined, and some larvæ were tufted with woolly matter, each thread being formed of a continuous spiracle.

This new Aleurodid was received on betel leaves from the Manager, Court of Wards Estates, Backergunge, who reported that it was doing considerable damage to the plants.

N.B.—This Aleurodid was received and identified before I joined the Entomological Section of the Museum. It is to be regretted that no description was drawn up of the larvæ or pupæ. The types in the Museum are too badly damaged for description. I hope hereafter to describe the earlier stages.

Explanation of Plate II.

All figures much enlarged.

Aleurodes alcocki.

Fig. 1. Larva 1st stage.
2. Leg of larva 1st stage.
3. Antenna of larva 1st stage.
4. Larva 2nd stage.
5. Pupa-case.
6. Vasiform orifice of pupa-case.
7. Margin of pupa-case.
8. Incurved thoracic margin of pupa-case.
9. Wing of adult female.

Aleurodes bengalensis.

Fig. 10. Vasiform orifice of larva 1st stage.
11. Vasiform orifice of larva 2nd stage.
12. Pupa-case.
13. Vasiform orifice of pupa-case.
14. Antenna of adult female.
15. Vasiform orifice of adult female.
16. " " " " "

Explanation of Plate III.

All figures much enlarged.

Aleurodes simula.

Fig. 1. Egg as seen within the body of the female.
2. Peduncle of egg.
3. Larva 1st stage.
4. Antenna of larva 1st stage.
5. Pupa-case.
6. Vasiform orifice of pupa-case.
7. Outcurved thoracic margin of pupa-case showing pores forming termination of thoracic radial bands.
8. Margin of pupa-case showing the circular pores on dorsum.
9. Pupa extracted from pupa-case.
10. Genital organs of male.
11. Wing of female.
12. Vasiform orifice of female.
13. Antenna of male.
14. " " female.

Explanation of Plate IV.

All figures much enlarged, except fig. 1, which is natural size.

Aleurodes bambusæ.

Fig. 1. Insects *in situ* on plant.
2. Larva 1st stage.
3. Ventral pores near margin of do.
4. Larva 2nd stage.
5. Larva 4th stage.
6. Margin of case of do.
7. Puparium.
8. Margin of case of do.
9. Vasiform orifice of do.

Explanation of Plate V.

All figures much enlarged.

Aleurodes hoyæ.

Fig. 1. Puparium.
2. Vasiform orifice of do.
3. Wing of adult female.

Aleurodes leakii.

Fig. 4. Puparium.
5. Vasiform orifice of do.

Aleurodes religiosa.

Fig. 6. Larva 1st stage.
7. Vasiform orifice of do.
8. Puparium.
9. Vasiform orifice of do.

Aleurodes quaintancei.

Fig 10. Puparium.
11. Parasited puparium.
12. Vasiform orifice of puparium.
13. Wing of adult female.
14. Antenna of do.

Explanation of Plate VI.

All figures much enlarged.

Fig. 1. Adult female.
2. Antennæ of do.
3. Edge of forewing of do.
4. Typical forewing of Aleurodes.

Fig. 5. Typical forewing of Aleurodicus.
6. Leg of adult.
7. Leg showing three claws on tarsus.
8. Male genital organs and vasiform orifice, dorsal view.
9. Side view of vasiform orifice of male.
10. Female genital organs, ventral view.
11. Head of adult, side view.
12. ,, ,, ,, front view.
13. Egg.
14. Typical vasiform orifice.

Silajit: an ancient Eastern Medicine.—By David Hooper, F.C.S.

[Received 29th April 1903. Read May 6th 1903.]

One of the most peculiar medicinal substances of the East is that called Silajit or Shilajatu. It is known by the former name in Hindi and Persian, and by the latter in Bengali and Sanskrit. The meaning of the term is derived from *Sila*=a stone, and *jatu*=produce or essence. It may therefore be regarded as a substance born of the rock, essence of stone, or, more literally, "rock sweat."

The localities in which this article is reported to be found are confined to Northern India. It is obtained from the lower, central and upper ranges of the Himalayas and the Vindhyan hills, and is procurable in Simla, Mussoorie, and Katmandu. In Vadarikasvan, near Hardwar, a sacred retreat at the foot of the Himalayas, it is fairly abundant. It is brought down by Bhuteas and other hill tribes, and sold with such commodities as brick tea, incense, gums and precious stones.

The occurrence and formation of silajit is at present somewhat obscure. It appears as an exudation upon rocks, and, according to report, is contained in the substance of the rock. Silajit is collected during the hot weather in May and June, the heat of the sun is said to be necessary in drawing out the extract from the rocks. In Sanskrit works it is stated that silajatu imbibes the therapeutic properties of the metals with which it remains associated. The black variety, which is the most commonly available, is said to possess the properties of iron, and the white variety is said to exert the peculiar action of silver. The manner in which this exudation occurs, and the kinds of rocks which afford it, are matters requiring investigation. The collection is in the hands of shepherds and nomadic tribes, who can, of course, furnish no intelligent account of its nature, or explain its origin with any degree of satisfaction.

Before describing what is at present recognised as medicinal silajit, it will be convenient to allude to the varieties of substances under this name which have been mentioned in Indian works or met with in the bazars.

In the first place, there is a kind of silajit which is of a mineral nature, and is a more or less pure native aluminium sulphate. This was described in 1833, by Mr. J. Stevenson, Superintendent of the Behar Saltpetre Factory (*Jour. As. Soc. Beng.* II. 321). It was found in Nepal, and was widely used as a medicine to cure green wounds and bruises. It occurred in small brownish-white lumps with a semi-crystalline structure internally. It consisted of 95 per cent. of aluminium sulphate with 3 per cent. of iron. It sold for the high price of two rupees for a rupee weight. In the same year Dr. A. Campbell, in a letter to the Asiatic Society, (*Jour. As. Soc. Beng.* II. 482) confirmed the existence and use of the alum earth, and stated that the average qualities contained only 66 per cent. of aluminium sulphate. The price of the product at Katmandu was from Rs. 11 to Rs. 15 a maund, but sold as a drug in the bazar, its price was purely fanciful. The rocks, it was suggested, might be lixiviated and be made to yield a larger supply, but it is very improbable that it could be obtained in sufficient quantities to be of commercial importance.

Mineral silajit was again referred to in 1846, by Capt. Sherwell in his account of Behar (*Journ. As. Soc. Beng.* XV. 58). This officer reported that a small quantity of alum was manufactured from shales in the Shahabad District; these rocks probably belonged to the pyritous shales of the Kaimur group of the Vindhyan series. The alum was sold at the high price of one rupee a tola. It was identical with the silajit of Nepal and was much esteemed as a drug.

That the mineral silajit does not all come from Nepal is confirmed by Dr. Hamilton in his account of Nepal, where he says: "I have collected Salajit in Behar with my own hands."

In the "Economic Geology of India," it is recorded that alum exudations or *silajit* are sometimes collected by the natives of Assam.

More recent geological investigations in India have not brought to light any fresh information regarding this aluminous mineral under the name of silajit, and although fresh deposits have been discovered, such as those in Baluchistan where it is called "*Phul-Mak*," they have not been regarded as medicinal.

The second variety of this substance, called Black Silajit, is quite a different article to that just described. It is sold in the bazars of Calcutta, in Dehra Dun and Hardwar. The Kabirājis are aware of the distinction between the two products, and hold out a warning that the Nepal alum earth is not the silajit of Sanskrit writers; they state that the former is an article of Yunāni medicine, while the latter, or black kind, is only suitable for Hindu practitioners.

Dr. Campbell appears to be the first to discriminate between the two drugs. He says (*Jour. As. Soc. Beng.* II. 483): "There is a dark bituminous substance used in Nepal, said to exude from rocks, and is called "Black Salajit." It resembles bituminous alum ore, but there is much vegetable matter in it, and it is probably a vegetable production, notwithstanding the belief by the Nepal physicians of its mineral nature."

Black silajit is sold in the form of brown or black cakes, tough or pasty in consistence, and having an odour of rancidity which has been stated in Sanskrit works to resemble that of cow's urine. The usual odour is that of leather. Its taste is bitter, saline, pungent and astringent. The partially purified specimens of this black substance, as brought down by the Bhuteas, are in the form of rounded flattened cakes about 2½ inches in diameter and half an inch thick, or in sticks resembling liquorice juice. Silajat is hygroscopic, and when exposed to a damp atmosphere becomes unctuous and sticky. In a dry state it is quite hard, and breaks with a shining black fracture, and in course of time some samples assume a brownish crystalline efflorescence on the surface.

Black silajit is soluble for the most part in distilled water, yielding a dark reddish-brown extract with an alkaline reaction. Ether, alcohol and other volatile liquids have little or no solvent action upon it. In one case ether extracted a small amount of a fatty compound having an odour of Russian leather. The aqueous solution is precipitated by mineral acids, plumbic acetate and ferric chloride, but not by acetic acid or alkalis. The aqueous solution is not precipitated by four volumes of alcohol. The organic matter is of the nature of an organic acid, and, in the specimens I examined, not one was of a bituminous nature.

There is a large quantity of mineral matter or ash left on incinerating the samples, and as this consists mainly of carbonated alkalis, it is indicative of the presence of one or more organic acids combined with bases in the orignal extract. In Dr. U. C. Dutt's "Materia Medica of the Hindus," p. 95, it is stated that the ashes left after burning silajatu on platinum foil, consist chiefly of lime, magnesia, silica, and iron in a mixed state of proto- and per oxide." It is said by the native doctors that the mineral constituents are regarded as impurities, and that the active principle is a cream-like body which rises to the surface of the liquid when the solid silajit is dissolved in hot water. The solution is placed in the sun until it thickens, the surface is removed, and this *sut-silajit* is allowed to dry.

That there is no uniform combination between the organic and mineral constituents is shown in the analysis of two specimens of black silajit supplied by two Kabirajis of Calcutta.

	No. 1.	No. 2.
Water	7·95	9·34
Organic matter	35·05	55·36
Mineral matter	57·00	35·30
	100·00	100·00
Ash soluble in water	10·90	24·4
soluble in acid	15·55	9·4
insoluble	30·55	1·5

A more complete examination was made last year of four additional samples: No. 1, round cakes from Calcutta; No. 2, long flattened cakes from Calcutta; No. 3, from Jaunsar, through the Director Imperial Forest School, Dehra Dun; No. 4 from Bashahr Forest, Punjab, through the Curator, Imperial Forest Museum.

	1	2	3	4
Water	9·85	15·90	11·15	10·99
*Organic matter	56·20	49·86	51·55	56·86
†Ash	34·95	34·24	37·30	32·15
	100·00	100·00	100·00	100·00
*Including nitrogen	1·03	·82	3·25	1·26
†Containing				
Iron and alumina	2·24	1·08	6·00	4·64
Lime	4·36	3·96	3·86	3·88
Magnesia	1·50	·52	·15	1·34
Potash	9·07	6·69	3·71	6·10
Soda	4·11	7·63	1·07	·81
Phosphoric acid	·16	·25	·27	·20
Sulphuric acid	·58	·24	·34	·14
Chlorine	·07	·12	·11	·06
Carbonic acid, &c.	11·51	12·13	3·69	4·83
Silica	1·35	1·62	18·10	10·15

The chief ingredients of the ash are the bases lime, magnesia, potash and soda, combined as carbonates. The absence of a large iron and alumina precipitate indicates the non-identity of this substance with the mineral silajit of Nepal and Behar.

The bulk of the organic material consists of an acid which is related to humic acid, a principle which by the way is not usually administered by the general practitioner. When the aqueous solution is precipitated by hydrochloric acid, and the precipitate washed and pressed, it readily dissolves in warm alcohol. The lead salt of the organic acid separated from the filtered solution, washed and dried, afforded 54·91 per cent. of lead oxide. Heated in a dry test tube, the silajit evolved white alkaline fumes with a strong empyreumatic odour.

The crystals formed on the surface of cakes of black silajit are those of potassium and sodium carbonate.

There are a few points of resemblance between this article and the minerals belonging to the oxydised hydro-carbons. *Dopplerite*, for instance, (*Ber. Akad. Wien.* 2.287, 1899; 52.281, 1865) is an acid substance or mixture of different acids related to humic acid. It is insoluble in alcohol and ether. The ash ranges from 3 to 14 per cent. It is found in peaty beds, and shows the transition from peat to coal.

It will be necessary in a few words to refer to the third kind or white variety of silajit. Alum earth is sometimes supplied for this substance, but only as a fraudulent substitute. The original white silajatu is said to be obtained from crevices of rocks in the vicinity of Mount Abu, and this variety is used largely in Rajputana. A sample of white silajatu from Jeypur was shown to me two years ago. It was a cream-coloured crystalline compound with a strong nauseous odour. It was apparently of animal origin, and evolved gaseous ammonia when mixed with slaked lime. It yielded 64 per cent. of pure urea when determined from the amount of nitrogen given off by means of hypobromate of sodium. It was, therefore, crude urea or inspissated urine in a solid state. A reference to *Taleef Shereef or Indian Materia Medica*, edited in 1833 by Dr. George Playfair, throws some light upon this source of the drug. Art. 577. "*Silajeet* is the urine of the wild hill-goat, which, when the animal is rutting, is discharged on the stones and evaporated by the sun's heat. It is found in small quantities. Some have said it is the urine of the wild ass, found as above."

In the *Makhzhan-ul-adwiyah*, a Persian work on Materia Medica of great antiquity, it is said that silajit is generally found among the haunts of monkeys, and that the drug is the alvine discharge of a certain species with a black face and long tail. It distinguishes between the *salajit-i-asli*, a black gummy inodourous substance, and *salajit-i-nagli*, the evacuated substance with a nauseous odour and hard consistence. The medicinal virtues of silajit are set forth in the *Makhzan-ul-adwiyah*. *Charaka*, *Susruta*, *Bhabaprokasha*, and Bagbhata's *Rasartna samuchchaya*.

It has heating properties, and is used in piles, leprosy, pleurisy, worms, asthma, gonorrhœa, and it is a specific for debility and for kidney and bladder diseases. Dr. Hem Chandra Sen, in a recent paper on "Shilajatu" in the *Indian Medical Record*, for 14th and 21st May, 1902, recommends it as digestive and laxative, suitable for dyspepsia, diabetes, diseases of the liver and spleen, to regulate the action of the heart, and as a good respiratory stimulant and expectorant. And finally, it is said to be a sheet anchor in diseases of the genito-urinary organs and of the nervous system. The *Taleef Shereef* says: "It is one of the most powerful remedies, and is stronger than any other ingredient in whatever formulæ it may form a part. It is the favourite medicine of all Hindu physicians." The author of *Charaka* says that there is no curable disease which will not yield to shilajatu in judicious combination with other drugs.

The medicinal uses of silajit are hence most varied, and it is difficult to realise what active therapeutic principles can affect this long list of ailments. Before European physicians can prescribe white, black, or brown silajit for any disorder, we must ascertain more exactly the nature of the chief ingredient, and be able to procure a regular supply of a uniformly prepared medicine. It is open to reason that no drug will become popular if no guarantee be given as to whether it belongs to the animal, vegetable or mineral kingdom.

Silajit is allied to another ancient drug named *momiyia* which has long been employed in the East. The original drug is said to have been made from Egyptian mummies, and subsequently to have been prepared by boiling down and extracting the essence of Abyssinian boys. Since the last source of supply has become scarce, several bituminous exudations are reported to have been substituted. There is little doubt that some forms of silajit may be entered in this category.

In conclusion, it will be necessary to alter the definition of this substance given in Indian glossaries. In a geological work it is called "Alum," and in more than one medical work it is termed "Bitumen;" but, from the evidence collated in the above notes, it is also an extractive matter containing an organic acid combined with alkalis, and almost completely soluble in water.

A note on the discovery of Thanasimus sp.[1] *prox.* nigricollis *in the N.-W. Himalayas with some remarks on its life-history.—By* E. P. STEBBING.

[Received May 27th, 1903—Read June 3rd, 1903.]

In June 1902, whilst touring in the Tehri Garhwal forests in the N.-W. Himalayas, the writer discovered and took a number of specimens of both larvæ and beetle of a species of *Thanasimus* prox. *nigricollis* Lewis, a beetle belonging to the family *Cleridæ.* The insect was submitted to the well-known specialist, the Rev. H. S. Gorham, who has reported that, with the exception of a few minute differences which will require comparison with the types to settle, the insect is identical with G. Lewis' *T. nigricollis*, taken by the latter in Japan and described in the Ann. Soc. Nat. Hist., Vol. X (1892), p. 187. It is owing partly to these minute differences to its greater size and perhaps to a certain extent to the fact that there appears to be a curious close relationship between the insects found in parts of Japan and some of those of the N.-W. Himalayas, that I at present put the species as prox. *nigricollis.* In the case of another predaceous insect a *Niponius* (the first species of which genus were found by Lewis in Japan) the N.-W. Himalayan one has proved to be a different species to Lewis' Japanese ones.

I think it may be shown that the discovery of this Thanasimus is one of very considerable importance, since it is predaceous upon several bark and wood boring *Scolytidæ* which have been recently discovered to commit serious damage in the coniferous forests of the N.-W. Himalayan area. My observations tend to prove that it takes the place in this region of the well-known *Thanasimus formicarius* of the European coniferous forests. This latter clerid preys upon (to mention but two) the larvæ and adults of *Myelophilus piniperda* and *M. minor* which are amongst the principal scolytid enemies of the European pine forests, and is in consequence very rightly looked upon as an insect ally of the greatest value to the forester in those regions. So great, in fact, is the value attached to its predaceous habits that it was imported into some of the coniferous forests of North America in 1892. The initiation of this experiment, the first of its kind to be undertaken on a larger scale (in forest areas), came about in the following manner:—Between 1900 and 1902 the pine trees in portions of Hampshire, Hardy, Grant, Pendleton, and Mineral counties, West Virginia; Bath, Highland, Augusta, and Rockingham counties, Virginia and also in portions of Maryville, died off in large numbers, the destruction being widespread and in some places universal. This wholesale mortality was soon traced to its origin, as countless numbers of small bark-beetles were found

[1] *Clerus* sp. Steb. Dept. Notes Ins. aff. For. No. 2, p. 213 (1903).

breeding in the bark of the trees, the depredator being *Dendroctonus frontalis.* So greatly had the insect increased that healthy trees were attacked equally with sickly ones. Dr. D. A. Hopkins, Entomologist to the West Virginia Agricultural Experiment station, made several tours of examination of the infected areas, and his observations showing him that there were no predaceous or parasitic insects of sufficient importance in the forests to cope with the attack, he suggested the importation of some European ones. A study of the question narrowed this suggestion down to the experimental introduction of *T. formicarius*, and with assistance of some of the great Lumber Companies, who were being seriously affected by the widespread deaths of the trees in large areas of forest owned by them, funds were made available to enable Dr. Hopkins to visit some of the European coniferous forests with a view to the collection of the clerid and its importation to the other side of the Atlantic. This experiment was conducted to a satisfactory conclusion. I think the above short note will prove that the discovery of the presence of a similar insect in the great and important coniferous forests of North Western India is not without a considerable economic as well as scientific value.

I give the following descriptions of the adult and larva :—

Beetle. Elongate stout and robust. Head and antennæ black. Antennæ 11 jointed with joints slightly increasing in width upwards, the last three forming a small club, the last joint of which is largest. Prothorax black and hirsute dorsally. Elytra under the prothorax broad, and rounded at their apices; red on the basal quarter of their length, then black, the black being twice crossed by white wavy bands, the first a narrow one just above the juncture of the black with the red colour, this band being reflexed backwards towards the apex and not upwards as in *formicarius* and in other species, and the other a broad one placed about $\frac{3}{4}$ of their length up from the base. There is also a small white patch at the extreme apex. Legs black. Abdomen a bright vermilion red, its segments very mobile. Body somewhat short, flattened, pubescent. Long ♂ 7·5–9 millim. ♂ 9–11 millim.

I would suggest, with Mr. Gorham's permission, that the species, should it prove new (at this distance from the types I am unable to speak with any certainty upon this point) should be named *himalayensis* since it would be useful to mark the locality where so important an insect to foresters was discovered.

Larva. General colour a bright pink. Head brown, flat, mandibles black. A brown dorsal patch on 1st thoracic segment and pair of brown spots situated dorsally on each of the two succeeding segments. These thoracic segments a paler pink than the following abdominal ones. Latter nine in number, bright pink to reddish pink except last which is narrower and brown posteriorly and terminates in two small black processes. The larvæ tapers anteriorly and has three pairs of legs on the thoracic segments and no others. It is slightly lighter in colour beneath. Long. 15-18 millim. (varies). A single specimen of the beetle was first taken on the 16th June at Kathian, in the Jaunsar Hills, but it was not until the 24th of the month that the insect was secured in any numbers; this was in the forests round Pajidhar in Tehri Garhwal. Some deodar fellings were being carried out in these forests, and trees, cut at the end of April and still lying unbarked upon the ground, were found to be full of the larvæ and adults of two recently discovered bark-boring Scolytidæ, *Scotylus major* and *S. minor*, Steb. MS. The *Thanasimus* was discovered in some abundance, flying about over the trees or running about on the bark, whilst in the beetle and larval galleries beneath the latter its pink-coloured larvæ were numerous.

Before describing the life-history of the clerid, it will perhaps be advisable to describe the state of affairs at Pajidhar. It has been mentioned that deodar fellings had commenced towards the end of April, and were still being carried on at the time of the writer's visit. The trees cut were not barked, or in any way touched, until converted into timber—chiefly sleepers. They therefore lay several months in the forest. The scolytid beetles above referred to commence laying the eggs of the first generation of the year towards the end of April or beginning of May. For this purpose they require the fresh bast layer of the deodar, preferring sickly trees and, more especially, newly felled ones in which the upward flow of sap has ceased. Failing such they will attack young, green, healthy trees. At Pajidhar the fellings had commenced at a most opportune time for the bark-borers and large numbers of females were attracted to the newly felled trees and at once burrowed into them and oviposited. Towards the end of June the larvæ from these eggs were full grown, and in many cases had changed to the pupal state. The larvæ were being attacked by the predaceous clerid grubs. A curious point about the life-history of these scolytid beetles, is that the female does not die as soon as she has finished laying her eggs, but remains in the long egg-gallery she bores in the bast layer and sap wood parallel to the long axis of the tree, or in the entrance gallery in the bark, and lives here until the larvæ are full grown, at times going up to the outside. When she finally dies she does so near the entrance hole, thus effectually blocking it up and preventing predaceous enemies from entering and feeding upon the pupæ at the end of the larval burrows. It would appear probable that this prolongation of life after oviposition is in some way connected with the protection of the young larvæ. It was upon these female scolytid beetles that the adult clerid was feeding.

Life History. It is possible that the *Thanasimus* is to be found on the wing more or less continuously from spring to the end of autumn in the localities which it affects. The eggs have not yet been discovered, but they are probably laid on the bark of the trees near or in the entrance holes of the bark beetles, and the young larvæ, or hatching out, make their way down these tunnels into the egg galleries in the bast and sap wood and from thence into the larval galleries. My observations up to the present have shown that larvæ of all sizes are generally to be found in these situations between May and October. The length of time spent in the larval stage is at present unknown, but it is unlikely to be more than a month in the case of the summer generations. On becoming full grown the grubs go into the thick outer bark of the tree to pupate. This is to facilitate the beetle when mature leaving the tree. The adult never enters the tree. It is a brightly-coloured, very active insect, running and flying well even in hot sunshine, and it spends its life flying round or running about on the bark of the trees. Its food consisting of bark and wood boring *Scolytidæ*, it searches for these on the bark, since it is much too bulky to enter their tunnels, and seizes them whilst they are engaged in either boring into or tunneling their way out of the tree. In the case of the *Scolytus major* and *minor* beetles, upon which it was preying when discovered, it would appear that they form its food for some weeks or months during the year, since they remain alive after egg-laying and until the larvæ are full grown. The mother beetles spend their time walking up or down the egg-gallery, or going up the entrance hole to the outside and the Thanasimus watches at the mouth of these holes and seizes and devours the beetles when they appear at the mouth of the tunnel. They only feed upon living beetles, and will not touch dead ones, and they catch their prey by sight only and not by scent: unless the bark beetle is right in front of them they will pass it by unnoticed. I was able to definitely ascertain this point by a number of experiments. Beetles kept for twenty-four hours without food passed close to their prey without noticing it although they were in a ravenous condition. It would appear that they only see directly in front, and this is borne out by the position of the eyes which are placed rather forwardly upon the head. When, however, the scolytid comes within their range of vision they pounce upon it, just as a tiger does, with one rush and if out of its hole the bark beetle has not the remotest chance of escape. I have not been able as yet to observe whether they ever take their prey upon the wing. The clerid seizes the bark-borer with its anterior legs and mandibles, picks it up off the ground, turns it round so as have the ventral surface facing it with the head uppermost, sits well back on its hind legs and commences to feed upon its prey, whose struggles are quite ineffectual in that deadly grip. In commencing to devour the scolytid it invariably begins with the head; it fastens its mandibles round the junction of the head and prothorax, following the parallel of the tiger, and chews and sucks at the head until it has finished this completely. It next goes to work on the prothorax, piercing with ease through the hard chitinous shell with its powerful mandibles and breaking it to pieces, the contents being entirely cleaned out and consumed, for the beetle is a neat feeder, and entirely clears the meat off the chitinous bone before rejecting it. Having finished the prothorax, it throws away the mangled shell and turns its attention to the body consisting of the meso- and meta-thorax and abdomen. In a bark beetle this is often in the shape of a blunt elliptical cylinder with a flattish top where it joins the prothorax. The beetle holds this between its front legs, the meso-thoracic end upwards, and proceeds to first pull off the elytra which are rejected: the under wings being consequently released open out to their full extent but remain attached to the trunk. The clerid then entirely cleans out this bottle-shaped cylinder, as neatly as one could clean out a jar with a spoon. When quite empty, it is thrown away and the insect starts off in search of another bark-beetle. A mangled prothoracic shell and the empty chitinous body cylinder with the outspread lower wings attached to it are all that are left of a *S. major* beetle six minutes from the moment it was captured alive. I have seen three such eaten consecutively, and of 20 beetles put in with four clerids only the above mentioned portions remained when the box was inspected $3\frac{1}{2}$ hours afterwards. As has been already mentioned the resemblance between this insect and the tiger in its methods of rushing upon, seizing, and commencing to feed upon its prey is remarkable, the difference being that the insect is more cruel than the mammal since it makes no pretence of killing the bark-beetle, but commences on it whilst it is alive and kicking, often bringing forward its middle pair of legs to assist in holding its struggling prey. As an instance of its tenacity and rapacity I may quote the following. In common with most insects the clerid dislikes being upon its back and when so placed makes violent efforts to right itself. A beetle had been placed in a tube with two Platypus (Platypodæ) beetles. It at once seized one and, though shaken violently about, clung to its victim and, falling on its back and finding it impossible to right itself at once, gave up the attempt and consumed its prey in this position, before restarting its struggles to resume the normal position. It then made an effort to seize the second *Diapus* but was removed as the writer wished to preserve the latter. The insect is polygamous. A ♂ kept in a box with three ♀ and fed with bark borers for four days, paired with one or other of the three whenever it was not feeding or searching for its prey. In pairing the ♂ rushes at the ♀ from behind with the same impetuosity with which it pounces upon its prey, mounts on her back and thrusts the tip of his very flexible abdomen downwards, curling it round till it reaches the tip of the abdomen of the ♀. The latter is at times larger than the ♂ though it may be of the same size. She walks about carrying the male whilst pairing lasts. I have not yet ascertained how long the beetles spend in the adult stage of their life-history. It is evidently several days and may extend to a week or two. We have seen that larvæ of all sizes (and consequently probably ages) are to be found in the scolytid larval tunnels during the spring and summer months (they have been so found in May, June, July, August, and September) and therefore with the long life of the beetle it is probable that the generations overlap, this meaning a continuous supply of larvæ and beetles throughout the spring, summer, and autumn. It will be shown later on how excessively important this fact is.

To sum up my observations on the habits of the ♂, I may say that when not eating or searching for bark-beetles it is pairing or *vice versâ* and the ♀, at any rate up to the time she commences egg-laying, appears to be an equally large and voracious feeder. Since the insect is fully twice as large as its European confrère, being from 8 to 10 millim. and more in length, whilst the bark-beetles are much of the same size as the European ones, from 2·5 to 5·5 millim., it is naturally capable of consuming in its lifetime a far larger number of beetles and it will therefore be readily understood that the beetle is a valuable ally to have in forests where bark-boring insects may assume the form of serious pests in seasons favourable to themselves.

Food. With the exception of one specimen taken on the wing in the middle of June, which was probably feeding upon *Diapus impressus* Jans., the insect may be said to have been first discovered feeding upon *Scolytus major* and *minor* in Deodar on the 24th June. From the study of the life-histories[1] of these latter beetles, which I have been able to make, it is certain that they are to be found in the adult state from the end of April (the beginning of spring when insect life commences to re-awake in the N.-W. Himalayas after its winter hibernation) to the end of June, or perhaps as late as the end of the first week in July. The beetles from the eggs laid at the end of April and beginning of May, begin to appear on the wing at the end of July or early in August and are to be found throughout that month and on into September. It is thus evident that with but a short interval of three weeks or so this form of food-supply is available for the clerid from its resumption of

[1] *Vide* Steb. Depart. Notes on Ins. aff. For., No. 1, p. 45. *Id.*, No. 2, pp. 203-212.

activity in the spring until the autumn. That the insect has an adequate food-supply will be evident from the following facts:—

From calculations made from measurements and countings taken in the forest I estimated that in a deodar tree of a hundred feet length of bole and three feet diameter at base which had been felled at the end of April and in which the scolytids had deposited their eggs in the bast layer from top to base, a first generation of some 56,300 adults was produced in July-August. Taking but 50 per cent. of the eggs (*S. major* lays about 60 and *S. minor* 40 per brood) laid (these being those of the second generation of the year) by these 56,300 beetles as arriving at maturity, we have the enormous total of 1,550,000 beetles at the end of the year, the result of the eggs laid in but one tree in the spring. I may say that in this calculation large deductions have been made to allow for over-estimation, &c., the large number of beetles which oviposited in the giant crown of the tree and their resultant offspring being left out of account altogether. Experiment has shown, however, that the *Thanasimus* is by no means dependent upon the Scolytus beetles for its food-supply as it will devour with almost, if not quite, equal avidity, various other scolytid pests found in the region of its known activity. I have fed it with the following beetles:—

1. Bark-boring species (*i.e.*, those species which confine their attacks to the bast layer of the trees attacked).

Scolytus major Steb. MS. *S. minor* Steb. MS.	mentioned above (Deodar).
Polygraphus major Steb. MS. *P. minor* Steb. MS.	(Blue pine and Spruce).
Pityogenes coniferæ Steb. MS.	(Blue pine, Deodar and *Pinus Gerardiana*).

Tomicus sp. (Blue pine and Spruce).

2. Wood-boring species (*i.e.*, those species which bore right into the wood of the tree and oviposit in it).

Rhyncholus sp. (Blue pine, Spruce, and perhaps Deodar)

Hylastes sp. (Blue pine and Spruce).

Diapus impressus Jans. (*Quercus incana*).

Platypus ? sp. (Deodar).

All the above are coniferous insects, with the exception of the *Diapus impressus* which bores into the wood of the oak *Quercus incana*.

This Thanasimus would therefore appear to be fairly omnivorous where bark-beetles are concerned, attacking freely many different species and in this resembling its European confrère *T. formicarius*.

I think the above short note on its habits will support and confirm the opinion held by the writer, as to the great value and importance of the presence of such an insect in the N.-W. Himalayan Coniferous Forests.

Plate I.

a. Young half-grown larvæ, dorsal and side view.

b. Full-grown larva, just before final moult, showing the rolled-up alar appendages beneath the last larval skin. The larva is thicker and shorter when full-grown.

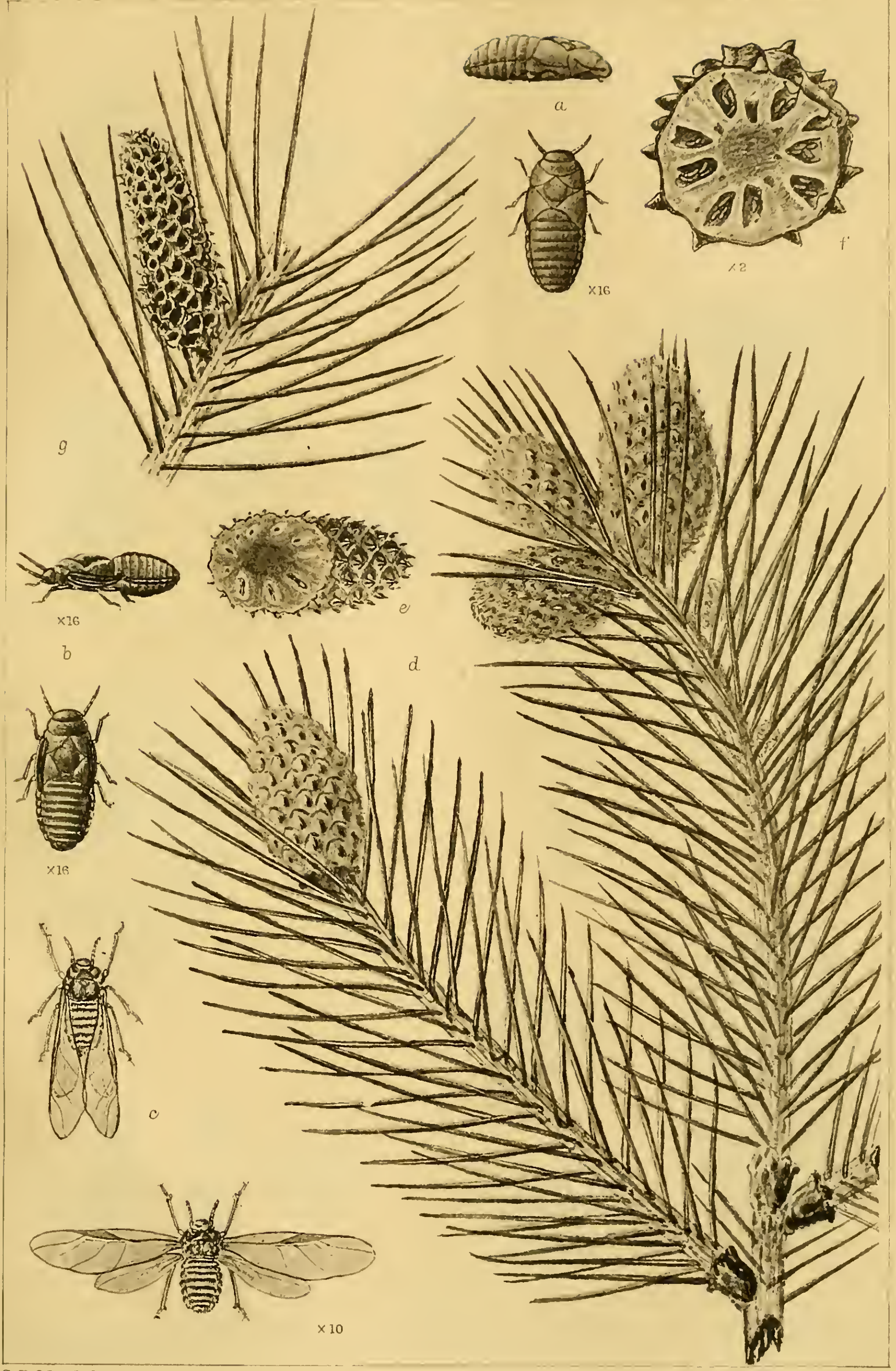
c. Winged adult.

d. Spruce branch bearing four pseudo-cones.

e. A gall or pseudo-cone in transverse section showing the partition into chambers.

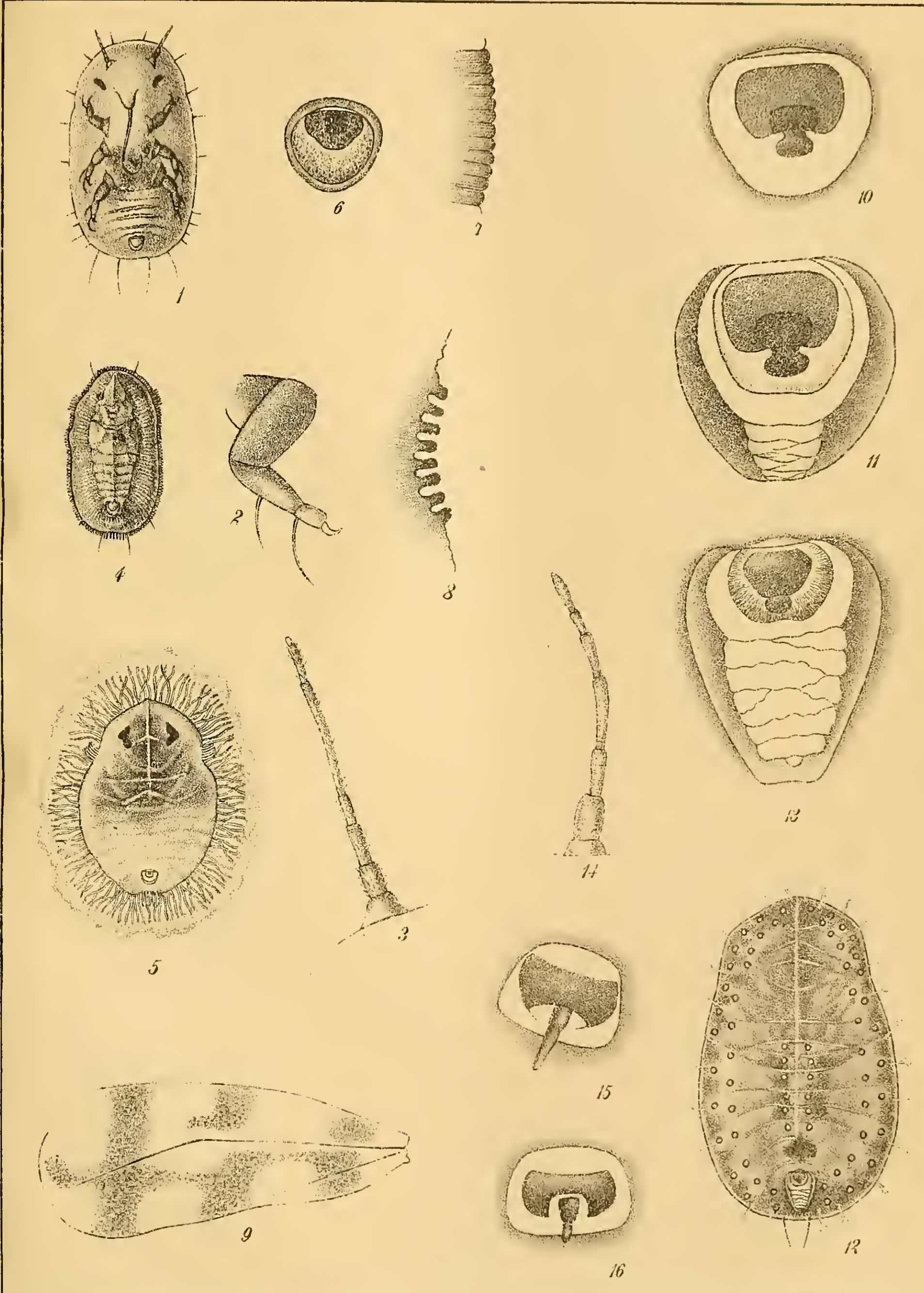
f. The same magnified showing larvæ *in situ* within the chambers.

[*Note.*—Plate I accompanies the paper on the "Alar appendages of *Chermes abietis-piceæ* in the N.-W. Himalayas," published in No. 2 of the Journal, Pt. II, 1903.]



S.B. Mondul, del. Photogravure, Survey of India Offices, Calcutta, June 1903.

CHERMES ABIETIS-PICEAE, STEB. MS.



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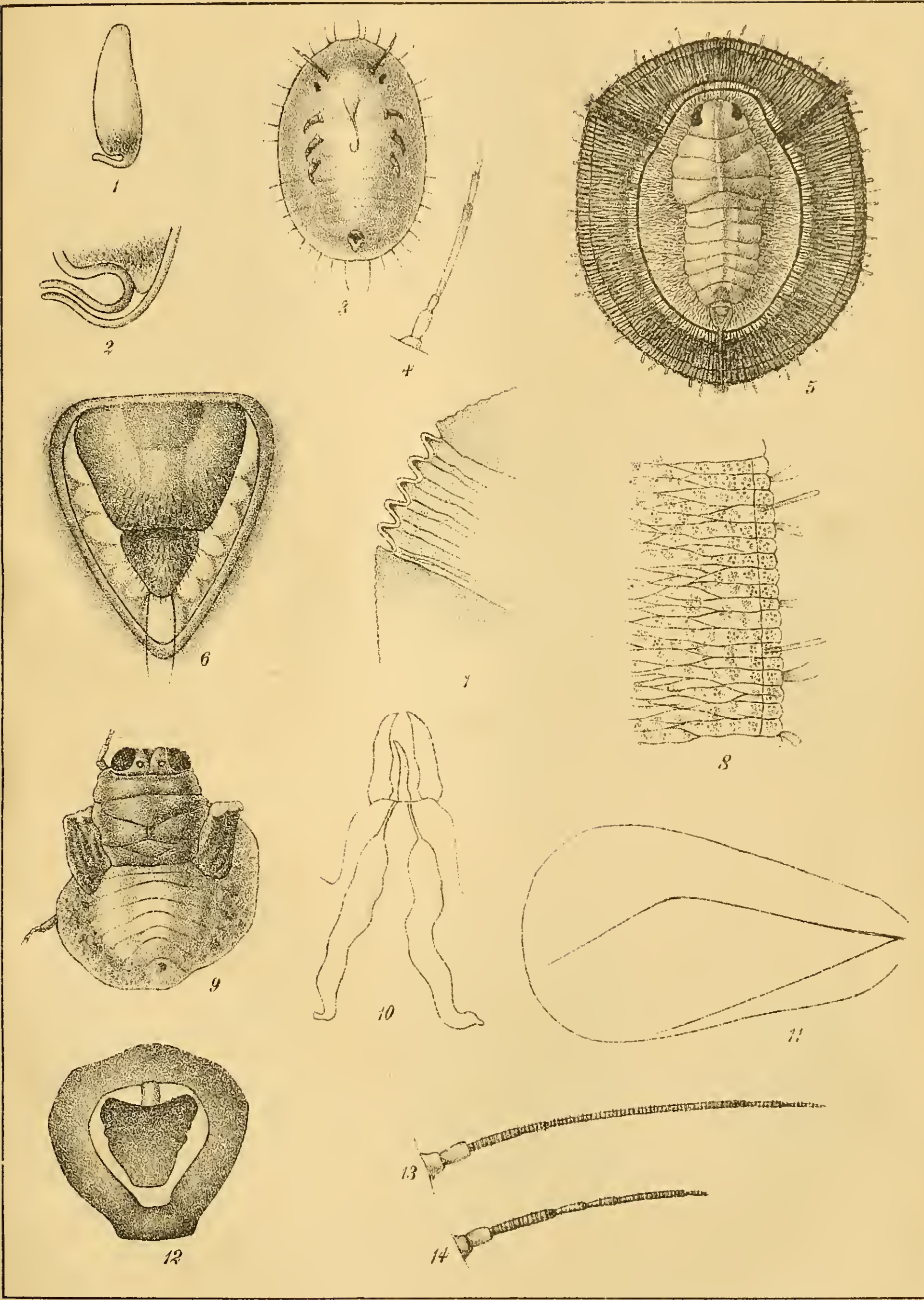

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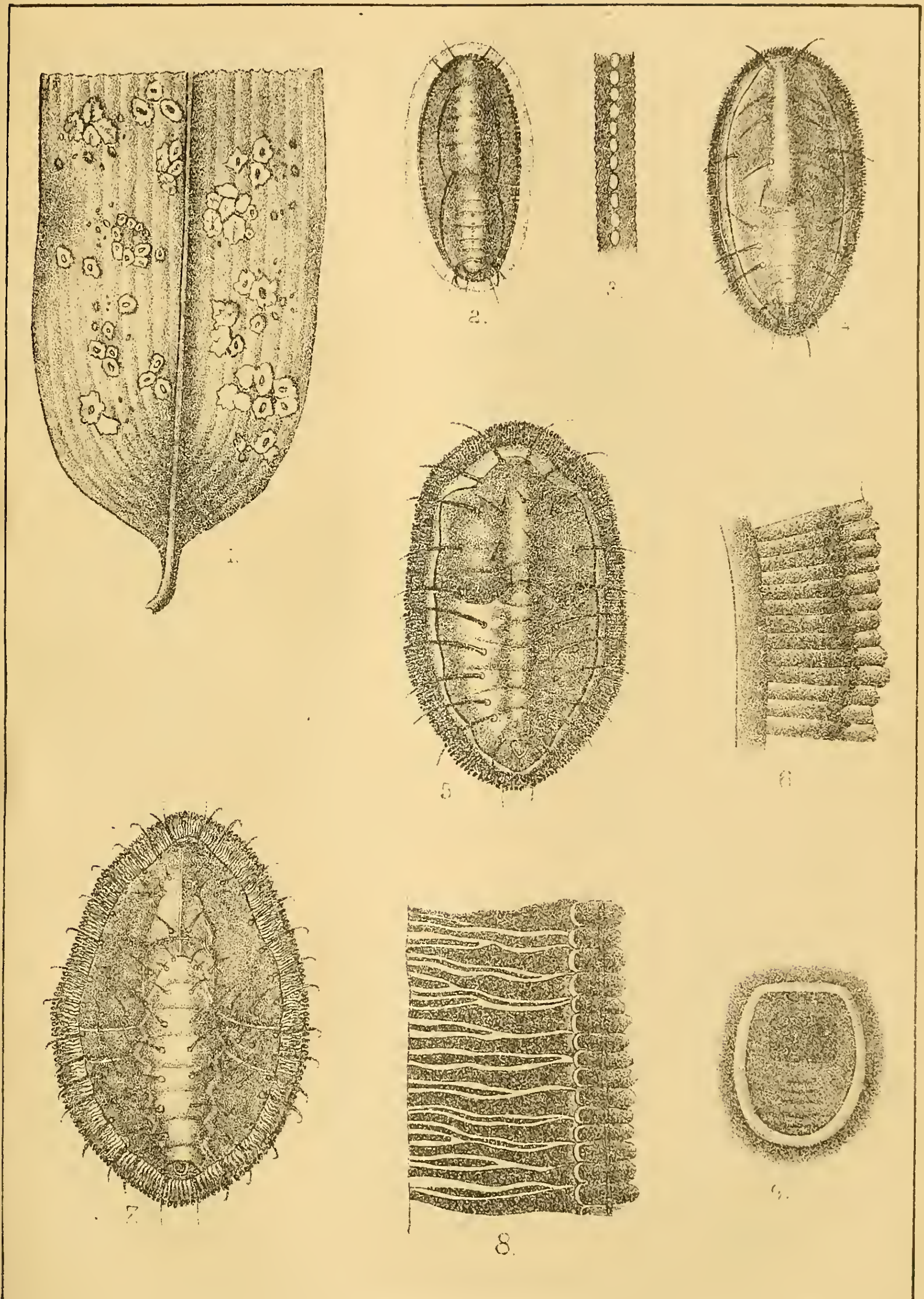

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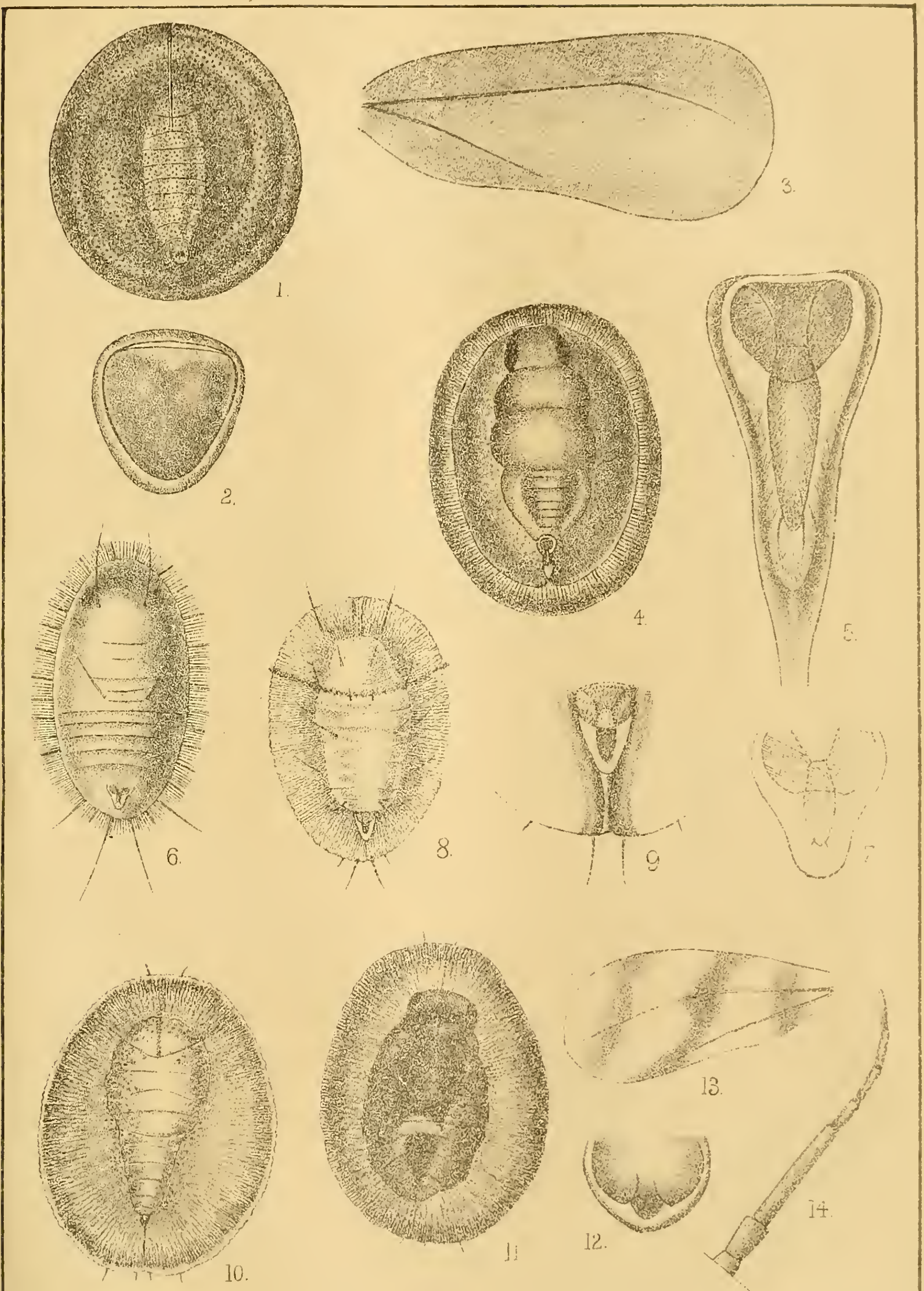

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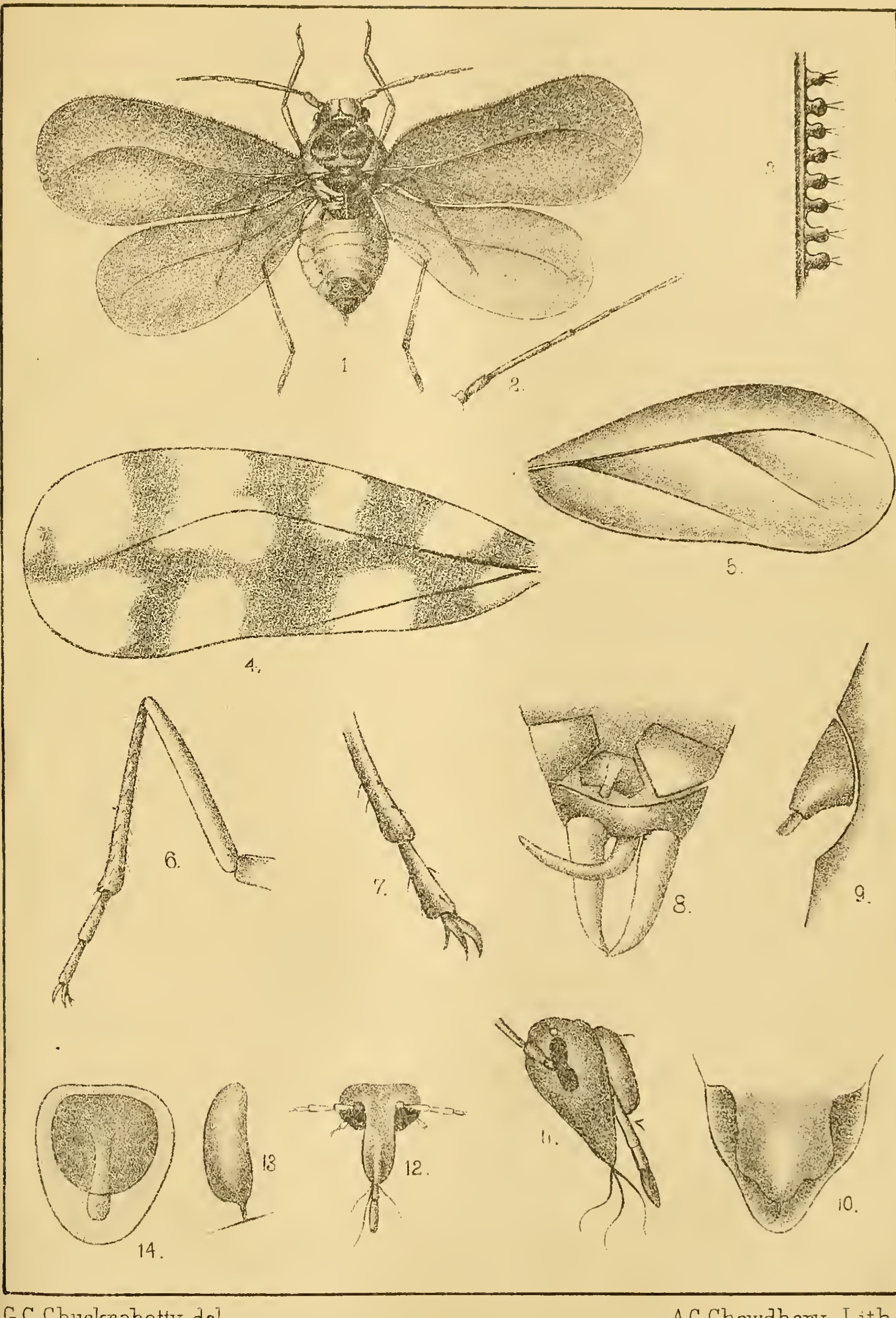

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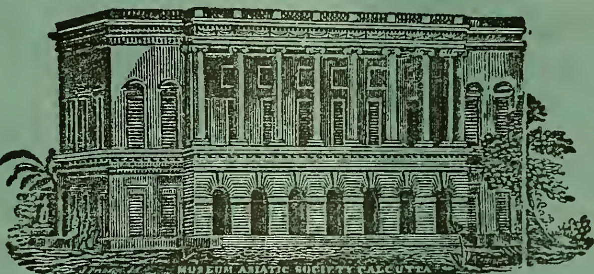

"The bounds of its investigation will be the geographical limits of Asia: and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."—SIR WILLIAM JONES.

⁂ *Communications should be sent under cover to the Secretaries, Asiat. Soc., to whom all orders for the work are to be addressed in India; or care of Messrs. Luzac & Co., 46, Great Russell Street, London, W. C., or Mr. Otto Harrassowitz, Leipzig, Germany.*

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ASIATIC SOCIETY OF BENGAL,

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No. 4.—1903.

Materials for a Flora of the Malayan Peninsula.—*By* Sir George King, K.C.I.E., LL.D., F.R.S., *late Superintendent of the Royal Botanic Garden, Calcutta, and* J. Sykes Gamble, C.I.E., F.R.S., *late of the Indian Forest Department.*

No. 14.

The present contribution contains an account by Mr. Gamble of the few species belonging to the Natural Order *Caprifoliaceæ*, which have so far been collected in the Malay Peninsula and adjacent Islands. But the larger part of it is occupied by a joint account by the authors of the species of the Order *Rubiaceæ*, which are characterised by having more ovules than one in each cell of the ovary. The key which precedes the text is only for these genera. In a paper which the authors hope soon to submit to the Society they will deal with the species of the genera which have only a single ovule in each ovarian cell; and that paper will, in like manner, be preceded by a key to these uniovular genera.

With the exception of the important family of *Leguminosæ*, which was elaborated entirely by Major D. Prain, of the Botanic Garden, Calcutta, and of one genus of *Melastomaceæ*, which was done in conjunction with Dr. O. Stapf, chief assistant in the Kew Herbarium, the whole of the orders dealt with in the preceding thirteen parts of these *Materials* have been worked out by Sir George King. With the view of expediting the completion of the series, and in consideration of the liberality of the Government of the Straits Settlements which has made feasible a more rapid rate of publication, it has been arranged that Mr. J. S. Gamble will henceforth, in the majority of the orders belonging to *Corollifloræ* and *Incompletæ*, work in collaboration with Sir George King; while certain orders will be worked out independently by botanical friends, who have kindly promised their aid.

Order LVIII. CAPRIFOLIACEÆ.

Small trees or shrubs, erect or climbing, rarely herbs. *Leaves* opposite, rarely alternate, simple, lobed or imparipinnate; stipules usually absent. *Inflorescence* various, usually cymose; flowers hermaphrodite, regular or irregular. *Calyx* adnate to the ovary; lobes 5, superior, usually imbricate, rarely valvate. *Corolla* superior, gamopetalous, tubular, funnel-shapel or rotate; limb 5-fid, lobes imbricate. *Stamens* 5, rarely 4, inserted on the corolla-tube, alternate with the lobes; filaments filiform or subulate; anthers 2-celled, introrse, longitudinally dehiscing. *Ovary* inferior, 2–6-, rarely 1-celled; style terminal, stigma capitate, undivided or bifid, sometimes short and 3-lobed; ovules sometimes solitary, pendulous, sometimes many, biseriate, anatropous. *Fruit* a berry or drupe or sometimes dry and indehiscent, many-celled, 1- to many-seeded. *Seeds* single or many in each cell; testa crustaceous or hard; albumen fleshy, copious; embryo usually minute, ovoid or clavate, 2-fid, radicle smooth, cotyledons ovate.—Distrib. Genera 13, species 200 to 220; chiefly found in the Northern Hemisphere more especially in temperate regions; a few in Australia and South America; none in tropical or Southern Africa.

Viburnum, Linn.

Shrubs or small trees. *Leaves* opposite, rarely alternately verticillate, simple, petiolate; entire, serrate or dentate, sometimes palmately lobed; sometimes stellately pubescent, sometimes gland-dotted; stipules usually inconspicuous or absent, in a few cases very large. *Flowers* hermaphrodite, in terminal or subterminal subumbellate corymbs, the branches cymose or panicled; bracts few, small; bracteoles 1 to 2, usually very small, generally quickly deciduous. *Calyx-tube* turbinate, cylindric or clavate; limb short, 5-toothed, persistent. *Corolla* white, pink or yellowish; rotate, campanulate or tubular; lobes 5, equal, imbricate. *Stamens* 5, inserted on the corolla, alternate with the lobes; anthers oblong, usually exserted; filaments linear or subulate. *Ovary* 1–3-celled; style short, conical, stigma small, obscurely 3-lobed; ovules solitary in the cells, pendulous. *Fruit* a drupe 1- or rarely 2–3-celled, 1-seeded; endocarp tough, papery or crustaceous. *Seed* oblong, compressed, grooved, the edges sometimes incurved; testa membranaceous; albumen fleshy, sometimes ruminate; embryo minute, cotyledons thin.—DISTRIB. Species over 80, chiefly of the temperate and sub-temperate regions of the Northern Hemisphere in Europe and Asia; a few in the West Indies, South America and Madagascar.

Leaves entire:—
  Corolla rotate; filaments long, linear; calyx-tube pubescent ... ... 1. *V. sambucinum.*
  Corolla tubular; filaments short, subulate; calyx-tube glabrous ... ... 2. *V. Beccarii.*
Leaves dentate or serrate; calyx-tube glabrous ... 3. *V. lutescens.*

1. VIBURNUM SAMBUCINUM, Reinw.; Blume Bijdr. 656. A large shrub or small tree up to 30 feet high; young branches stout, smooth, somewhat angled; youngest parts and branches of the inflorescence brown, stellate-pubescent. *Leaves* opposite, entire, thinly coriaceous, elliptic-oblong or -lanceolate, abruptly acuminate, the base cuneate; both surfaces glabrous except for a few hairs on the midrib beneath and occasional tufts in the axils of the main-nerves; main-nerves 4-6 pairs, prominent, curved upwards, joined by prominent arches near the margin, lesser nerves reticulate; length 5 to 10 in., breadth 1·5 to 4 in., petiole ·75 to 1·25 in., pilose especially on the inner surface. *Corymb* terminal, usually peduncled but sometimes nearly sessile, umbellate, primary branches 6 to 8 and ·5 to 1 in. long, upper cymosely branched, short in flower, longer in fruit; bracts of primary branches very early deciduous, linear-spathulate, ·2 to ·3 in. long, bracteoles also very deciduous, very short, linear-oblong, densely brown stellate-pubescent. *Calyx*-tube cylindric, ·05 in. long, pubescent; lobes 5 spreading, lanceolate-acute. *Corolla* hemispheric in bud, rotate when open; lobes 5, rounded, imbricate, yellow-white. *Stamens* 5; anthers oblong, exserted; filaments longer than the petals, much folded in bud. *Ovary* 1-celled, style conical. *Fruit* a drupe, broadly ovate, suddenly acute, compressed, wrinkled, 2-grooved on one and 3-grooved on the other face, ·35 in. long, ·2 in. broad, endocarp thick, osseous. DC. Prodr. IV. 325; Miq. Fl. Ind. Bat. II. (1856) 120; Oersted in Vidensk. Meddel. (1860) 299, t. 7, *figs.* 11-13; C. B. Clarke in Hook. fil. Fl. Br. Ind. III. 5; Koord. & Val. Boomsoort. Java in Mededeel. 'sLands Plant. XXXIII. (1900) 40. *V. integerrimum*, Wall. Cat. 457; DC. Prodr. IV. 324; Hook. fil. and Th. in Journ. Linn. Soc. II. 476. *Premna* (?), Wall. Cat. 9077.

PERAK: *Wray* 1237, 1483, 2951; *Scortechini* 514. PENANG: *Wall.* 457; *Walker* 92, 272; *Maingay* (K.D.) 712/2; *King's Collector* 1586, 2273, 5202; *Curtis* 278. MALACCA: *Griffith* 3395. SINGAPORE: *Ridley* 6335. DISTRIB. Sumatra; Java; Borneo.

The Perak specimens show two forms, the one (No. 1483 *Wray*) with leaves elliptic-oblong, glabrous beneath; the other (No. 2951 *Wray*) with smaller leaves elliptic-lanceolate, with occasional stellate hairs beneath. Other specimens from various localities show intermediate forms so that they are not constant varieties.

2. Viburnum Beccarii, Gamble n. sp. Apparently a small tree, young branches rather thick, smooth. *Leaves* opposite, entire, coriaceous, ovate, obtuse or very shortly and bluntly acute, base cuneate; glabrous above, minutely glandular-dotted beneath; main-nerves 4 to 6 pairs, smaller nerves reticulate; length 3 to 5 in., breadth 2 to 3 in., petiole ·75 to 1·25 in. *Corymb* terminal, long-peduncled (1·5 to 3 in.), umbellate, main branches 6 to 8, upper branches cymose, all brown stellate-pubescent when young; bracts and bracteoles small, linear, very numerous, rusty stellate-pubescent, very quickly deciduous. *Calyx*-tube clavate, glabrous, ·1 in. long; teeth very minute. *Corolla* tubular, ovoid in bud, ·15 in. long; teeth 5, acute. *Stamens* 5; anthers oblong, pendulous from the summit of a subulate thickened filament, ·075 in. long. *Ovary* 1-celled; style short, conical. *Fruit* (young only) a drupe, 1-celled, faintly 1-grooved on one face, 2-grooved on the other.

Perak: *Scortechini* 375*b*. Distrib. Sumatra (*Beccari* No. 194 on Mt. Singalan in Herb. Kew).

Specimens of the fully opened corolla or of the mature fruit are not yet available.

3. Viburnum lutescens, Blume Bijdr. 655 (1825). A small tree, young branches slender, smooth, youngest parts and branches of the inflorescence brown, stellately-pubescent. *Leaves* opposite, ovate-acuminate, thinly coriaceous, cuneate at base, upper two-thirds deeply crenate-dentate, sometimes serrate, teeth mucronate, lower one-third entire; both surfaces glabrous; main-nerves 6 to 8 pairs, ascending, prominent, lesser nerves reticulate; length 3 to 5 in., breadth 1·5 to 2·5 in., petiole ·5 to ·75, rough when dry. *Corymb* terminal, long-peduncled (1·5 to 2·5 in.), umbellate, primary branches 3 to 6 and ·5 to ·75 in. long, paniculate-cymosely branched above; bracts of primary branches deciduous, linear-spathulate, ·4 to ·5 in. long, bracteoles very minute, ovate-acuminate, both stellately brown-pubescent. *Calyx*-tube angular, glabrous, ·05 in. long; lobes 5, erect, ovate, bluntly acute. *Corolla* hemispheric in bud, rotate-campanulate when open; lobes 5, rounded, imbricate, white. *Stamens* 5; anthers oblong, exserted; filaments short, equal to the petals. *Ovary* 1-celled; style short, conical, faintly 3-lobed. *Fruit* a drupe, oblong-ellipsoid, abruptly apiculate, compressed, 1-grooved on one and 2-grooved on the other face, ·3 to ·4 in. long, ·2 in. broad; endocarp thick, hard. DC. Prodr. IV. 325, *V. monogynum*, Blume Bijdr. 655; DC. Prodr. IV. 327. *V. sundaicum*,

Miq. Fl. Ind. Bat. II. (1856) 121; Koord. & Val. Boomsoort. Java in Mededeel. 'sLands Plant. XXXIII. (1900) 43.

PERAK: *Wray* 1496, at 4900 feet on Ulu Batang Padang. DISTRIB. Sumatra; Java.

Nat. Ord. LIX. RUBIACEÆ.

Trees, shrubs or herbs, erect, climbing, twining or prostrate, unarmed or spinous. *Leaves* simple, opposite, usually quite entire; stipules inter- or intra-petiolar, free or united to each other or to the petiole; in the tribe *Galieæ* leaf-like and forming a whorl with the leaves. *Inflorescence* various. *Flowers* usually hermaphrodite, mostly regular and symmetrical. *Calyx-tube* adnate to the ovary: its limb various, sometimes petaloid. *Corolla* gamopetalous, regular, usually 4–5-lobed, rarely bilabiate; the lobes of the limb valvate, imbricate or contorted. *Stamens* equal in number to the lobes of the corolla, sessile or on short or long filaments; *anthers* 2-celled, usually linear, dorsifixed, and dehiscing longitudinally, rarely with porous dehiscence. *Disk* epigynous, usually annular or cushion-shaped, sometimes lobed, or reduced to glands. *Ovary* inferior, 1–10-celled; style simple or cleft (but rarely cleft to the base); stigmas various, usually on the style-arms, but sometimes connate and fusiform, oblong, capitate or mitriform and simple or lobed. *Ovules* in the ovarian cells solitary or in pairs, or numerous. *Fruit* capsular, baccate, drupe-like, 2–10-celled, or dehiscing into 2 or more dehiscent or indehiscent cocci. *Seeds* various, with horny albumen; embryo straight or curved; cotyledons flat or semi-terete; radicle superior or inferior.—DISTRIB. About 4,800 species, chiefly tropical and sub-tropical.

Ovules numerous in each cell of the ovary:—
  Fruit dry, capsular or separating into 2 or 4 cocci:—
    Flowers collected into dense globular heads: corolla funnel-shaped, its lobes valvate or imbricate in bud: stigma simple:—
      Lobes of the corolla valvate ... ... 1. MITRAGYNE.
      Lobes of the corolla imbricate:—
        Tubes of the calyces concrete ... ... 2. SARCOCEPHALUS.
        Tubes of the calyces free:—
          Seeds not winged ... ... 3. ANTHOCEPHALUS.
          Seeds winged:—
            Trees:—
              Capitules solitary or few ... ... 4. NAUCLEA.
              Capitules numerous, small ... ... 5. ADINA.
            Climbers:—
              Capitules usually solitary, axillary, on peduncles curving into hooks when in fruit ... ... 6. UNCARIA.

Flowers in corymbs or panicles, not in globular heads; corolla-lobes valvate, imbricate or contorted in bud. Fruit capsular, 2-celled, seeds winged:—

Corolla funnel-shaped, its lobes twisted in bud; flowers in terminal pendulous panicles; lobes of calyx equal, not petaloid: stigma simple fusiform... 7. COPTOSAPELTA.

Corolla with a short tube, its lobes slightly twisted in bud; flowers stalked, in erect corymbs or panicles; one of the lobes of the calyx sometimes large, petaloid and persistent; stigma fleshy, 2-lobed ... 8. MUSSAENDOPSIS.

Flowers in subscorpioid cymes: corolla funnel-shaped, its lobes valvate, but somewhat twisted in bud; capsule 2-celled; seeds numerous, obscurely winged; stigmas 2 linear, revolute ... ... 9. GREENIA.

Corolla and inflorescence various, corolla-lobes valvate in bud. Stamens 4 or 5. *Fruit* a loculi- or septicidal capsule with 2 or 4 cells, or consisting of 2 or 4 adnate dry dehiscent or indehiscent (rarely quite indehiscent) cocci; seeds small or minute, rarely winged. Herbs or small shrubs (never trees) with entire leaves:—

Fruit 2-celled, usually indehiscent: stipules entire:—

Corolla funnel-shaped, 4- or 5-toothed; anthers included, dehiscing longitudinally ... ... 10. DENTELLA.

Corolla rotate; anthers large, exserted, connivent, dehiscing by apical pores ... ... 11. ARGOSTEMMA.

Fruit oblong, sub-globose, or orbicular, 2- rarely 4-celled, usually dehiscent, many-seeded, rarely 1-seeded: stipules often divided into bristles:—

Corolla funnel-shaped or campanulate, 4-lobed; capsule loculi- or septicidal, rarely indehiscent; calyx-teeth contiguous; seeds usually angular ... 12. HEDYOTIS.

Corolla rotate, funnel- or salver-shaped, 4- rarely 5-lobed; capsule loculicidal above the remote calyx-teeth, rarely indehiscent; seeds minute, angular ... ... 13. OLDENLANDIA.

Fruit broadly and didymously obcordate, compressed, composed of 2 spreading lobes, loculicidal above the calyx; flowers secund on the branches of dichotomous cymes ... ... 14. OPHIORRHIZA.

Fruit fleshy, dehiscing irregularly or at the apex, or drupe-like and separating into 2 or more many-seeded cocci:—

Flowers in capitula:—

Capitula without involucres: calyx entire: stamens 4 ... ... 15. LUCINAEA.

Capitula involucrate; calyx obliquely campanulate, obtusely 2-4-lobed or 2-lipped: stamens 5; climbing shrubs ... ... 16. LECANANTHUS.

Capitula bracteate, crowded; calyx with 5 ciliate lobes; corolla 5-lobed; stamens 5; arms of style 2, truncate; berry with thin pericarp; herbaceous 17. COPTOPHYLLUM.

Flowers in terminal corymbs or racemes: one of the calyx-lobes occasionally long, petaloid, persistent; erect or scandent shrubs ... ... 18. MUSSAENDA.

Flowers in panicled terminal umbels; calyx-limb cupular, deciduous; corolla 5-lobed; stamens 5; arms of style linear-lanceolate; woody scandent shrubs ... 19. TRISCIADIA.

Flowers in axillary cymes; shrubs or small trees :—

Flowers polygamous; cymes panicled; lobes of calyx and corolla and the stamens 8 to 16; disc large, convex, with as many lobes as the stamens and stigma ... ... 20. AULACOODISCUS.

Flowers hermaphrodite :—

Cymes short, few-flowered; calyx minutely toothed; fruit with scanty pulp ... ... 21. UROPHYLLUM.

Cymes loose; flowers 4-5-merous; lobes of corolla reduplicate-valvate; fruit baccate, fleshy, 2-5 celled ... ... 22. ADENOSACME.

Corolla-lobes twisted in bud: fruit baccate, fleshy or dry; seeds usually large, cotyledons often foliaceous :—

Seeds numerous in each cell of the fruit :—

Flowers dioecious :—

Cymes from the axils of fallen or undeveloped leaves; style arms 2; berries with thin pericarp, ellipsoid or globular ... ... 23. BRACHYTOME.

Flowers hermaphrodite :—

Flowers in cymes :—

Cymes terminal, corymbose; flowers 5-merous; stigma simple, fusiform; fruit pisiform, 2-celled ... ... 24. STYLOCORYNA.

Cymes usually axillary; stigma fusiform or bifid; fruit baccate with thick pericarp :—

Calyx-limb various; fruit 2-celled ... 25. RANDIA.

Calyx-limb usually tubular; fruit 1-celled ... 26. GARDENIA.

Flowers in spikes :—

Calyx-limb minutely 5-toothed: anthers thickened at the apex ... ... 27. PETUNGA.

Ovules and seeds 2 or 3 in each cell :—

Flowers in axillary fascicles on small cymes; calyx-limb truncate or 4-5-toothed; fruit baccate, ovoid or globose, sessile ... ... 28. DIPLOSPORA.

Ovules never more than 2 in each cell of the two-celled ovary :—

Corolla-lobes twisted; ovules inserted together halfway up the ovarian cell, one pendulous, the other erect; flowers in dense axillary pedunculate cymes: a small littoral tree ... ... 29. SCYPHIPHORA.

Corolla-lobes valvate; ovules erect, on the top of an erect basilar placenta; flowers in scorpoid cymes, collected in corymbose panicles ... ... 30. JACKIA.

1. MITRAGYNA, Korthals.

Trees with petiolate leaves and large caducous bracts and stipules. *Flowers* sessile, crowded in globose, solitary or paniculate, pedunculate capitules, each peduncle with 2 foliacious long-petioled bracts near its apex: the flowers mixed in the capitules with numerous, spathulate paleaceous bracteoles. *Calyces* conoid, densely crowded, but quite separable from each other: the calyx-tube short, its mouth truncate or 5-toothed. *Corolla* funnel-shaped; the tube long, the mouth with a ring of villose hairs inside below the base of the lobes; lobes 5, thickened towards the apex, lanceolate, valvate in astivation. *Stamens* 5, originating just above the ring of hairs; *anthers* lanceolate, apiculate, cordate or sagittate at the base; filaments short. *Ovary* 2-celled; *style* filiform, exserted; *stigma* cylindric or mitriform, its base overlapping the apex of the style; *ovules* numerous, on pendulous placentas. *Fruit* of two 5-ridged cocci dehiscing at the apex. *Seeds* numerous, small; the testa with thin wings, the albumen fleshy.—DISTRIB. Eight species, 5 of which are Indo-Malayan and 3 tropical African.

Main-nerves of leaves 7 to 9 pairs; corolla ·2 in. long; calyx-tube narrow, not ridged ... ... 1. *M. diversifolia.*
Main-nerves of leaves 12 to 15 pairs; corolla ·3 in. long; calyx-tube wide, ridged ... ... 2. *M. speciosa.*

1. MITRAGYNA DIVERSIFOLIA, Haviland in Journ. Linn. Soc. XXXIII. 71. Young branches pale, compressed. *Leaves* thickly membranous, ovate or elliptic, to rotund-ovate; obtuse or sub-acute; the base rounded (in the lower leaves slightly cordate); both surfaces glabrous, the lower minutely reticulate, sometimes puberulous especially on the nerves; main-nerves 7 to 9 pairs, rather straight, spreading; length 4 to 8 in.; breadth 2 to 6 in.; petiole ·35 to 1·25 in.; *stipules* oblong, blunt. *Corolla* ·2 in. long; tube of *calyx* not ridged, about ·025 in. wide. *Anthers* cordate at the base. *Stigma* cylindric, overlapping the apex of the style by its hollow base. *Mitragyne javanica*, Koord. & Valet. Bijdr. 8, 38. *Stephegyne diversifolia*, Hook. fil. Fl. Br. Ind. III. 26. *S. parvifolia*, Korth. Verh. Nat. Gesch., p. 161 (*in part*). *Nauclea diversifolia*, Wall. Cat. 6096: G. Don Gen. Syst. III. 467. *N. rotundifolia*, Roxb. Fl. Ind. I. 516; Kurz For. Fl. Burm. II. 67. *N. Brunonis*, Wall. Cat. 6097: G. Don, l.c. *N. parvifolia*, Roxb. var. 2, Kurz For. Fl. Burm. II. 67.

ANDAMAN ISLANDS.—DISTRIB. Burma; Chittagong; Philippines.

The occurrence of this in a wild state in the Malay Peninsula is doubtful. In the Andaman islands it is common.

The stigma of this is externally almost cylindrical. But it is hollowed at the base like a wine-bottle and covers the apex of the style like a cap. The leaves of the upper part of the branches are smaller and more or less ovoid in form; those of the lower parts are larger and more rotund, hence the specific name. Roxburgh, thinking only of the lower leaves, named the species *Nauclea rotundifolia*.

2. Mitragyna speciosa, Korth. Obs. de Naucleés Indicês, p. 19 (name only). Young branches usually dark-coloured, compressed. *Leaves* membranous, oblong-obovate to oblong, shortly and abruptly acuminate or sub-acute, the base broad and rounded or rarely slightly and suddenly contracted; both surfaces glabrous, the lower minutely reticulate and sometimes puberulous on the 12 to 15 pairs of slightly curved ascending nerves; length 4 to 5·5 in.; breadth 2 to 3·5 in.; petiole thin, ·8 to 1·2 in. long; *stipules* lanceolate, sparsely pubescent. *Corolla* ·3 in. long; tube of calyx wide, ridged, its mouth about ·075 in. across. *Anthers* sagittate at the base. *Stigma* mitriform. Haviland in Journ. Linn. Soc. XXXIII. 69. *Stephegyne speciosa*, Korth. Verh. Nat. Gesch. Bot., p. 160. *S. parvifolia*, K. Schum. Fl. Kaiser-Wilh. Land., p. 127. *Nauclea speciosa*, Miq. Fl. Ind. Bat. II. 140.

Pahang: *Ridley* 2190. Perak: *Wray* 1896, 4280; Perak: *Scortechini* 616; *King's Collector* 1770, 10021, 10459.—Distrib. Sumatra, *Forbes*, Borneo; *Motley* 1169; *Korthals*, Philippines; *Cuming; Motley; Vidal;* New Guinea.

2. Sarcocephalus, Afzel.

Shrubs or trees with petiolate leaves and small or large caducous or persistent stipules. *Flowers* sessile, conjoined by their confluent calyx-tubes into globose, axillary or terminal, pedunculate, ebracteolate heads, the peduncles with 2 small bracts near or below the middle. *Calyx-tube* short; its mouth with 4 or 5 imbricate, persistent or caducous teeth. *Corolla* infundibuliform; its mouth with 4 or 5 broad, blunt, imbricate teeth not thickened near the apex. *Stamens* 4 or 5, inserted in the glabrous throat of the corolla by very short filaments, or sessile; *anthers* broadly ovate. *Stigma* clavate, fusiform or capitate, exserted, the *style* long, filiform. *Ovary* 2-celled; ovules numerous, on two pendulous placentas. *Fruits* combined into a globose fleshy mass of 2-celled pyrenes, with thin septa. *Seeds* ovoid, compressed, not winged; testa crustaceous; albumen fleshy.—Distrib. About a dozen species, mostly Indo-Malayan; one Australian and one African.

Leaves pubescent beneath: capitules about ·8 in. in diam. ... ... 1. *S. hirsutus*.

Leaves minutely scaly beneath, more or less obovate; capitules 1·5 in. in diam. ... ... 2. *S. Maingayi.*
Leaves quite glabrous:—
Leaves oblong-lanceolate to elliptic-oblong; capitules ·5 to ·75 in. in diam. ... ... 3. *S. subditus.*
Leaves more or less obovate; capitules ·5 in. in diam. ... ... 4. *S. Junghuhnii.*

1. Sarcocephalus hirsutus, Havil. in Journ. Linn. Soc. XXXIII. 32. A tree: young branches slender, pubescent, the bark pale. *Leaves* thickly membranous, oblong-oblanceolate, shortly and abruptly acuminate, the base attenuate: upper surface quite glabrous, shining, the lower with short pubescence on the nerves and midrib, otherwise minutely scaly; main-nerves 7 to 9 pairs, ascending, slightly prominent on the lower surface; length 3 to 5 in.; breadth 1·5 to 2·25 in. petiole ·2 to ·3 in., pubescent; *stipules* oblong-oblanceolate, obtuse, ·3 in. long. *Peduncle* solitary, terminal, about 1 in. long, with 2 lanceolate small bracts about the middle. *Capitules* about ·8 in. in diam. *Calyx* very short; the limb truncate, hairy. *Corolla* infundibuliform, glabrous both outside and inside; the mouth with 4 rarely 5 broad rotund slightly obovate lobes. *Anthers* 4, broadly ovate not apiculate, cordate at the base, inserted at the base of the corolla-lobes by short broad filaments; numerous flattened and ridged imperfect flowers mixed with the perfect ones. *Style* shortly exserted, *stigma* cylindric.

Malacca: *Ridley* 3214.—Distrib. Borneo.

The Malacca specimens described above have their leaves more attenuate at the base and rather more hairy beneath than the Bornean type (Herb. Hav. 3406) on which Haviland founded the species. But in other respects they agree.

2. Sarcocephalus Maingayi, Havil. in Journ. Linn. Soc. XXXIII. 33. A spreading tree, 40 to 80 feet high; young branches rather stout, yellowish-brown, glabrous. *Leaves* coriaceous, broadly elliptic or elliptic-obovate, shortly and abruptly acuminate, the base attenuate; upper surface quite glabrous, shining; the lower covered with minute white scales: main-nerves 9 to 14 pairs, impressed on the upper surface, prominent and sparsely puberulous on the lower; length 4 to 8 in.; breadth 2·25 to 3·5 in.; petiole ·5 to ·75 in., slightly winged; *stipules* oblong, sub-acute, thick, conjoined at the base, ·65 in. long. *Peduncles* solitary, terminal, short (·25 to ·5 in. long) bearing several oblong or lanceolate bracts, about ·5 in. in length. *Capitule* 1·5 in. in diam. *Calyx*-tube tomentose, 4-5-lobed. *Corolla* ·3 in. long, infundibuliform; the tube sub-glabrous; the lobes 4 or 5, lanceolate, pubescent on both surfaces. *Anthers* oblong, sub-acute, apiculate, filaments very short. *Style* exserted; *stigma* large, overlapping at its base the apex of the style. *Nauclea Maingayi*, Hook. fil. Fl. Br. Ind. II, 27.

MALACCA: *Maingay* (K.D.) 823. PERAK: *King's Collector* 4470, 4771, 6424, 7768, 7977, 10020, 10363; *Wray* 2043, 4173; *Scortechini* 265. SELANGOR: *Ridley* 2851. PROVINCE WELLESLEY: *Ridley* 9388.

3. SARCOCEPHALUS SUBDITUS, Miq. Fl. Ind. Bat. II. 133. A shrub or small tree; young branches slender, pale, the very youngest dark-coloured, glabrous. *Leaves* dark-coloured (when dry), thickly membranous, glabrous, oblong-oblanceolate to elliptic-oblong, shortly and obtusely acuminate, the base cuneate; main-nerves 6 or 7 pairs, spreading; length 3 to 4·5 in.; breadth 1·25 to 2·5 in.; petiole ·2 to ·4 in. *Peduncles* usually solitary, slender, axillary or terminal, less than 1 in. long when in flower, longer in fruit, glabrescent or puberulous; bearing two small lanceolate bracts below the middle. *Capitules* ·5 to ·75 in. in diam. *Calyx-tube* short; the mouth expanded, truncate. *Corolla* with a narrow cylindrical tube; the mouth expanded into 4 broadly oblong or sub-obovate, obtuse lobes, slightly hairy on the inner surface; *anthers* ovate, almost sessile; *style* exserted, stigma clavate. *Syncarpium* globular, ·5 to ·75 in. in diam.; pale, covered with striate pits. *Seeds* black. Hook. fil. Fl. Br. Ind. II. 22; Havil. in Journ. Linn. Soc. XXXIII. 30; Koord. & Valet. Bijdr. 8, 16. *Platanocarpum subditum*; Korth. Verh. Nat. Gesch. 133, t. 32.

PERAK: *Scortechini; Wray* 4167; *King's Collector* 1073, 3027, 6646, 7812, 8854, 10436. SELANGOR: *Ridley* 10212. MALACCA: *Griffith* (K.D.) 1770, 2771.—DISTRIB. Sumatra; Borneo.

4. SARCOCEPHALUS JUNGHUHNII, Miq. Fl. Ind. Bat. II. 133. A tree, 40 or 50 feet high; young branches brown when dry. *Leaves* pale brown (when dry), thinly coriaceous, glabrous, elliptic to obovate-elliptic, abruptly, shortly and bluntly acuminate, the base more or less cuneate; main-nerves 5 to 7 pairs, curving upwards, prominent beneath; length 3·5 to 5·5 in.; breadth 1·65 to 3·5 in.; petiole ·35 to ·65 in. *Peduncles* axillary or terminal, solitary or in groups of three, from 1 to 1·5 in. long, with four small unequal, ovate-acute bracts below the middle, minutely pubescent. *Capitules* ·5 in. in diam. *Corolla* infundibuliform; its mouth with 4 large obovate-rotund blunt lobes, imbricate in aestivation, glabrous; *anthers* short, almost sessile, broadly ovate. *Style* exserted; *stigma* clavate. *Syncarpium* globular, covered with shallow striate pits. *Seeds* black. Hook. fil. Fl. Br. Ind. III. 23; Havil. in Journ. Linn. Soc. XXXIII. 29.

MALACCA: *Griffith* (K.D.) 2772; *Maingay* (K.D.) 822; *Derry* 1110, 1188. SINGAPORE: *Ridley* 2847, 2850, 2880, 3397, 6534, 6897. PENANG: *Curtis* 303; *Fox* 10674. PERAK: *Scortechini* 2166, 2105; *King's Collector* 4440, 4499, 8179, 8315.—DISTRIB. Sumatra; Borneo; Philippines; Cochin-China.

3. Anthocephalus, A. Rich.

Large glabrous trees with petiolate coriaceous leaves and large caducous stipules. *Flowers* sessile, crowded in solitary terminal globose pedunculate heads, the peduncles bracteate at the base: the capitules ebracteolate. *Calyx* with a narrow cylindric tube expanding above and divided into 5 linear-oblong sparsely pubescent persistent lobes. *Corolla* tubular below, infundibuliform above, with 5 deep linear lobes, glabrous. *Anthers* linear-oblong, the apex apiculate. *Style* long, exserted; stigma elongate, cylindric, slightly fusiform. *Ovary* 2-celled; placentas linear, attached to the middle of the septum; *ovules* numerous. *Seeds* minute, ellipsoid; testa sub-membranous, albumen fleshy.—Distrib. 2 species both Indo-Malayan.

Anthocephalus indicus, A. Rich. in Mém. Soc. Hist. Nat. Paris, 1834, p. 237. A tall tree; young branches slender, dark-coloured. *Leaves* elliptic, elliptic-oblong or ovate; the apex acute; the base cuneate or rounded, sometimes sub-oblique; upper surface glabrous, the lower sometimes puberulous; main-nerves 10 to 12 pairs, spreading, slightly prominent on both surfaces; length 5·5 to 8 in.; breadth 2·5 to 3·5 in.; petiole 1·2 to 1·75 in., somewhat winged near the apex; stipules triangular. *Capitules* 1 to 2 in. in diam.: their peduncles 1·5 to 2 in. long. *Calyx* short, tubular below, infundibuliform above and deeply divided into 5 narrowly oblong lobes with obtuse, somewhat thickened apices, glabrous. *Corolla* elongate, infundibuliform, glabrous; the teeth broadly lanceolate, sub-acute. *Anthers* 5, linear-oblong, apiculate, the filaments short. *Style* long, exserted; *stigma* large, fusiform. *Fruit* 4-celled, with thin walls, the upper part containing 4 cartilaginous, indehiscent several-seeded pyrenes, the lower part only 2-celled and containing numerous seeds. *A. indicus*, Koord. & Valet. Bijdr. 8, p. 8. *A. morindæfolius*, Korth. Verh. Nat. Gesch. 154, t. 48; Miq. Fl. Ind. Bat. II. 135. *A. Cadamba*, Miq. Fl. Ind. Bat. II. 135; Bedd. Fl. Sylv. 127; t. 35; Brand. For. Fl. N.-W. Ind. 261; Hook. fil. Fl. Br. Ind. III. 23. *Nauclea Cadamba*, Roxb. Hort. Beng. 14; Fl. Ind. II. 512. *Sarcocephalus Cadamba*, Kurz. For. Fl. Burm. II. 63; Wall. Cat. 6088 (excl. sheet C).

Perak: *King's Collector* 6913. Andaman Islands: *Prain's Collector* 43, 93.—Distrib. British India; Malayan Archipelago.

A perusal of Richard's original description of *Anth. indicus* convinces one that the shrub which he describes is not *Nauclea purpurea*, Roxb., as he says, but *Nauclea Cadamba* of the same author.

4. Nauclea, Linn.

Trees or shrubs with petiolate or sessile, coriaceous or sub-coriaceous leaves, often of rather large size; the stipules caducous or sub-persistent, large. *Flowers* sessile, in solitary or ternate, pedunculate heads; the peduncles often thickened near the apex and bearing caducous bracts, often of large size, mostly caducous; the flowers mixed with bracteoles consisting of long thin stalks and conical hairy heads, or ebracteolate. *Calyx*-tubes closely adpressed; but not united with each other; the lobes 5, deciduous, filiform or spathulate, often thickened at the apex and hairy, valvate in æstivation. *Corolla* infundibuliform; the lobes 5, short, imbricate, the throat glabrous. *Stamens* 5; the anthers oblong or linear, included in the tube of the corolla; filaments very short. *Style* elongate, rather stout: *stigma* sub-globose or globose-ovoid. *Ovary* 2-celled, the placentas pendulous; ovules imbricate. *Fruit* of 2 cocci, often separating from the persistent axis, dehiscent. *Seeds* flattened; the testa with a wing, bifid at one end, acute at the other.—Distrib. About 30 species mostly tropical and Indo-Malayan.

Lobes of corolla densely sericeous-strigose externally; peduncles solitary, short, each with 2 large sub-persistent bracts ... ... 1. *N. Gageana.*
Lobes of corolla minutely glandular-puberulous externally; bracts of peduncle deciduous, minute ... 2. *N. synkorynes.*
Lobes of corolla glabrous or nearly so:—
  Capitule enveloped in two large sub-persistent bracts ... ... 3. *N. purpurascens.*
  Bracts near the base of the capitule, small, deciduous ... ... 4. *N. nicobarica.*
  Bracts near the base of the peduncle, small, ternate, deciduous ... ... 5. *N. peduncularis.*

1. Nauclea Gageana King. n. sp. A tree; young branches rather stout, slightly compressed, when dry pale-brown. *Leaves* coriaceous, broadly ovate-elliptic (sub-rhomboidal) gradually narrowed to the obtuse apex, the base cuneate; both surfaces quite glabrous, the upper shining (when dry); the lower dull, reticulate; main-nerves 8 to 10 pairs, spreading, prominent on the lower surface: the midrib very bold; length 6 to 8 in.; breadth 3·5 to 4·5 in.; petiole ·6 to ·8 in., flattened, winged in its upper part. *Capitules* about 1·5 in. in diam., solitary or in pairs. *Peduncles* 1 in. long, with a pair of large (1·25 in. long) sub-persistent bracts above the middle. *Calyx* short, cylindric, densely sericeous; the mouth very short, with 5 broad truncate lobes. *Corolla* infundibuliform, ·4 to ·5 in. long, outside glabrous in its lower, sericeous-strigose in its upper part; inside glabrous; lobes of the mouth 5, ovate. *Style* exserted, glabrous; *stigma* ovoid. *Fruit* villous. *Bracteoles* of the capitulum fusiform, villous.

Andaman Islands: *King's Collector* 463, *Prain's Collector* 76.

A very distinct species named in honour of Captain Gage, Curator of the Calcutta Herbarium, who was the first to recognise it as a hitherto undescribed species.

2. Nauclea synkorynes, Korthals Verh. Nat. Gesch. 160. A tree 30 to 40 feet high; young branches thin, compressed, broad at the nodes, pale-coloured (when dry). *Leaves* thinly coriaceous, oblong-ovate or oblong-obovate or narrowly elliptic, shortly rather abruptly acuminate, the base cuneate: both surfaces quite glabrous; main-nerves 7 or 8 pairs, rather straight, ascending, thin but prominent on the lower surface; length 3·5 to 5 in.; breadth 1·5 to 2·5 in.; petiole ·25 to ·4 in., slightly winged near the apex: stipules oblong-obovate, blunt, ·5 in. long. *Peduncles* two or three together, erect, 1·5 to 2·5 in. long, dilated near the minutely bracteate apex. *Capitules* about 1 in. in diam. *Calyx*-tube short: its lobes long, partly deciduous; hirsute and sub-lanceolate in the lower persistent part, glabrous and clavate in the upper deciduous part. *Corolla* infundibuliform; the tube glabrous, ·25 in. long: its lobes minutely glandular, pubescent outside, broadly ovate, blunt. *Anthers* reaching to the top of the tube, linear-oblong, shortly apiculate, the base sub-cordate. *Capsules* cuneiform, ridged, the apex villous, crowned by the calyx-limb. Havil. in Journ. Linn. Soc. XXXIII. 60.

Perak: *King's Collector* 10276.—Distrib. Borneo.

3. Nauclea purpurascens, Korth. Verh. Nat. Gesch. 158. A small tree, the young branches brown when dry, purple when fresh. *Leaves* thinly coriaceous, elliptic, elliptic-oblong, oblanceolate or oblong-oblanceolate, acute or sub-acute, the base attenuate; both surfaces glabrous; main-nerves 7 to 9 pairs, rather straight, spreading, prominent on the lower surface, the midrib broad, length 4·5 to 8·5 in.; breadth 1·75 to 3 in.; petiole ·35 to ·75 in.; *stipules* ovate, acute, ·75 in. long. *Capitules* 1·5 to 1·75 in. in diam., the peduncles 1·5 to 3 in. long, solitary or in threes, with 2 large boat-shaped sub-persistent bracts at the apex embracing the capitule. *Calyx*-tube short; the lobes 5, erect, linear, blunt, adpressed hairy. *Corolla* infundibuliform, glabrous; the lobes 5, short, broad, blunt, puberulous outside. *Anthers* 5, linear with a minute apical appendage; filaments shorter than the anthers. *Fruit* ribbed; the apex depressed, densely villous, the remains of the calyx-lobes short, hairy. Havil. in Journ. Linn. Soc. XXXIII. 58. Koord. & Valet. Bijdr. 8, p. 24. *N. Blancoi*, Vidal Phan. Cum. Phil. 175. *N. purpurea*, Blume Bijdr. 1008 (not of Roxb.).

Selangor: *Ridley* 7446. Pahang: *Ridley* 2189. Perak: *Scortechini* 112; *Ridley* 9721; *King's Collector* 8603, 10276, 10641; *Wray* 195. Andamans and Nicobars: *Kurz; Prain's Collector.*—Distrib. Java; Borneo; Celebes; Philippines.

The large bracts which envelope the capitules in their younger stages are very characteristic of this species. It is closely allied to *N. peduncularis*, G. Don, as noted under that species.

4. NAUCLEA NICOBARICA, Havil. in Journ. Linn. Soc. XXXIII. 59. A tree; young branches slender, compressed, pale, smooth. *Leaves* thickly membranous, elliptic or obovate-elliptic, shortly and bluntly acuminate, the base cuneate, both surfaces glabrous; main-nerves 5 to 7 pairs, spreading, slightly curved, prominent on the lower surface, midrib very stout; length 3·5 to 7 in.; breadth 2 to 3·5 in.; petiole ·5 to ·8 in.; stipules shorter than the petiole, obovate-oblong, blunt. *Peduncles* usually in threes, rarely solitary, slightly compressed and thickened towards the bracteate, striate, adpressed hairy apex. *Calyx* with a short cylindric tube: the mouth with 5 broadly oblong, blunt lobes, pubescent. *Corolla* glabrous, ·35 in. long, infundibuliform; the lobes of the mouth 5, broadly oblong, blunt. *Anthers* 5, oblong, sagittate at the base, slightly apiculate at the apex, half exserted from the throat of the corolla; filaments more than half as long as the anthers. *Fruit* ridged, densely villous on the apex and covered by the white calyx-teeth. *N. purpurascens*, var. *latifolia*, Korth. (*fide* Haviland) Korth. ex Miq. Ann. Mus. Lugd. Bat. IV. 182.

NICOBAR ISLANDS: *Kurz.* ANDAMANS: *Prain's Collector* 83.

5. NAUCLEA PEDUNCULARIS, G. Don Syst. III. 469. A tree 40 to 60 feet high; young branches pale purplish-brown when dry. *Leaves* coriaceous, elliptic or elliptic-obovate, sub-acute, the base cuneate or rounded; upper surface quite glabrous, shining, the lower dull, minutely scaly when dry; main-nerves 9 to 11 pairs, ascending, very slightly curved; length 5 to 9 in.; breadth 2·5 to 4 in.; petiole ·4 to ·6 in. *Capitules* globose-ovoid, 1·25 to 1·5 in. broad; the peduncles usually in threes, sometimes solitary, slightly compressed, thickened at the apex; bracts near the base (*fide* Haviland) small, ternate, deciduous. *Calyx*-tube short, silky, the lobes 5 or 6, erect, ovate, acute or sub-acute. *Corolla* infundibuliform, the tube glabrous; lobes 5, ovate, glabrous, rarely puberulous outside. *Stamens* 5, inserted in the tube of the corolla: *anthers* linear-oblong, sagittate at the base, the apex with a broad membranous apiculus; filaments as long as the anthers. *Style* exserted: *stigma* short, ovoid. *Fruit* cuneiform, boldly ribbed, its apex depressed and slightly hairy. *Bracteoles* of the capitule with filiform stalks and double fusiform heads; the upper part of the head papillose and yellow; the lower covered with pale hair. Wall. Cat. 6091; Hook. fil. Fl. Br. Ind. III. 27; Havil. in Journ. Linn. Soc. XXXIII. 57.

PENANG: *Porter*; *Curtis* 1056, 3405. PERAK: *Wray* 2598, 3197; *King's Collector* 3404, 3578, 6424, 6761.—DISTRIB. Borneo, *Beccari* (P.B. 1890).

Very close to *N. purpurascens*, Korth., but the nerves of the leaves of this are more numerous, the bracts of the peduncles are much smaller; the apical appendage of the anthers is much longer and the filaments shorter.

5. Adina, Salisb.

Trees or shrubs with petiolate sub-coriaceous or membranous leaves; the stipules small or large. *Flowers* sessile, in small bracteolate capitules. *Peduncles* in large or small panicles, or solitary, terminal or axillary. *Calyces* not concrete; the tube angled: lobes of the limb 5, short, persistent, or none. *Corolla* infundibuliform: the throat glabrous: lobes of the limb 5, imbricate or pseudo-valvate, the flowers mixed in the capitules with bracteoles. *Stamens* 5, on the mouth of the corolla; anthers short, oblong; filaments short. *Ovary* 2-celled; style thin, filiform, elongate; *stigma* clavate or capitate. *Ovules* numerous, imbricate on a pendulous placenta in each cell. *Fruit* 2-coccous, many-seeded. *Seeds* oblong, flat; testa winged; albumen fleshy.—Distrib. Eight or nine species, tropical Asiatic or African.

Capitules in threes on axillary peduncles; stigma globose... 1. *A. rubescens.*
Capitules in large lax usually terminal panicles; stigma clavate ... ... 2. *A. polycephala.*

1. Adina rubescens, Hemsl. in Journ. Bot. XXV. (1887), 204. A tree 60 to 80 feet high; young branches pale, striate, slender. *Leaves* sub-coriaceous, elliptic, shortly caudate-acuminate, the base cuneate; upper surface glabrous, the lower sometimes puberulous on the nerves, faintly reddish-brown in colour (when dry): main-nerves 8 to 10 pairs, spreading, curving, prominent below; length 2·5 to 4 in.; breadth 1·25 to 1·75 in.; petiole ·15 to ·25 in., slightly winged for half its length; *stipules* small bifid. *Capitules* about ·4 in. in diam. when in flower, in short, pedunculate, trichotomous, pubescent panicles, much shorter than the leaves. *Calyx* pubescent; the lobes very short, oblong. *Corolla-tube* ·1 in. long, hairy outside; its lobes 4 or 5, ovate, sub-valvate. *Stamens* inserted in the throat; *anthers* extending to the middle of the lobes, sub-setose at their bases. *Style* exserted; *stigma* globose. *Bracteoles* linear, compressed, pubescent. Havil. in Journ. Linn. Soc. XXXIII. 45.

Perak: *Wray* 539; *King's Collector* 7850. Singapore: *Ridley* 10458. Penang: *Curtis* 369.

2. Adina polycephala, Benth. Fl. Hongkong 146. A small tree; the young branches sub-compressed, slender, striate, at first dark but becoming pale. *Leaves* sub-coriaceous, oblong-oblanceolate, shortly caudate-acuminate, the base alternate; both surfaces glabrous: main-nerves 7 to 10 pairs, curving upwards, slightly prominent beneath;

length 4·5 to 9 in.; breadth 1·5 to 3 in.; petiole ·2 to ·6 in., winged near the apex. *Capitules* about ·35 in. in diam. when in flower, in pedunculate, trichotomously-branched, lax or condensed axillary or terminal pubescent panicles, shorter than the leaves. *Lobes* of the *calyx* oblong, obtuse, persistent. Tube of *corolla* glabrous, narrow; ·1 in. long; lobes 4 or 5, ovate. *Anthers* reaching to the middle of the lobes of the corolla. *Style* exserted, stigma clavate. *Fruit* obovoid, hairy in its upper part: bracteoles filiform. *Seeds* very shortly winged. Miq. Ann. Mus. Lugd. Bat. IV. 183; Koord. & Valet. Bijdr. 8, 17. *Nauclea polycephala*, Wall. Cat. 6100; G. Don Gen. Syst. III. 467; Kurz For. Flora Burma II. 65.

VAR. *macrophylla* Hook. fil. Fl. Br. Ind. II. 25, leaves oblanceolate, with 10 to 12 pairs of main-nerves, 6 to 10 in. long and 2·5 to 4 in. broad. *N. microcephala*, Wall. MSS. in Herb. Hook. *Adina aralioides*, Benth. & Hook. Gen. Plant. II. 30. *Nauclea capitellata*, Voigt Hort. Calc. 375. *N. trichotoma*, Zoll. Verz. Ind. Archipel. 61. *N. aralioides*, Miq. Fl. Ind. Bat. II. 344. *Cephalanthus aralioides*, Zoll. l.c.

PENANG: *Curtis* 2737, 2751. MALACCA: *Ridley* 758; *Derry* 130.—DISTRIB. Java; Sumatra; Cochin China; Burma; Chittagong.

The variety *macropylla* is the form most frequent in our region.

6. UNCARIA, Schreb.

Climbing shrubs. *Leaves* shortly petioled; stipules entire or bifid. *Flowers* in peduncled globose heads, solitary and axillary or collected in terminal panicles; peduncles (often without flowers) converted into stout, recurved hooks. *Calyx-tube* cylindric or double fusiform; the limb usually expanded, 5-toothed or 5-lobed. *Corolla* with a long cylindric tube, often expanded towards the apex, the limb with 5 slightly imbricate or valvate lobes, the throat glabrous. *Stamens* 5, inserted by short filaments on the throat of the corolla; *anthers* dorsifixed, with 2 basal bristles. *Ovary* fusiform, 2-celled. *Style* long, slender; *stigma* capitate; ovules many, ascending on the placentas. *Capsule* elongate, usually double fusiform, septicidally 2-valved, many-seeded. *Seeds* minute, numerous, imbricating upwards; the nucleus small, its testa winged at each end; albumen fleshy, embryo clavate, cotyledons short.—DISTRIB.: about 40 species mostly tropical Asiatic.

Lobes of calyx narrow, acute :—
  Flowers and capsules subsessile ... ... 1. *U. Roxburghiana.*
  Flowers and capsules distinctly pedicellate :—
    Leaves pubescent beneath :—
      Calyx-lobes lanceolate, acute, shorter than the tube :—
        Flowers ·75 in. long; leaves ovate-lanceolate, 2·5 to 3·5 in. long ... ... 2. *U. lanosa.*

Flowers 1·5 in. long; leaves broadly oblong or ovate-rotund, 5 to 7 in. long	3. *U. sclerophylla.*
Flowers 1 in. long; leaves 4 or 5 in. long, oblong or ovate, never rotund-ovate	4. *U. pedicellata.*
Calyx-lobes filiform, longer than the tube, spreading; tube of corolla very slender; capsules on long, slender stalks:—	
Young branches, under surfaces of leaves, and capsules rusty-pubescent	5. *U. ferrea.*
Young branches and capsules glabrous; leaves slightly pubescent on the under surface only ...	6. *U. glabrata.*
Leaves glabrous or nearly so on both surfaces:—	
Lobes of the calyx shorter than the tube ...	7. *U. Kunstleri.*
Lobes of the calyx as long as the tube	8. *U. Wrayi.*
Lobes of the calyx short, broad, blunt:—	
Leaves quite glabrous, not glaucescent beneath:—	
Leaves 1·75 to 2·5 in. long:—	
Leaves with 3 or 4 pairs of nerves; tube of calyx densely pubescent, the lobes of the limb sub-glabrous	9. *U. ovalifolia.*
Leaves with 5 or 6 pairs of nerves; tube and lobes of calyx pubescent externally	10. *U. jasminiflora.*
Leaves 3·5 in. or more in length:—	
Nerves of leaves 5 or 6 pairs	10. *U. jasminiflora* var. *macrophylla.*
Nerves of leaves 3 pairs	11. *U. trinervia.*
Leaves glabrous, glaucescent beneath; nerves of leaves 7 or 8 pairs, the reticulations transverse and very distinct beneath	12. *U. pteropoda.*
Leaves glabrous, but the 4 or 5 pairs of main-nerves with tufts of hair on the lower surface, at their union with the midrib	13. *U. Gambier.*
Leaves uniformly canescent beneath: nerves 5 or 6 pairs	14. *U. canescens.*
Under surfaces of midrib and the 4 to 6 pairs of main-nerves laxly hirsute, sometimes with tufts of hair in the nerve-axils	15. *U. dasyoneura.*
Calyx-tube long, the teeth very short and blunt:—	
Nerves of leaves 6 to 8 pairs, stout, and bearing like the midrib and transverse veins short pale-brownish hairs ...	16. *U. attenuata.*

1. Uncaria Roxburghiana, Korth. in Ver. Nat. Gesch. Bot. 172. Young branches obtusely 4-angled, densely clothed with minute, partially deciduous, harsh, rusty tomentum. *Leaves* coriaceous, ovate, acuminate sometimes caudately so; the base rounded, emarginate or minutely cordate; both surfaces reticulate, the upper strigose-scabrid, the lower with longer curved hispid hairs; main-nerves 4 or 5 pairs, curved, spreading, ascending, depressed on the upper and prominent on the lower surface like the midrib; length 2·5 to 3·5 in.; breadth 1·5 to

2 in.; petiole ·15 in., tomentose; stipules broad, bifid, glabrous, ·2 in. long. *Peduncles* five or six times longer than the petioles, axillary, stout, compressed, tomentose, bracteate near the apex, sometimes one of them barren and forming a much-recurved hook; heads in flower about 1 in. in diam., in fruit rather less. *Calyx* almost sessile, ·15 in. long, pilose; the tube oblong-ovoid; lobes of its mouth linear, blunt, twice as long as the tube. *Corolla* about three times as long as the calyx, glabrous: the tube narrowly cylindric, angled, the lobes of the limb broadly oblong, very obtuse. *Capsules* sub-sessile, narrowly double-fusiform, glabrous, ·35 in. long, crowned by the short calyx-lobes. Hook. fil. Fl. Br. Ind. III. 32: Havil. in Journ. Linn. Soc. XXXIII. 87.

Singapore: *Anderson* 106; *Ridley* 2844. Perak: *King's Collector.* 2148. Malacca: *Maingay* (K.D.) 831.—Distrib. Sumatra.

2. Uncaria lanosa, Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II. 131: Wall. Cat. 6110. Young branches sparsely hirsute, reddish-brown when dry. *Leaves* membranous, ovate-lanceolate, shortly acuminate, the base rounded or narrowed: upper surface of a warm-brown when dry, glaberulous or with scattered hairs, the midrib and nerves pubescent: lower surface pale brown, clothed with soft, adpressed long slender tawny hairs especially on the midrib and 6 or 7 pairs of rather bold slightly curved ascending main-nerves; length 2·5 to 3·5 in.; breadth 1 to 1·6 in.; petioles ·15 to ·2 in. long, pubescent; *stipules* broadly triangular, deeply bifid, reflexed, glabrous inside. *Peduncles* axillary, several times longer than the petioles, tapering upwards, somewhat compressed, pubescent, with 4 linear reflexed glabrous bracts near the apex. *Capitules* ·75 in. in diam. when in flower, 2 in. when in fruit. *Calyx* ·2 in. long, pedicellate, glabrescent, the tube double-fusiform, not longer than the 5 linear externally hairy lobes of the limb. *Corolla* glabrous, three times as long as the calyx; the tube very narrow, the lobes linear, spreading. *Capsules* clavate-fusiform; ·25 to ·35 in. long, on long slender pedicels, longer than themselves, glabrous. Hook fil. Fl. Br. Ind. III. 33; Havil. in Linn. Journ. XXXIII. 85. *Nauclea lanosa*, Poir. Encycl. Suppl. IV. 64. *N. setigera*, Blume Bijdr. 1013.

Penang: *Phillips; Curtis* 917. Perak: *Scortechini.*

3. Uncaria sclerophylla, Hunter in Roxb. Hort. Beng. 86; Fl. Ind. ed. Wall. II. 130; idem ed. Carey I. 520. Very large; young branches as thick as or thinner than a goose-quill, densely rusty-pubescent or villous, 4-angled, sometimes bearing stout recurved hooks. *Leaves* coriaceous, broadly oblong or ovate or rotund-ovate; shortly and bluntly apiculate, the base rounded and sometimes minutely cordate: upper surface dark-coloured, shining, the nerves hairy; the lower densely rusty-pubescent; the midrib, 8 to 10 pairs of main-nerves and

the transverse veins much depressed on the upper, very prominent on the lower surface; length 5 to 6·5 in.; breadth 3 to 5 in.; petiole ·4 to ·6 in.; stipules large, rounded, bluntly bifid, sparsely hairy, reflexed, ·5 in. long. *Heads* from 4 to 5·5 in. in diam. to the ends of the style, on thick, axillary, rusty-pubescent spreading peduncles shorter than the leaves, bearing a whorl of bracts about the middle. *Calyx* pedicellate about ·5 to ·8 in. long, densely adpressed-sericeous, the tube short, ovoid; the limb campanulate, cut into 5 narrowly lanceolate, acute lobes. *Corolla* villous or sericeous externally; about twice as long as the calyx; its tube narrow, cylindric below; the mouth funnel-shaped and deeply cut into 5 oblong or lanceolate sub-acute, erect lobes. *Capsules* on slender, rusty stalks; ·5 to 1 in. long, oblong, tapering much to each end; densely but shortly rusty-pubescent, ribbed, ·6 or ·7 in. long, crowned by the large funnel-shaped calyx-limb. *U. sclerophylla*, DC. Prod. IV. 347; Miq. Fl. Ind. Bat. II. 148; Hook. fil. Fl. Brit. Ind. III. 28; Koord. & Valet. Bijdr. 8, 42. *U. speciosa*, Wall. Cat. 6106. *U. insignis*, DC. Prod. IV. 348: Havil. l.c. 78: *U. Ralli*, Korth. Verh. Nat. Gesch. Bot. 165, t. 33. *Nauclea rotundifolia*, DC. Prod. IV. 346. *Nauclea sclerophylla*, Hunter in Trans. Linn. Soc. IX. 223.

In all the provinces except the Andamans, more or less common.—DISTRIB. Malay Archipelago.

This is closely allied to *U. pedicellata*, Roxb., which see.

4. UNCARIA PEDICELLATA, Roxb. Hort. Beng. 86: Fl. Ind. ed. Carey I. 520; idem, ed. Wall. II. 128. Like *U. sclerophylla*, Roxb. in all its parts, but somewhat less robust and much less hairy, the leaves smaller, narrower, never subrotund, paler and much less hairy beneath; sometimes even sub-glabrous; the flowers smaller (only about 1 in. long); the lobes of the calyx only ·25 in. long; the tube of the corolla only ·4 or ·5 in. long, more slender, ferrugineous-silky, rather than pilose or villous; capsule shorter (·5 to ·6 in.) but wider in proportion. DC. Prod. IV. 348; Korth. Verh. Nat. Gesch. 166; Miq. Fl. Ind. Bat. II. 142; Hook. fil. Fl. Brit. Ind. II. 28; Havil. in Journ. Linn. Soc. XXXIII. 77 (in part); Koord. & Valet. Bijdr. 8, 43. *U. sclerophylla*, Deless. Ic. Pl., t. 81: Havil. l.c. (in part). *U. ferruginea*, DC. Prod. IV. 348; Korth. Verh. Nat. Gesch. 166; Kurz. Fl. Burm. II. 69. *U. sclerophylla* Havil. (not of Roxb.) in Journ. Linn. Soc. XXXIII. 78. *Uncaria pedicellata*, Bl. Bijdr. 1012. *Nauclea ferruginea*, Bl. Bijdr. 1013.

In all the Provinces, very common.

This closely resembles *U. sclerophylla*, Roxb., and should probably be treated as a variety of that species. In a few specimens of this the under surfaces of the leaves between the reticulations are pale-grey and pitted.

5. Uncaria ferrea, DC. Prod. IV. 348. Young branches much thinner than a goose-quill, minutely but deciduously rusty-pubescent, the bark dark-coloured. *Leaves* membranous, ovate or ovate-lanceolate, shortly and bluntly acuminate, the base rounded or slightly emarginate; upper surface dark-coloured when dry, glabrous or with a few scattered deciduous sub-adpressed pale hairs, the midrib and sometimes the main-nerves pubescent; lower surface pale, minutely reticulate, sub-adpressed rusty-pilose on the midrib and nerves; main-nerves 7 or 8 pairs, curving upwards, depressed on the upper surface like the midrib and prominent on the lower; length 2·5 to 3·25 in.; breadth 1·35 to 2 in.; petioles ·1 to ·2 in., tomentose; stipules broadly semilunar, deeply two-lobed, adpressed rusty-pilose, ·25 in. long. *Peduncles* much longer than the petioles, but shorter than the leaves, lengthening in fruit, compressed, densely ferruginous-tomentose; bracteate above the middle; heads about 1·5 to 2 in. in diam. when in flower, and 2 to 3 in. when in fruit. *Calyx* shortly stalked, ·25 in. long, silky; the tube narrowly oblong-ovoid; the limb deeply divided into filiform lobes longer than the tube. *Corolla* about twice as long as the calyx, glabrous; its tube very narrowly cylindric, angled: the lobes of the mouth broadly oblong or obovoid, very obtuse. *Capsules* double-fusiform, ridged, pubescent, ·5 to ·75 in. long, crowned by the filiform calyx-lobes, tapered into slender pedicels as long as themselves. Hook. fil. Fl. Br. Ind. III. 33; Havil. in Journ. Linn. Soc. XXXIII. 87; Koord. & Valet. 8, 44. *U. Horsfieldiana*, Miq. Fl. Ind. Bat. II. 151. *Nauclea ferrea*, Blume Bijdr. 1014.

Perak: *Scortechini* 130; *Wray* 2555; *Curtis* 1305; *King's Collector* 2240, 2453, 4899. Selangor: *Goodenough.*—Distrib. Sumatra; Borneo; Java.

var. *tomentosa;* young branches, under-surfaces of leaves and peduncles densely rusty-tomentose, calyx and capsules more silky than in the type.

Malacca: *Maingay* (K.D.) 830; *Derry* 1070; *Ridley* 10078. Perak: *King's Collector* 429, 790, 5390. Pahang: *Ridley* 2192. Negri Sembilan: *Ridley* 10080. Andamans: *Helfer* 2761.—Distrib. Java; Sumatra.

6. Uncaria glabrata, DC. Prod. IV. 348. As in *U. ferrea* but with young branches glabrous and often bearing shining, much recurved slender hooks about than ·5 in. long; longer peduncles (which are glabrous and bracteate not much below the apex); less filiform, blunt calyx lobes; and glabrous capsules which are thicker but shorter (about ·4 in. long). Havil. in Journ. Linn. Soc. XXXIII. 85; Koord. & Valet. Bijdr. 8, 44. *U. Lobbii*, Hook. fil. in Fl. Br. Ind. III. 33.

Singapore: *Lobb.* 100, 332; *Ridley* 2846, 2853, 8035; *Hullett; King's Collector* 277. Selangor: *Goodenough.*—Distrib. Sumatra; Java; Borneo.

7. UNCARIA KUNSTLERI, King n. sp. Young branches thinner than a goose-quill, 4-angled, grooved, deciduously puberulous. *Leaves* coriaceous, elliptic or obovate-elliptic, narrowed to the petiole, the apex with a small blunt acumen; both surfaces sparsely and minutely puberulous especially on the midrib and 5 or 6 pairs of ascending slightly curved main-nerves; main-nerves depressed on the upper surface, thin but prominent on the lower; length 2·5 to 4 in.; breadth 1·25 to 2·25 in.; petiole ·35 to ·5 in., puberulous; stipules ·3 in. long. *Peduncles* as long as or slightly longer than the petioles, axillary, compressed in the lower half, often hooked, bracteate about the middle; *heads* nearly 1 in. in diam. when in flower. *Calyx* ·1 in. long, its stalk ·05 in., densely pubescent, the tube narrowly funnel-shaped, the lobes of the mouth narrowly oblong, acute, shorter than the tube. *Corolla* three times as long as the calyx, adpressed-pilose, very narrowly cylindrical, funnel-shaped in its upper third, the lobes of the limb oblong, blunt.

PERAK: *King's Collector* 5376, 6843.

Very near *U. jasminiflora*, but with more coriaceous leaves, and narrower, more oblong calyx-lobes.

8. UNCARIA WRAYI, King n. sp. A bush (?). Young branches half as thick as a goose-quill, dark-coloured, with small pale white lenticels, obtusely 4-angled, glabrous. *Leaves* coriaceous, broadly obovate-elliptic, shortly and bluntly acuminate, narrowed at the base; both surfaces glabrous, the upper shining olivaceous when dry: the lower paler and minutely reticulate (the veinlets very dark); main-nerves 5 pairs, slightly curved, ascending, inconspicuous; length 2·5 to 3 in.; breadth 1·35 to 1·9 in.; petioles ·5 in., slender. *Peduncles* axillary, slightly longer than the petioles, compressed; bracteate above the middle; glabrous below the bract and pubescent above it. *Calyx* shortly pedicelled, densely pubescent, ·2 in. long; the tube cylindric or somewhat double fusiform, about as long as the narrowly campanulate limb; lobes lanceolate, sub-acute. *Corolla* softly pubescent, known only in bud.

PERAK: *Wray* 2383.

9. UNCARIA OVALIFOLIA, Roxb. Hort. Beng. 86; Fl. Ind. I. 519; in Wall. Cat. sub. 6103 B, C, (*U. Gambier*). Young branches thinner than a crow-quill, obtusely 4-angled, glabrous. *Leaves* membranous, elliptic to ovate-elliptic, the apex shortly and obtusely acuminate or sub-acute, the base cuneate; both surfaces glabrous; main-nerves 3 or 4 pairs, ascending, slightly curved, thin; length 1·75 to 2·75 in.; breadth ·85 to 1·4 in.; petiole ·35 to ·45 in., slender, stipules broad, lunate-acute, bifid, ·35 in. long. *Peduncles* axillary, about twice as long as the

petioles, slender, rusty-puberulous, or glabrous, occasionally forming compressed tapering much recurved hooks, the bract small and near the base. *Head* about 1 in. in diam. in flower and 1·5 in. in fruit. *Calyx* ·15 in. long, nearly sessile, densely rusty-pubescent except the lobes; the tube narrowly ovoid, contracted into a cylindric deeply lobed limb, the lobes short, broadly oblong, blunt, spreading, sub-glabrous. *Corolla* twice as long as the calyx, very narrowly funnel-shaped, pale pubescent outside, the teeth narrowly oblong, blunt, glabrous inside. *Capsules* narrowly double-fusiform, occasionally somewhat curved, about ·4 or ·5 in. long, crowned by the thick, erect calyx-tube, narrowed into the short rusty pilose pedicel, adpressed-pubescent. Hook. fil. Fl. Br. Ind. III. 30. *N. ovalifolia*, Spreng. Syst. IV. Curae Post. 80.

MALACCA: *Griffith* (K.D.) 2758, 2759; *Cunning* 2292. SELANGOR: *Curtis* 2342. PERAK: *Scortechini; King's Collector* 5262.—DISTRIB. Burma; Borneo.

10. UNCARIA JASMINIFLORA, Hook. fil. Fl. Br. Ind. III. 32. Young branches thinner than a goose-quill, somewhat compressed, 4-angled, puberulous. *Leaves* thinly coriaceous, broadly elliptic, rarely elliptic-lanceolate, with an abrupt, short, blunt acumen, the base rather abruptly narrowed to the slender petiole; both surfaces glabrous; when adult the nerves and midrib on the lower surfaces puberulous; when young the upper pale brown and shining when dry; the lower paler and minutely reticulate; main-nerves 5 or 6 pairs, spreading, curving upwards, thin; length 2 to 2·5 in.; breadth 1 to 1·5 in.; petiole ·5 in., puberulous; stipules entire, ·2 in. long. *Peduncles* axillary, longer and thicker than the petioles; compressed, puberulous; heads rather more than 1 inch in diam. when in flower, about 1·75 when in fruit, bracteate near the apex. *Calyx* shortly pedicellate, ·15 in. long, adpressed pilose; the tube shortly double-fusiform, about as long as the campanulate limb, lobes short, broad, obtuse, glabrous inside. *Capsules* about ·5 in. long, double-fusiform, crowned by the calyx-limb, ridged, puberulous, their pedicels slender, ·15 to ·2 in. long. Wall. Cat. 6103 C.F.; Havil. in Journ. Linn. Soc. XXXIII. 80.

MALACCA: *Griffith* (K.D.) 2766; *Maingay* (K.D.) 832, 833. SINGAPORE: *Ridley* 10415, 6467; *King* 382. PERAK: *King's Collector* 4619, 7860; *Wray* 3124. SELANGOR: *Ridley* 8579.—DISTRIB. Borneo.

VAR. *macrophylla*, King. Stem-hooks stout, compressed, much curved. *Leaves* 3·5 to 5 in. long, dark brown and very shining in the upper surface, 3·5 to 5 in. long and 2 to 2·5 in. broad; capsules nearly glabrous.

SINGAPORE: *Schomburgk* 65; *Anderson* 87; *Hullett* 41, 75.

11. UNCARIA TRINERVIS, Haviland in Journ. Linn. Soc. XXXIII.

80. Young branches thinner than a goose-quill, obtusely 4-angled, compressed and broad at the nodes, pale brown, glabrous; the hooks much curved and compressed. *Leaves* coriaceous, pale brown when dry, ovate or elliptic, slightly and abruptly narrowed at the base, the apex shortly, abruptly and broadly acuminate; both surfaces quite glabrous, with fine transverse veins and minute reticulations; main-nerves 3 pairs, ascending, depressed on the upper, but prominent on the lower surface; length 3·5 to 4·5 in.; breadth 1·75 to 2·5 in.; petiole ·7 to ·9 in.; stipules small, broad, entire. *Inflorescence* racemose; peduncles ·75 in. long, compressed, minutely pubescent; their bases broad and glabrous; bracts (*fide* Haviland) entire, ·15 in. long. *Heads* (including the styles) about 1 in. in diam., the flowers sub-sessile, pale tomentose externally. *Calyx* ·1 in. long, its lobes broad, blunt. *Corolla* ·25 in. long, the tube cylindric; the lobes broad, blunt. *Capsules* double-fusiform, crowned by the conspicuous calyx, minutely pilose, ·5 in. long; *receptacles* without bracteoles, hirsute.

PENANG: *Curtis* 1247. PERAK: *Curtis* 2981.

Allied to *U. pteropoda*, Miq., but with smaller quite glabrous leaves which have only 3 pairs of nerves and with smaller flowers. Allied also to *U. canescens*, Korth., from which it is distinguished by its smaller, fewer-nerved, glabrous leaves.

12. UNCARIA PTEROPODA, Miq. Fl. Ind. Bat. II. 343. Young branches 4-angled, somewhat compressed, broadly grooved, as thick as a goose-quill, glabrous. *Leaves* coriaceous, elliptic-rotund, the apex with a short, broad, blunt point, the base broad and rounded; both surfaces glabrous, the upper shining, minutely reticulate (when dry): the lower pale-glaucescent; main-nerves about 8 pairs, deeply depressed like the midrib on the upper surface, prominent on the lower, spreading, curving slightly upwards; length 5 to 6·5 in.; breadth 3·5 to 5 in.; petiole ·35 to ·85 in. long, with a broad undulate wing. *Peduncles* axillary, strong, much compressed, grooved, somewhat longer than the petioles, often much recurved, bracteate near the apex; sometimes collected into a terminal panicle longer than the leaves; *heads* about 1 inch across when in flower, two or three times as much when in fruit. *Calyx* shortly stalked, ·25 to ·3 in. long in flower, rusty-pubescent; its tube narrow, double-fusiform, about ·25 in. long, crowned by the short narrowly campanulate limb, its lobes narrowly oblong, blunt or sub-acute. *Corolla* nearly three times as long as the calyx, silky, the tube narrowly cylindric; the lobes of the limb broad, obovate, blunt. *Capsules* narrowly double-fusiform, ·6 to ·75 in. long, up to 1 in. when quite ripe; on stalks nearly as long, minutely rusty-pubescent, crowned by the short calyx-tube. Hook. fil. Fl. Br. Ind. III. 29; Havil. in Journ. Linn. Soc. XXXIII. 82.

SINGAPORE: *Ridley* 2854; *Anderson* 105. PERAK: *Wray* 2738, 3115 *Scortechini* 256; *King's Collector* 2528, 4587, 6576, 7831, 7882, 10189, 10593. PENANG: *Phillips; Curtis* 332. MALACCA: *Maingay* (K.D.) 829. —DISTRIB. Sumatra; Borneo.

A very distinct species, the leaves drying of a pale colour.

13. UNCARIA GAMBIER, Hort. Beng. 86; Fl. Ind. I. 517. Young branches thinner than a goose-quill, obtusely 4-angled, glabrous. *Leaves* thinly coriaceous, olivaceous; brown when dry, the lower surface paler; ovate or oblong-ovate, shortly acuminate, the base usually rounded, occasionally a little narrowed and oblique; both surfaces glabrous except for the tufts of hair at the origin of the main-nerves from the midrib on the lower: main-nerves 4-5 pairs, curved, spreading, obscure on the upper, bold on the lower surface (when dry); length 3 to 4·5 in.; breadth 1·85 to 2·25 in.; petioles ·2 to ·25 in.; *stipules* ovate, bluntly acuminate, ·3 in. long. *Peduncles* axillary, usually shorter than the leaves, slightly compressed, bracteate above the middle, glabrous below and pubescent above the bract; *heads* 1·75 in. in diam. when in flower, 2·75 in. in fruit. *Calyx* shortly stalked, ·35 in. long, densely adpressed-silky; the tube cylindric, ridged; the mouth campanulate, somewhat shorter than the tube; its lobes spreading, ovate, blunt, glabrous inside. *Corolla* ·5 in. long, narrowly funnel-shaped, with sparse (rarely dense) white hairs outside, the lobes broadly oblong, blunt, densely silky outside, glabrous inside. *Capsules* narrowly double-fusiform, sometimes curved, ·75 to 1 in. long, crowned by the large calyx-tube, ridged, sparsely pubescent; the pedicels unequal, ·2 to ·4 in. long. Korth. Verh. Nat. Gesch. Bot. t. 34: Hook. fil. Fl. Br. Ind. III. 31: Havil. in Journ. Linn. Soc. XXXIII. 81; Wall. Cat. 6103 A.E.C. (in part) and 6107 in part. *Nauclea Gambier*, Hunter in Linn. Trans. IX. 218 t. 22; Flem. in As. Res. XI. 187. *U. acida*, Roxb. Fl. Ind. I. 520. *Nauclea acida*, Hunter in Linn. Trans. IX. 223.

SINGAPORE: *Cunning* 2403; *Anderson* 95; *Ridley* 2843; *Walker* 90; *King's Collector* 1158; *Hullett* 361. PERAK: *King's Collector* 2262. JOHOR: *King* 671. MALACCA: *Derry* 59; *Griff.* 2757.—DISTRIB. Over the whole Malayan Archipelago either cultivated or wild.

Maingay No. 827 differs from the sheets above noted in having brown leaves and rusty-pubescence. This may be the species named *U. acida* by Roxburgh whose description makes it impossible now to distinguish it from *U. Gambier.*

14. UNCARIA CANESCENS, Korth. Verh. Nat. Gesch. 172. A slender creeper; young branches thicker than a crow-quill; grooved, compressed and obtusely 4-angled, minutely pubescent. *Leaves* coriaceous,

olivaceous and shining on the upper surface, pale and dull on the lower (when dry), elliptic or ovate-elliptic, abruptly, bluntly and shortly acuminate, rounded or slightly narrowed at the base; upper surface glabrous except the puberulous midrib and nerves, the lower minutely pale-puberulous; main-nerves 5 or 6 pairs, depressed on the upper and prominent on the lower surface, slightly curved, ascending; length 3·5 to 5 in.; breadth 1·85 to 3 in.; petioles ·5 to ·7 in., pubescent. *Peduncles* slender, slightly longer than the petioles, densely rusty-pubescent in the upper parts bracteate about or below the middle; heads ·5 or ·6 in. in diam. *Calyx* ·15 in. long, shortly stalked, adpressed rusty-pilose, the tube double-fusiform, the mouth expanded, its lobes broad, blunt, glabrous within. *Corolla* rather more than twice as long as the calyx, pilose, the tube very narrowly cylindrical; the lobes of the mouth short, lanceolate-ovate, sub-acute, glabrous inside. *Capsules* unknown. Hook. fil. Fl. Br. Ind. III. 29: Havil. in Journ. Linn. Soc. XXXIII. 80.

PERAK: *King's Collector* 3871, 4584. PENANG: *Griffith, Curtis* 331.

15. UNCARIA DASYONEURA, Korth. Ver. Nat. Gesch. 169. Young branches obtusely 4-angled, glabrous. *Leaves* elliptic or elliptic-rotund, shortly, abruptly and bluntly acuminate, the base rounded or narrowed, upper surface dark-brown when dry, glabrous, shining; the lower paler brown; laxly hirsute on the midrib and nerves, otherwise glabrous, rarely with tufts of hair in the nerve axils; main-nerves 4-6 pairs, very slightly curved, ascending, distinct below; the intermediate veins horizontal: length 3 to 4 in.; breadth 1·75 to 2·25 in.; petioles about ·5 in. long, narrowly winged above, glabrous; *stipules* minute; entire. *Peduncles* shorter than the petioles, broad, glabrous and compressed at the base, thin and pubescent in the upper two-thirds, with deciduous, linear-oblong bracts at the point of constriction. *Flowers* sub-sessile. *Calyx* narrowly urceolate, minutely ferruginous-tomentose, about ·15 in. long; its limb with broad, blunt lobes. *Corolla* three times as long as the calyx: the tube narrowly cylindric, adpressed hairy, the limb shortly campanulate, with 5 blunt lobes, glabrous inside. *Capsules* narrowly double-fusiform, glabrous, ·8 in. long, their pedicels shorter. Miq. Fl. Ind. Bat. II. 143; Hook. fil. Fl. Br. Ind. III. 31; Havil. in Linn. Journ. XXXII. 82. *U. Gambier*, Thw. Enum. Pl. Zeyl. 138. *U. elliptica*, R. Br. in Wall. Cat. 6104 A. (in part), B.

MALACCA: *Griffith* 2756; *Maingay* (K.D.) 827/2. SINGAPORE: *Lobb.* PENANG: *Phillips; Curtis* 1070. PERAK: *King's Collector* 2501.—DISTRIB. Java, Ceylon.

16. UNCARIA ATTENUATA, Korth. in Verh. Nat. Gesch. Bot. 170; t. 34. Young branches thinner than a goose-quill, obtusely 4-angled, minutely rusty-pubescent. *Leaves* coriaceous, broadly elliptic or ovate-

elliptic, slightly narrowed at base, the apex with a very short, blunt acumen; upper surface dark olivaceous-brown, shining; lower warm brown, with short pale brownish hairs on the midrib, nerves, and their axils, and on the distant transverse veins: main-nerves 6 to 8 pairs, boldly prominent on the lower, depressed on the upper surface; rather straight, ascending; length 3 to 5 in.; breadth 1·75 to 3 in.; petiole ·4 to ·5 in. *Peduncles* solitary, axillary, about twice as long as the petioles, much compressed in the lower half, rusty-pubescent. *Heads* (to the ends of the styles) nearly 1·5 in. in diam. *Flowers* shortly pedicellate. *Calyx* ·15 in. long, funnel-shaped, rusty-tomentose; the tube slightly inflated, the limb as long as the tube with short blunt teeth. *Corolla* twice as long as the calyx, narrowly cylindric, the mouth abruptly expanded and cut into 5 deep, broad, blunt, oblong lobes. *Capsules* narrowly double-fusiform, crowned by the wide calyx-limb, ·7 to ·9 in. long, rusty-tomentose. *U. Gambier*, Wall. Cat. 6105 C. *in part.* Hook. fil. Fl. Br. Ind. I. 29; Havil. in Journ. Linn. Soc. XXXIII. 83. *? U. sclerophylla*, Deless. Ic. Select. III. t. 81.

Malacca: *Holmberg* 889. Penang: *Hunter*, *Phillips*, *Curtis* 135. Perak: *King's Collector* 4880; *Wray* 3150. Tenasserim and Andamans: *Helfer* (K.D.) 2767.—Distrib. Borneo; ? Java.

Doubtful Species.

Uncaria ovata, R. Br. in Wall. Cat. 6112: Hook. fil. Fl. Br. Ind. III. 29. The single sheet bearing the No. 6112 in the Wallichian Herbarium at Burlington House has two things glued down on it, *viz.*, two twigs of *U. Gambier*, Roxb., and a third twig which must, by exclusion, be this. Unfortunately a specimen exactly resembling this third twig, collected by Finlayson and probably, like so many of his plants, in Siam, was issued by Wallich under the number 6103 D. and the name *U. Gambier*, while another also exactly like it, but collected in Sylhet, was issued by him under the number 6107 and the name *U. sessilifolia.* I have seen no Malayan specimens which resemble these two except the one attributed by Wallich to Singapur, which I, therefore, believe must have been so attributed as the result of some confusion of specimens at the time of issue.

7. Coptosapelta, Korth.

Scandent shrubs with terete branches. *Leaves* coriaceous, softly hairy beneath; stipules small, triangular, deciduous. *Flowers* in terminal many-flowered often thyrsoid panicles; the buds 5-angled; the pedicels short, bi-bracteolate. *Calyx-tube* ovoid, 5-ridged, the limbs shortly 5-toothed, persistent. *Corolla* coriaceous, salver-shaped; the tube narrow, its throat naked or hairy; the limb deeply divided into 5 linear-oblong, blunt, valvate lobes, longer than or as long as the tube. *Stamens* 5, inserted on the throat; anthers long, linear, flexuose, bifid at the base, hairy on the back; filaments short, subulate. *Ovary* 2- to 3-celled, with many ascending ovules, the placentas on the septum. *Style* short; stigma exserted, long-fusiform, or quadrangular. *Capsule* 2-3-celled, sub-globose, loculicidally dehiscing by 2 or 3 valves. *Seeds* small, numerous, peltate, imbricate, winged; embryo straight, in fleshy albumen.—DISTRIB. Species all Malayan.

Corolla-tube nearly as long as the lobes, its throat glabrous; calyx-tube under ·05 in. in diam.... ... ... 1. *C. flavescens.*
Corolla-tube much shorter than the lobes, its throat densely woolly; calyx-tube more than ·15 in. diam. ... ... 2. *C. Griffithii.*

1. COPTOSAPELTA FLAVESCENS, Korth. in Ned. Kruidk. Arch. II. 113. Young branches, panicles and under surfaces of the leaves covered with soft, minute, partly deciduous hair. *Leaves* elliptic or ovate, minutely apiculate, the base rounded, somewhat narrowed; upper surface glabrous and shining; main-nerves 4 or 5 pairs, curving upwards, slightly prominent on the lower surface; length 2·5 to 4 in.; breadth 1·5 to 2·5 in.; petiole ·2 to ·3 in., pubescent. *Stipules* very acuminate, ·15 in. long. *Flowers* about 1 in. long (of which the calyx forms only ·15 in.) *Calyx* under ·05 in. in diam., tubular, 5-ridged, pilose; the 5 teeth small, erect, sub-glabrous. *Corolla-tube* ·3 in. long, narrow; the lobes of the limb oblong, blunt, ·4 in. long, reflexed, glabrous or sub-glabrous. *Anthers* and stigma nearly as long as the corolla-lobes. *Stigma* cylindric-fusiform, puberulous. *Capsule* broadly obovoid, glabrous, ·3 or ·4 in. in diam. Hook. fil. Fl. Br. Ind. III. 35. *Stylocoryne macrophylla*, Wall. Cat. 8405 (excl. syn.) *Webera macrophylla*, Roxb.

PENANG: *Porter*, *Griffith* (K.D.) 2788. MALACCA: *Maingay* (K.D.) 908. PERAK: *Wray* 1801, 2521, 4276; *King's Collector* 4651, 7938, 10384, 10393, 10853. PAHANG: *Ridley* 2192.—DISTRIB. Burma; Malay Archipelago.

2. COPTOSAPELTA GRIFFITHII, Hook. fil. Hook. Ic. Plant. t. 1089: Fl. Br. Ind. III. 35. *Leaves* as in *C. flavescens;* but with only 3 pairs of nerves and the under surface paler and rather more hairy; also the *panicles* with fewer flowers. *Flowers* only ·85 in. long, their buds nearly ·15 in. in diam. *Calyx* rather more than ·2 in. long and ·15 in. in diam., the tube densely tomentose: the limb scantily hairy, cylindric, nearly as long as the tube; its 5 or 6 teeth short, broad, erect. *Corolla-tube* ·25 in. long and half as much wide, the throat densely woolly, the lobes of the limb linear-oblong, obtuse, reflexed, twice as long as the tube, rusty adpressed-pubescent on the lower, glabrous or sub-glabrous on the upper surface.

MALACCA and SINGAPORE: *Griffith* (K.D.) 2789; *Maingay* (K.D.) 907. PERAK: *Scortechini* 1983; *Wray* 1827; *King's Collector* 4366, 7938.

SINGAPORE: *King's Collector* 75. *Anderson* 101; *Ridley* 6824, 6891. PAHANG: *Ridley* 2229.

8. MUSSAENDOPSIS, Baillon.

A tall tree, all parts glabrous except the inflorescence. *Leaves* very coriaceous, broad, entire, petiolate, main-nerves few, stout, veins indistinct; stipules coriaceous, oblong, blunt. *Flowers* shortly pedicellate in lax, axillary, cymose panicles, with opposite spreading branches. *Calyx* puberulous, campanulate; the limb truncate, with 5 minute, broad lobes, one of them occasionally developed into a large coloured obovate 5-nerved lobe attenuate at base, 1 in. long. *Corolla* short, puberulous outside, ovoid in bud: the tube very short or none, the lobes 5, thick, oblong, slightly twisted in bud, slightly papillose near the margin. *Disc* fleshy. *Stamens* 5; anthers linear-oblong, curved. *Style* fleshy, short, lobes of the stigma short, thick, rounded. Ovary 2-celled, the placentas attached to the septum. Ovules numerous. *Fruit* capsular, many-seeded, septicidal. *Seeds* small, winged at the margin; embryo fleshy with scanty albumen. A single species, Malayan.

MUSSAENDOPSIS BECCARIANA, Baillon in Adansonia, XII. 282. A tree 100 feet high. *Leaves* sub-orbicular to elliptic, shortly apiculate, 4 to 6 in. long and 2·75 to 4·5 in. broad: main-nerves about 6 pairs, rather straight, depressed on the upper and prominent on the lower surface: petiole ·75 to 1 in. long: stipules oblong, blunt, almost as long as the petiole. *Panicles* about 8 in. in diam., and half as much long; their peduncles 3 to 4 in. long. *Calyx* ·15 in. long: the foliaceous lobe obovate, tapering to the base, 1 to 1·25 in. long and ·6 to ·8 in. broad, white. *Corolla* lobes about ·15 in. long and ·1 in. broad, spreading or reflexed. *Capsule* oblong-subclavate, slightly compressed, ·6 in. long; puberulous, very coriaceous, splitting from above downwards, the septum also coriaceous. Stapf in Hook. Ic. Pl. 2388. *Creaghia fagræopsis,* Scortechini in Journ. Bot. 1884, 370.

MALACCA: *Maingay* (K.D.) 835, 1692; *Derry* 1044. PERAK: *Scortechini, King's Collector* 6195.—DISTRIB. Borneo, *Beccari, Haviland;* Sumatra, *Ridley* 9016.

9. GREENIA, W. & A.

Shrubs with terete branches. *Leaves* sometimes in whorls of three, membranous; stipules various. *Flowers* small, sessile, in terminal, panicled, scorpoid cymes, with or without bracteoles. *Calyx-tube* turbinate with 4 or 5 short, erect, persistent, subulate or ovate lobes, one longer than the others. *Corolla* funnel-shaped, pointed in bud, pubescent outside: the tube long almost glabrous inside; the limb with 4 or 5 erect ovate lobes, valvate in bud, but twisted. *Stamens* 4 or 5, inserted by short filaments on the mouth of the corolla; anthers bifid at base and apex, slightly exserted. *Ovary* 2- (rarely 3-) celled; ovules numerous on peltate placentas attached to the septum: *style* filiform; stigmas 2, exserted, linear, revolute. *Capsule* small, globose, crustaceous, 2-celled, dehiscing septicidally by 2 valves. *Seeds* falcate or rather square, somewhat compressed; the testa reticulate and sub-acute; embryo small, clavate, in fleshy albumen.—Distrib. Species 5 or 6, Malayan and Burmese.

Greenia Jackii, W. & A. Prod. 404. An evergreen shrub. *Leaves* oblanceolate, minutely acuminate, gradually narrowed from above the middle to the short petiole, drying brown: upper surface with the midrib minutely pubescent; otherwise sparsely adpressed-puberulous, or quite glabrous; lower surface softly tawny-pubescent, especially on the midrib and 20 to 30 pairs of slightly curved, spreading main-nerves, or subglabrous; length 6 to 12 in.; breadth 2 to 3·5 in.; petioles ·4 to 1 in., pubescent. *Stipules* broad, abruptly acuminate, ·4 in. long, or broadly lanceolate and about ·6 in. long. *Panicles* terminal, branched, shorter than the leaves, on long, compressed, pubescent peduncles, the lower branches nearly as long. *Flowers* numerous, secund, sessile, ·3 to ·35 in. long; the corolla several times longer than the calyx. *Capsule* globose, less than ·1 in. in diam. crowned by the spreading calyx-lobes; the epicarp adpressed, pubescent, peeling off and showing the glabrous endocarp. Hook. fil. Fl. Br. Ind. III. 41. *Rondeletia corymbosa*, Jack in Mal. Misc. I. 4; *R. spicata*, Wall. in Roxb. Fl. Ind., ed. Carey & Wall. II. 139. *Wendlandia ? corymbosa*, Wall. Cat. 6276; DC. Prod. IV. 413; Kurz For. Fl. Burma. II. 75; *W. ? spicata*, DC. l.c. 412.

In all the Provinces.

Rather variable as regards pubescence and the shape of the stipules: differs from the closely allied *G. Wightiana*, W. & A., chiefly in its leaves, having twice as many nerves as that species.

10. Dentella, Forst.

A small prostrate much-branched herb with 4-angled stems thinner than a crow-quill, rooting at the nodes, 4 to 12 inches long. *Leaves* small, shortly petioled; the stipules short, scarious. *Flowers* small, solitary in the axils of the leaves and forks of the branches, sessile or shortly pedicelled. *Calyx-tube* sub-globose; the limb membranaceous, tubular, toothed, persistent. *Corolla* white, funnel-shaped; the tube hairy inside: the limb with five 2- or 3-toothed lobes, valvate in the bud, but with the edges induplicate. *Stamens* 5, attached in the middle of the corolla-tube; *anthers* included, dorsifixed, linear, entire at base and apex; filaments short. *Ovary* 2-celled, with numerous ovules or hemispheric placentas. *Style* short; stigmas 2, filiform, papillose. *Fruit* rather large for the size of the plant, dry, globose, 2-celled, indehiscent, with many minute, angled, dotted seeds.—Distrib. A single species inhabiting Asia, tropical Australia, and the islands of the Pacific.

Dentella repens, Forst. Char. Gen. 26; t. 13. *Leaves* obovate-spathulate or oblanceolate, one-nerved, puberulous, ·2 to ·3 in. long, and less than ·1 in. broad. *Flowers* ·25 to ·3 in. long. *Calyx*-tube somewhat compressed, shorter than the 5-toothed erect limb. *Corolla* longer than the calyx. *Style* bifid nearly to the base. *Capsule* pellucid-hispid or glabrous, somewhat compressed, broadly ovoid, with 2 vertical grooves, about ·1 in. long, crowned by the membranous calyx-tube. Roxb. Fl. Ind. I. 532; Wall. Cat. 6206; W. & A. Prod. Fl. Penins. Ind. 405; Dalz. & Gibs. Fl. Bomb. 115: Hook. fil. Fl. Br. Ind. III. 42. *Oldenlandia repens*, Linn. Mant. 40. *Hedyotis repens*, Lam. Ill. 1424 (not of Don). *Lipaya telephioides*, Endl. Atakt. t. 13.

In moist spots near cultivation: in all the provinces.

11. Argostemma, Wall.

Small, delicate, flaccid or somewhat fleshy herbs, glabrous or pilose, the hairs sometimes jointed. *Leaves* usually membranous, the leaves in pairs, equal or very unequal, opposite or sub-verticillate. *Stipules* entire, persistent, or obsolete. *Flowers* in pedunculate cymes or umbels. *Calyx*-tube short, campanulate, turbinate or obconic: its lobes usually 4 or 5 (sometimes 3-7). *Corolla* white, rotate, with 4 or 5 valvate lobes. *Stamens* 4 or 5; anthers large, elongate, free, connivent or coherent, erect or declinate, dehiscing by 1 or 2 terminal pores or by longitudinal slits; filaments short. *Ovary* 2-celled; ovules numerous on placentas projecting from the septum. *Style* filiform, stigma capitellate. *Capsule* membranous or coriaceous, 2-celled, many-seeded, dehiscence valvular or opercular. *Seeds* minute, angled or compressed; testa reticulate or muriculate, punctate; embryo very small, in dense fleshy albumen.—Distrib. Species about 40 or 50, mostly from mountains, in sub-tropical Asia and in Malesia.

Leaves of the pairs equal in size, or one smaller but not minute:—
  Leaves numerous, in a pseudo-whorl near the apex of the stem ... ... 1. *A. acuminatum.*
  Leaves a single pair at the apex of the stem:—
    Flowers ·15 in. long ... ... 2. *A. pictum.*
    Flowers ·3 in. long ... ... 3. *A. subinequale.*
  Leaves two pairs at the apex of the stem ... 2. *A. pictum* var. *tetraphylla.*

Leaves in a pseudo-whorl at the base of the stem ... 6. *A. nutans* var. *verticillata.*

Leaves numerous scattered along the whole length of the stem :—

Leaves glabrous :—

Leaves thickly membranous, narrowly elliptic, acute at the base ... ... 4. *A. Yappii.*

Leaves thinly membranous, broadly ovate, the base widely cordate ... ... 5. *A. membranaceum.*

Leaves more or less pubescent :—

Cymes dense, many-flowered :—

Leaves oblong-elliptic, oblong, or elliptic, sub-acute, flowers drooping in bud ... ... 6. *A. nutans.*

Leaves broadly oblanceolate, shortly acuminate; flowers erect in bud ... ... 7. *A. urticifolium.*

Cymes lax, few-flowered ... ... 8. *A. Ridleyi.*

Leaves of the pairs very unequal, the smaller one minute and about equal to the stipules :—

Leaves a single pair at the apex of the stem :—

Corolla with narrow buds, its lobes lanceolate; anthers with apical appendages longer than themselves, the filaments thick; leaves with 5 or 6 pairs of main-nerves ... ... 9. *A. unifolium.*

Corolla ovate in bud; its lobes boldly nerved, ovate; anthers sessile, their apical appendages short: leaves with 9 to 14 pairs of main-nerves ... 10. *A. unifolioloide.*

Leaves several pairs crowded near the apex of the (often short) stem, pubescent; flowers ·35 to ·4 in. long, glabrous: calyx-lobes short, acute; calyx and corolla glabrous ... ... 11. *A. spinulosum.*

Leaves scattered along the whole length of the stem :—

Leaves more or less pubescent on both surfaces, the lower not glaucous: calyx hairy and corolla glabrous externally ... ... 12. *A. Elatostemma.*

Leaves pubescent on both surfaces; or if glabrescent (var.) the midrib, nerves and edges with a few short, thick hairs; calyx and corolla pubescent externally ... ... 13. *A. involucratum.*

Leaves quite glabrous, succulent :—

Leaves linear-oblong; main-nerves obscure ... 14. *A. Curtisii.*

Leaves elliptic- or oblanceolate-oblong; with 7 to 12 pairs of main-nerves ... ... 15. *A. subcrassum.*

Leaves glabrous on both surfaces, occasionally with a few adpressed hairs, not glaucous beneath :—

Leaves thinly membranous, broadly oblanceolate, flowers in terminal umbels ... ... 16. *A. perakense.*

Leaves thickly membranous :—

Leaves with broad, obliquely pseudo-cordate bases ... ... 17. *A. oblongum.*

Leaves with narrow bases never pseudo-cordate:—
Stem terete, scurfy; leaves more or less oblanceolate, 1·35 to 4·5 in. long: flowers ·4 in. long: calyx-lobes broad, ovate ... 18. *A. ophirense.*
Stem angled, not scurfy: leaves lanceolate, 2 to 3 in. long: calyx-lobes lanceolate, acuminate ... ... 19. *A. Wrayi.*
Leaves glabrous except the midrib and nerves, under surfaces glaucous:—
Leaves distinctly petiolate, ovate, or oblong-lanceolate, unequal but not cordate at the base, ·75 to 1·35 in. long: calyx campanulate ... 20. *A. Hookeri.*
Leaves sessile or very nearly so, elliptic-oblong, unequal and cordate at the base, 1·5 to 2·15 in. long: calyx rotate ... ... 21. *A. bicolor.*

1. ARGOSTEMMA ACUMINATUM, King n. sp. Glabrous except occasionally for a few scattered minute pale hairs on both surfaces of the leaves; about 12 in. high. *Stem* erect, unbranched, twice as thick as a crow-quill when dry, obscurely 4-angled or minutely winged, naked. *Leaves* crowded near the apex of the stem, thinly membranous when dry, very unequal; the larger of each pair oblong-lanceolate, sometimes sub-oblique or sub-falcate, the apex acuminate, gradually narrowed from above the middle into a petiole of varying length; both surface glabrous; drying of a deep olivaceous colour, the midrib broad and rather distinct and the 10 to 15 pairs of curved spreading nerves indistinct; length 3·5 to 6·5 in.; breadth 1 to 1·5 in.; petioles ·1 to ·4 in.; the smaller leaf of the pair sessile, sub-rotund, under ·1 in. long. *Stipules* usually with broad bases and acuminate apices about the same length as the smaller leaf. *Cymes* terminal, about half as long as the leaves, pedunculate, di- or tri-chotomous; the peduncle and branches slender, slightly swollen and bracteolate near the divisions. *Flowers* few, ·3 in. long on capillary pedicels longer than themselves and bracteolate at the base. *Calyx* campanulate with 5 broad, blunt, spreading lobes. *Corolla* nearly three times as long as the calyx, its lobes slightly shorter than the staminal cone: *anthers* linear-lanceolate, acuminate, dehiscing longitudinally, the connective forming narrow marginal wings and long flattened, apical appendages. *Style* somewhat longer than the anthers: stigma clavate. *Capsules* almost hemispheric, crowned by the obscurely toothed cupular remains of the calyx, smooth, ·15 in. in diam. *Seeds* rather large for the genus, angled, pitted, black.

PENANG: *Wallich.* SELANGOR: *Ridley* 8233.

This plant was collected 65 years ago in Penang by Wallich, and until Mr. Ridley obtained it in Selangor it does not appear to have been found since. In the

Flora of British India it has been put under *A. verticillatum*, Wall.—a species originally described by Wallich from the Nepal Himalaya, from which species this differs amongst other things in its larger size and more numerous leaves.

2. Argostemma pictum, Wall. in Roxb. Fl. Ind. ed. Carey and Wall. II. 327. A succulent herb 3 to 5 in. high. *Stem* 1 to 2 in. long, twice as thick as a crow-quill, ebracteate, glabrous. *Leaves* a single pair at the apex of the stem, membranous, sub-equal, broadly or rotund-ovate, sub-acute or obtuse; the base broad, sub-truncate or slightly cordate, upper surface blackish-brown when dry, glabrous or with sparse, short, thick hairs, the midrib and nerves faint (when dry); lower surface paler, glabrous or with a few coarse hairs on the 4 or 5 pairs of rather straight, ascending, broad, flat main-nerves; midrib broad, flat; length 1·5 to 3·5 in.; breadth 1·25 to 2·5 in.; petiole under ·1 in. or none. *Stipules* lanceolate or ovate, acute, ·2 to ·3 in. long. *Umbel* solitary, terminal, on a slender, ebracteolate peduncle, more slender than the stem and from ·75 to 2 in. long. *Flowers* from 8 to 12, drooping in bud, ·15 in. long (to the end of the exserted style), on pedicels more than twice as long, with a whorl of small bracteoles at their bases. *Calyx* narrowly campanulate, coarsely puberulous, with 5 acute, triangular, erect lobes. *Corolla* nearly twice as long as the calyx, its 5 lobes oblong, obtuse, reflexed, rather longer than the stamens. *Anthers* free, oblong, blunt, dehiscing longitudinally, not apiculate, the base bifid, the connective behind the cells thickened; filament short, broad, thick. *Style* filiform, longer than the anthers: stigma small, capitate. Wall. Cat. 8392: Benn. Pl. Jav. Rar. 94: Hook. fil. Fl. Br. Ind. II. 43.

Perak: *King's Collector* 3105, 3110, 10585, 10586; *Scortechini* 310; *Wray* 1202. Penang: *Curtis* 480. Malacca: *Maingay* (K.D.) 896.

Var. *tetraphylla*. Leaves in two unequal pairs, or three in a whorl.

Perak: *Wray* 1202.

3. Argostemma subinequale, Benn. Pl. Jav. Rar. 95. Glabrous; succulent when fresh, 4 to 8 in. high: *stem* fleshy when fresh, thinner than a goose-quill, 1·5 to 4·5 in. long, ebracteolate. *Leaves* membranous, only a single pair, somewhat unequal (rarely a whorl of three) broadly ovate-oblong to ovate-elliptic, acute or bluntly acuminate, the base truncate and broad or slightly cuneate; upper surface brown when dry, glabrous, the nerves and midrib indistinct; lower surface paler, glabrous except for a few hairs on the broad flattened midrib and 5 or 6 pairs of broad, flat, obliquely ascending main-nerves; length of the longer leaf 4 to 6 in.; breadth 2·5 to 3·5 in.; of the smaller leaf 2 to 3 in.; breadth 1·75 to 2 in.; petioles ·1 to ·2 in. *Stipules* lanceolate, ·3 to ·75 in. long. *Cymes* umbellate, terminal, solitary or in pairs, pedunculate; peduncles slender, bearing a pair or whorl of lanceolate bracteoles near the middle.

Flowers ·3 in. long, numerous, on pedicels shorter or longer than themselves, pubescent, bracteolate at the base. *Calyx* campanulate; the tube small, narrow; the 4 lobes thin, lanceolate, much longer than the tube. *Corolla* longer than the calyx; its lobes 5, imbricate, ovate-lanceolate, acute, spreading slightly, imbricate. *Anthers* alternately quite free, at first slightly cohering in the upper half, linear, not winged but with a flattened, 2-pored apical appendage, the bases thickened and cordate: filaments free, nearly half as long as the anthers. *Style* as long as the anthers; stigma filiform.

PERAK: *King's Collector* 2242.—DISTRIB. Sumatra.

4. ARGOSTEMMA YAPPII, King n. sp. Glabrous; stem erect, unbranched, 6 to 12 inches high, succulent, when dry nearly as thick as a goose-quill at the base, tapering rapidly upwards. *Leaves* almost equal in size, thick (almost fleshy when fresh), elliptic, narrowed pretty equally at both ends, shining, upper surface pale-olivaceous, minutely scaly when dry, the lower olivaceous yellow, the midrib distinct and the 6 to 8 pairs of spreading main-nerves indistinct on both: length 2 to 3·5 in.; breadth ·75 to 1·35 in., petiole ·15 to ·5 in., winged in its upper half. *Stipules* free, ovate-oblong, blunt, ·4 to ·7 in. long. *Cymes* terminal, trichotomous, on pedicels exceeding an inch in length, with a whorl of bracteoles at the apex and (like the branches) pink when fresh, branches often trichotomous. *Flowers* few, ·5 in. long, on slender pedicels longer than themselves. *Calyx* campanulate; the lobes 5, triangular, acute, spreading, as long as the tube. *Corolla* more than twice as long as the calyx, green; its 5 lobes oblong-lanceolate, sub-acute, spreading, much longer than the short tube and slightly longer than the staminal cone. *Anthers* lanceolate, dehiscing longitudinally, coherent by the marginal wings of the connective, shortly apiculate, slightly shorter than the filiform style: stigma small.

PERAK: *Scortechini* 245, 1334; *Wray* (no number); *Yapp* 435.

Named in honour of Mr. R. H. Yapp who, as botanist, accompanied an exploring party sent to the Malayan Peninsula by the University of Cambridge.

5. ARGOSTEMMA MEMBRANACEUM, King n. sp. Glabrous; except for a few slender adpressed hairs on the upper surface of the leaves and on the calyx and pedicels. *Stem* erect, 8 to 10 in. high, thinner than a goose-quill, angled. *Leaves* sub-equal, few, scattered, large, thinly membranous, green when dry, slightly unequal-sided, the apex sub-acute; the base broadly ovate-cordate, main-nerves 4 or 5 pairs, the lower one branched on the side and spreading, the upper ascending, all distinct and pale on both surfaces, length 2·5 to 5 in.; breadth 1·5 to 3·5 in.; petiole about as long as the blade. *Cymes* axillary and terminal, condensed, 6- to 12-flowered, on long, slender, sometimes puberulous

peduncles, bearing 1 or 2 small leaf-like bracts near the apex, otherwise naked. *Calyx* broadly ovoid, about ·1 in. long, puberulous, the tube broadly ovoid, the teeth narrowly lanceolate; pedicel nearly as long and also puberulous. *Corolla* unknown.

PENANG: *Curtis* 955.

6. ARGOSTEMMA NUTANS, King n. sp. *Stem* erect, 4 to 12 in. high, sometimes decumbent and rooting at the base, thicker than a crow-quill, bearing many scurfy but deciduous hairs. *Leaves* somewhat unequal but not conspicuously so, membranous, oblong, elliptic, or elliptic-oblong, occasionally slightly obovate, often more or less oblique, the apex acute, the base cuneate rarely rounded; upper surface dark olivaceous-brown, densely and uniformly adpressed glandular-hispidulous; the lower surface paler, coarsely pubescent on the midrib and nerves; almost glabrous between; main-nerves 5 to 8 pairs, curved, spreading and ascending, rather prominent on the lower surface only; length from 1·75 to 4 in.; breadth ·75 to 2 in.; petioles ·2 to ·8 in., pubescent. *Stipules* ovate-lanceolate, ·15 to ·25 in. long, deciduous. *Umbels* cymose, terminal, usually solitary, on deciduous, pubescent peduncles, 1 to 2·5 in. long, surrounded at their bases by a whorl of lanceolate, small, pubescent bracteoles; many-flowered. *Flowers* ·3 in. long, pendulous on pubescent pedicels 2 or 3 times as long as themselves. *Calyx* campanulate; the tube short, densely hairy outside: the lobes 5, ovate, sub-erect, longer than the tube, almost glabrous. *Corolla* slightly longer than the calyx, sparsely glandular-hairy outside; the 5 lobes membranous, reflexed, lanceolate, acute, longer than the *stamens*. *Stamens* 5, free, basifixed by the short flat filaments opposite the lobes of the corolla; *anthers* linear, dehiscing longitudinally, the connective coriaceous, with a short broad slightly notched apical appendage. *Style* filiform; stigma small, slightly exserted. *Capsules* erect, ovoid-globular, ridged, hairy, crowned by the short erect calyx-teeth, 2-celled, many-seeded, ·05 in. in diam.

PERAK: *Wray* 843, 1296; *King's Collector* 585, 7190, 7802, 8060; *Scortechini* 157.

VAR. 1 *glabra*. Only a few inches high; all parts glabrous; *leaves* with shorter petioles and less narrowed at the base than in the type.

PERAK: *Scortechini* 297; *Wray* 2646; *King's Collector* 1985.

VAR. 2 *verticillata*. Only a few inches high; glabrous; leaves few (often only a single pair) lying flat on the ground: peduncle of umbel several times longer than the leaves; *umbels* often few-flowered.

PERAK: *Scortechini* 310; *King's Collector* 427, 1920.

7. ARGOSTEMMA URTICIFOLIUM, n. sp. King. Stem decumbent and rooting at the base, 8 to 12 in. long, thinner than a goose-quill and scurfy when dry. *Leaves* membranous, somewhat unequal in size;

broadly oblanceolate, shortly acuminate, cuneate and sometimes slightly unequal at the base; upper surface dark-brown with sparse, coarse, glandular, bulbous hairs, the midrib and main-nerves obscure; lower surface paler, with many glandular hairs on the bold midrib and slightly prominent 7 or 8 pairs of spreading, slightly curved main-nerves; the interspaces with a few similar hairs, minutely papillose; length of larger leaf of the pair 3 or 4 in.; of the smaller 2 to 2·5 in.; breadth of the larger 1·7 to 2 in.; of the smaller ·9 to 1·2 in.; petioles from ·3 to ·7 in., glandular-pubescent. *Cyme* umbellate, terminal, solitary, 10- to 12-flowered, pedunculate; the peduncle 4-angled, scurfy like the stem and also glandular-hairy. *Flowers* on deciduously hairy pedicels, ·3 to ·4 in. long, bracteolate at the base. *Calyx* globular-campanulate, densely glandular-hairy outside; the teeth short, erect, acute, fleshy, glabrous inside; disk large tumid. *Corolla* unknown. *Capsule* globular, crowned by the small erect calyx-teeth and the disk hairy at first, but becoming glabrous; 2-celled, the placentas axile. *Seeds* numerous, triangular, pitted, black.

PERAK: *Scortechini.*

This appears to be the same species as one of Beccari's Sumatra plants (Herb. Becc. Argostemma 33).

8. ARGOSTEMMA RIDLEYI, King n. sp. Stem decumbent or prostrate rooting in its lower half, about as thick as a crow-quill, 6 or 8 in. long, 4-angled, softly rusty-pubescent. *Leaves* in each pair slightly unequal, membranous, narrowly oval or oval-oblong, acute, the base cuneate; upper surface darkly olivaceous, densely and coarsely pubescent on the midrib and nerves and with some scattered hairs on the spaces between; lower surface paler, the pubescence on the midrib and 5 or 6 pairs of main-nerves not so coarse as on the upper, the reticulations with a single row of hairs, the areolæ glabrous, but with minute white scales; length ·8 to 1·8 in.; breadth ·4 to ·8 in.; petioles ·15 to ·6 in., densely and coarsely pubescent. *Stipules* lanceolate to broadly ovate, their apices acute and bifid, about ·2 in. long. *Cyme* terminal, solitary, pedunculate, longer than the leaves, umbellately 2-3-flowered; rusty-pubescent in all its parts; peduncle ·75 to 1·5 in. long, bearing a whorl of bracteoles about the middle and another at the base of the pedicels. *Flowers* ·4 in. long, their pedicels much longer. *Calyx* campanulate with 5 broad spreading ovate-acute lobes slightly longer than the tube. *Corolla* unknown. *Capsules* obconic, crowned by the prominent calyx-teeth, ·15 in. in diam., pubescent. *Seeds* numerous, small.

MALACCA: *Ridley* 10110.

9. ARGOSTEMMA UNIFOLIUM, Benn. Pl. Jav. Rar. 94. Rhizome short, fleshy; whole plant glabrous, succulent, 6 to 8 in. high. *Stem*

simple, erect, bearing, about or below the middle, a pair of lanceolate bracts about ·2 in. to ·4 in. long and, at the base of the peduncle, a whorl composed of a single pair of very unequal thin membranous (when dry) leaves and a pair of stipules; the larger leaf broadly ovate, shortly acuminate, the base rounded or cordate; when dry the upper surface dark brown, the midrib broad and channelled, the nerves elevated; lower surface pale brown, the midrib and 5 or 6 pairs of spreading slightly curved nerves slightly prominent; length 3 to 6 in.; breadth 1·5 to 3 in.; petiole ·4 to ·8 in. Smaller leaf sessile, ovate-lanceolate, acute, 1-nerved, ·2 to ·5 in. long. *Stipules* similar to smaller leaf. *Cymes* terminal, simply or compoundly and laxly *umbellate*, few- or many-flowered; peduncle slender, 1·5 to 8 in. long, with a whorl of narrow bracteoles at the origins of the branches. *Flowers* narrow in bud, ·25 in. long; their slender pedicels slightly longer, sometimes lengthening in fruit. *Calyx* under ·1 in. long, campanulate, with broad, blunt, thick, short, spreading lobes. *Corolla* narrow in bud, more than twice as long as the calyx; its 5 lanceolate lobes slightly shorter than the erect staminal cone. *Anthers* lanceolate, the cells narrowly linear, cordate at the base, edged by the cohering wings formed by the connective and surmounted by membranous, flat, apical appendage longer than themselves: filaments short, thick, curved. *Capsule* hemispheric, crowned by the rather large calyx, subglabrous, ·1 in. in diam., 2-celled, dehiscence circumscissile. Hook. fil. Fl. Br. Ind. III. 45.

Johor: *Ridley* 3730. Penang: *King; Curtis* 990; *King's Collector* 2276. Malacca: *Maingay* (K.D. 895).

10. Argostemma unifolioloide, King n. sp. Rhizome woody: stem fleshy when fresh, glabrous, thinner than a goose-quill and angled when dry, 3 to 7 in. high, bearing one or more pairs of lanceolate, glabrous bracts about ·25 in. long, and at the base of the peduncle a pair of very unequal membranous leaves and a pair of stipules all in a whorl; the longer leaf sessile, broadly ovate or ovate-rotund, shortly acuminate, the base rounded or cordate; upper surface dark brown when dry, with sparse, coarse, glandular hairs or (in var. *glabra*) glabrous; lower surface pale brown, the broad midrib and main-nerves sparsely glandular-pubescent, otherwise glabrous; main-nerves 9 to 14 pairs, curved, spreading, slightly prominent on both surfaces (when dry) but chiefly on the lower; length 5·5 to 10 in.; breadth 3·5 to 6·5 in.; smaller leaf sessile, narrowly ovate, acute, about ·5 in long; the stipules similar but usually narrower. Inflorescence terminal, solitary, pedunculate, paniculately umbellulate, lax, usually many flowered; peduncle and branches glabrous, fleshy when fresh and somewhat stout; bracteoles in whorls (usually of 4), oblong obtuse, concave, connate at the base, about ·3 in. long. *Flowers*

rather broad in bud, ·2 to ·25 in. (sometimes ·4 in.) long, the pedicels varying in length, the ultimate umbellules with rather large, broad, blunt bracteoles at the base. *Calyx* under ·1 in. long, campanulate, the lobes 5, broad, blunt, thick, spreading. *Corolla* several times longer than the calyx, broadly ovate and angled in bud; the 5 lobes ovate, acute, boldly 1-nerved, longer than the cone of anthers, spreading or reflexed. *Anthers* almost sessile, narrowly linear-lanceolate, the connectival margin narrow and the apicular appendage short. *Capsules* somewhat fleshy, hemispheric, ·1 in. in diam., crowned by the small calyx, 2-celled, the dehiscence circumscissile.

PERAK: at elevation of from 2,500 to 4,500 feet; *Scortechini* 282, 384; *Wray* 410.

VAR. *glabra.* *Leaves* glabrous on both surfaces.

PERAK: *Scortechini* 412, 1204; *Wray* 2814; *King's Collector* 5064; *Curtis* 3146.

This differs from *A. unifolium* in its corolla being broadly ovate in bud and having ovate, boldly 1-nerved lobes, in having its anthers almost sessile, with very long cells and short apical appendages. This has also larger leaves with more nerves which are sometimes hairy; its stems are also shorter and stouter.

11. ARGOSTEMMA SPINULOSUM, Clarke in Hook. fil. Fl. Br. Ind. III. 46. *Stem* only 3 to 8 inches long, nearly as thick as a goose-quill, decumbent and rooting at the base, obscurely 4-angled; with a few deciduous flexuose hairs. *Leaves* crowded, subcoriaceous, very unequal, the larger of each pair oblong-oblanceolate, acute or acuminate, slightly narrowed from above the middle to the somewhat unequally-sided base; upper surface olivaceous, with a few thick, scattered hairs chiefly on the broad depressed midrib and near the edges, otherwise glabrous; the lower pale brown with many thinner hairs on the prominently raised broad midrib and on the nerves, and a few on the interspaces; main-nerves 10 to 14 pairs, curved, spreading, distinct on the lower surface, faint on the upper; length 2·5 to 5 in.; breadth 1 to 1·75 in.; petiole ·2 to ·5 in. Smaller leaf lanceolate to oblong, sessile, 3- to 5-nerved, ·5 to ·75 in. long. *Stipules* like the smaller leaves but shorter and with only one nerve. *Umbels* terminal, simple or compound, solitary or several, all on long peduncles shorter than the leaves, sometimes united at their bases; succulent, few-flowered, glabrous, 1·5 to 2 in. long; umbels or umbellules 3- or 4-flowered. *Flowers* ·35 to ·4 in. long, on slender pedicels of about the same length, with lanceolate scarious bracteoles at their bases, glabrous. *Calyx* campanulate; the limb with 5 triangular acute spreading lobes shorter than the tube. *Corolla* about twice as long as the calyx; its lobes broadly lanceolate, acuminate, shorter than the erect staminal cone; filaments short, curved; *anthers* linear-oblong,

dehiscing longitudinally; the connective with long linear apical process. *Capsule* obconic, smooth, ·2 in. long, crowned by the calyx, 2-celled, 2-seeded. *Seeds* minute, dark brown.

PERAK: *Scortechini* 454, 500; *Ridley* 2920; *Wray* 463, 1083, 2910, 2953, 3936; *King's Collector* 2789, 2892, 7520. SELANGOR: *Ridley* 7409.

This species is closely allied to *A. Elatostemma*. It has, however, a shorter stem and larger fewer leaves.

12. ARGOSTEMMA ELATOSTEMMA, Hook. fil. Fl. Br. Ind. III. 45. *Stem* thinner than a goose-quill, 4 to 12 in. long, decumbent and rooting at the lower nodes, deciduously scurfy-hairy, sometimes becoming sub-glabrous. *Leaves* thickly membranous, very unequal; the longer one of the pair somewhat oblique, oblong-lanceolate; the apex broad or sub-acute, sometimes shortly apiculate, more or less narrowed from a little above the middle to the often somewhat unequally-sided or obliquely-cordate base, the edges not ciliate; upper surface glabrous or nearly so, the slightly depressed midrib and main-nerves sometimes puberulous; the lower surface minutely scaly, rusty adpressed-pubescent on the prominent midrib, reticulations, and 10 to 12 pairs (only 7 or 8 in var.) of slightly curved spreading main-nerves; length 1·25 to 2·25 in.; (shorter in var.); breadth ·75 to 1 in.; petioles unequal, ·15 to ·2 in long, scurfy-pubescent; the smaller leaf ovate-lanceolate (broadly ovate in var.) sessile, ·15 to ·2 in. long, with 2 to 4 pairs of nerves. *Stipules* about the same in size and shape as the smaller leaves. *Corymbs* terminal, solitary, pedunculate, few-flowered, usually shorter than the leaves; the peduncles slender, minutely pubescent or sub-glabrous; bracteoles at the forks, minute. *Flowers* ·4 in. long, on slender sometimes puberulous pedicels about as long as themselves. *Calyx* ·1 in. long, pubescent, campanulate, with 5 triangular, spreading, acute lobes. *Corolla* white, glabrous, with 5 long lanceolate much reflexed lobes. *Anthers* linear-lanceolate, cohering by the narrow wings and long terminal appendage of the connective, erect, dehiscing by long vertical slits. *Style* long, slender, cylindric: stigma small, slightly exserted beyond the narrow staminal cone. *Capsule* pyriform, glabrous, crowned by the calyx-teeth, ·2 in. long.

PENANG: *Hullett* 195; *Curtis* 962, 2250; *King's Collector* 1605, 1752. SINGAPORE: *Lobb* 295. MALACCA: *Griffith* (K.D.) 2876. PERAK: *Scortechini; Wray* 3334; *King's Collector* 2131.

VAR. *obovata*, King. *Leaves* obovate, minutely apiculate, the base obliquely cordate: upper surface with a few scattered, short, thick hairs, length ·9 to 1·4 in.; breadth ·5 to ·75 in. *Corymb* 2- to 4-flowered, its peduncle pubescent, with a whorl of minute bracts near its apex.

PERAK: *King's Collector* 10815.

13. Argostemma involucratum, Hemsl. in Hook. Icon. t. 1556. *Stems* thinner than a goose-quill, succulent, decumbent, 4 to 12 in. long with partially deciduous, long, flexuose, white hairs. *Leaves* membranous, very unequal in size, the larger of the pair obliquely and narrowly lanceolate or oblanceolate (linear-ovate-lanceolate or ovate in vars.) more or less narrowed to the slightly unequal base; both surfaces greenish or olivaceous-brown when dry, the lower paler, the upper more or less bulbous-strigose especially on the midrib and nerves: the under hispidulous, sometimes pitted, the edges shortly ciliate, main-nerves 7 or 8 pairs (in var., glabrous sometimes only 5 or 6 pairs) curved, spreading or ascending, slightly conspicuous when dry; length 1·25 to 3 in.; breadth ·5 to 1·25 in.; petiole ·1 to ·4 in.; the smaller leaf ovate or ovate-lanceolate, 3-nerved, sessile, from ·1 to ·4 in. long. *Stipules* like the smaller leaves, but not cordate, free. *Flowers* ·5 in. long, from 1 to 3 in a multibracteolate pubescent terminal raceme shorter than the leaves; the pedicels about as long as the flowers, hairy. *Calyx* densely hairy; the tube short; the 5 lobes many times longer, lanceolate, acuminate, spreading. *Corolla* with lobes like the calyx but slightly broader and less hairy, not reflexed. *Stamens* 5, erect; the filaments short, thick, curved, dorsifixed near the base of the linear-lanceolate, acuminate, apiculate, but not winged, longitudinally dehiscing anthers. *Capsule* small, compressed, obovoid, crowned by the long spreading calyx-teeth, 2-celled, 2-seeded: *seeds* compressed, brown.

Perak: *King's Collector* 2204, 2820, 8062. Penang: *Ridley* 10273; *Curtis* 342, 3148; Gunong Tahan, *Yapp*.

var. *mollis*, King. *Leaves* usually more than 1 in. broad, obliquely ovate-lanceolate, acuminate, the under surfaces and inflorescence with soft flexuose rather coarse hair.

Perak: *Ridley* 2927; *King's Collector* 2898; *Scortechini* 38.

var. *glabrescens*, King. *Leaves* linear-lanceolate to oblanceolate, rarely ovate, glabrous except for a few stiff strigose hairs on the midrib and main-nerves; ·9 to 2 in. long.

Perak: *Scortechini* 303, 455; *Ridley* 9763; *King's Collector* 2714; *Wray* 696.

The bracteoles on the inflorescence often form an involucre at the bases of the pedicels, hence the specific name.

14. Argostemma Curtisii, King n. sp. All parts quite glabrous; *stems* succulent, decumbent, glabrous, reddish when fresh, rooting in the lower part, thicker than a crow-quill when dry; 4 to 8 in. long. *Larger leaves* succulent, unequal; the larger linear-elliptic, much attenuated to either end, the apex gradually acuminate, the base more abruptly so; both surfaces olivaceous when dry, the lower the paler; main-nerves

invisible; the midrib depressed on the upper surface, prominent on the lower; length 1·25 to 2·75 in.; breadth ·1 to ·4 in.; petiole ·1 to ·25 in.; the smaller leaves linear, ·3 in. long. *Stipules* like the smaller leaves but somewhat shorter and broader. *Cymes* terminal, pedunculate, shorter than the leaves, 2–4-flowered. *Peduncles* slender, longer than the pedicels, with one or two whorls of small lanceolate bracteoles; pedicels longer than the flowers, bracteolate at the base. *Flowers* ·35 in. long, white. *Calyx* campanulate; with 5 triangular, acute, spreading teeth as long as the short tube. *Corolla* with 5 spreading lanceolate, acuminate lobes twice as long as the calyx. *Stamens* 5 in an erect cone; the filaments short, thick, curved; *anthers* linear-lanceolate; the connective margined and apiculate.

PERAK: *Scortechini* 1890. PENANG: *Curtis* 3332.

15. ARGOSTEMMA SUBCRASSUM, King n. sp. A glabrous herb 12 to 18 in. high; *stems* succulent, thinner than a goose-quill when dry, little branched, decumbent near the base, ascending, covered with a layer of smooth, oblong scales. *Leaves* very unequal, membranous; the larger of each pair membranous when dry, succulent when fresh; elliptic- or oblanceolate-oblong, somewhat oblique, acuminate, narrowed at the base; both surfaces olivaceous-brown when dry, the lower the paler; main-nerves 7 to 12 pairs, ascending, much curved, faint on both surfaces when dry; the midrib raised on the upper surface, flat and broad on the lower; length 3·5 to 7 in.; breadth 1 to 1·5 in.; petioles ·1 to ·3 in.; slightly winged. *Smaller leaf* ovate-cordate, sessile, only ·1 to ·25 in. long. *Stipules* like the small leaves but smaller. *Cymes* with few or many umbellate branches, the ultimate branches few-flowered, lax; the branches with small lanceolate bracteoles at the forks. *Flowers* ·4 or ·5 in. long, on slender pedicels as long as themselves and minutely bracteolate at the base. *Calyx-tube* short, campanulate, its 5 lobes thick, short, broadly ovate, blunt or acute, spreading. *Corolla* three times as long as the calyx; its 5 lobes lanceolate, ·25 in. long, spreading. *Stamens* conjoined in an erect cone longer than the corolla; *anthers* linear-lanceolate, the connective with a long terminal process half as long as the anther; filaments short, thick, curved, dorsi-fixed near the base of the anther. *Capsule* obovoid-globular, truncate, crowned by the calyx, smooth, 2-celled, many-seeded.

PERAK: *Scortechini* 1203, 1912; *King's Collector* 10154; *Ridley* 9762. SELANGOR: *Ridley* 7408.

16. ARGOSTEMMA PERAKENSIS, King n. sp. *Stem* erect, unbranched, with the peduncle 8 in. high, thicker than a crow-quill, bearing a few scattered coarse hairs near the base, otherwise glabrous. *Leaves* 2 pairs, thinly membranous, very unequal; the larger oblanceolate-elliptic,

the apex acuminate, the base much narrowed; both surfaces dirty olivaceous when dry, glabrous; main-nerves 5 or 6 pairs, ascending, faint; length 2·5 to 3·5 in.; breadth 1·2 to 1·5 in.; petiole ·4 in.; winged near the apex: smaller leaf about ·1 in. long, lanceolate, sessile. *Peduncle* terminal, erect, 3 in. long; minutely hairy, with a whorl of lanceolate bracts near its base and another ·2 in. long at the base of the 10- to 12-flowered terminal umbel. *Flower-pedicels* about ·3 in. long, slightly unequal, flattened, sub-glabrous. *Calyx* with a broadly ovate-rotund puberulous tube ·1 in. long, and 5 minute radiating teeth. *Corolla* unknown.

PERAK: *Ridley* 110.

17. ARGOSTEMMA OBLONGUM, King n. sp. *Stem* 6 to 15 in. high, slightly branched, half as thick as a goose-quill, rooting in its lower part, covered with scaly deciduous pubescence. *Leaves* membranous, very unequal; the larger of each pair elliptic to oblong, acute, the base rounded and slightly and obliquely cordate; upper surface brownish, olivaceous, everywhere glabrous, the midrib depressed; the lower pale, glabrous except the midrib and 6 to 8 pairs of curved spreading slightly prominent main-nerves; length 2 to 3 in.; breadth 1 to 1·35 in.; petiole ·1 to ·2 in.; smaller leaf sessile, ovate-oblong or ovate-cordate, ·25 to ·4 in. long: *stipules* like the smaller leaf but not so large. *Cymes* few-flowered, solitary, pedunculate, terminal or from the upper axil, shorter than the leaves, with very few, shortly pubescent branches, often with a whorl of lanceolate bracts below the middle of the peduncle and at the base of the umbels. *Flowers* ·25 in. long, on pubescent pedicels of about the same length. *Calyx* pubescent, campanulate, with 5 short, triangular, acute, spreading teeth. *Corolla* twice as long as the calyx, slightly hairy outside; the lobes broadly lanceolate, nerved, reflexed. *Stamens* 5, coherent in an erect cone slightly shorter than the corolla. *Anthers* dehiscing longitudinally; the connective forming marginal wings and a long flat apical process slightly recurved at the point; filaments short, curved, thick, attached to the back of the anther near its base. *Capsule* sub-globular, crowned by the slightly enlarged calyx-lobes, minutely pubescent, ·1 in. in diam. *Seeds* numerous, angled, black, large in size for the genus.

PERAK: *King's Collector* 907, 10261, 10675; *Scortechini* 159. SELANGOR: *Ridley* 7410. JOHOR: *King*.

18. ARGOSTEMMA OPHIRENSE, Maing. ex Hook. fil. Fl. Ind. III. 45. *Stem* ascending, rooting at the base, little-branched, minutely nodose, succulent, terete and thicker than a crow-quill when dry, deciduously scurfy-hairy, 4 to 10 in. high. *Leaves* sub-coriaceous, glabrous but occasionally with a few scattered hairs on the midrib, very unequal, the

larger of each pair oblanceolate or elliptic-oblanceolate or elliptic, often more or less oblique, acuminate or acute, narrowed to the base; upper surface olivaceous when dry; the lower pale brown, sometimes scurfily puberulous on the short midrib and nerves; main-nerves 5 to 8 pairs, curved, ascending, obscure on the upper but slightly prominent on the lower surface when dry; length 2 to 3·5 in.; breadth ·7 to 1·25 in.; petiole ·1 to ·35 in. *Smaller leaf* of the pair obliquely ovate-cordate, or lanceolate, acute, sessile, ·1 to ·2 in. long. *Stipules* like the small leaves but not so large. *Cymes* terminal, spreading, sometimes branched, solitary, usually shorter than, but sometimes as long as the leaves, glabrous, with whorls of small lanceolate or ovate bracteoles in the lower part of the 1 to 2 in. long peduncle and at the forks of the branches. *Flowers* ·4 in. long; their pedicels about as long and minutely bracteolate at the base. *Calyx* pubescent, short, campanulate, with 5 broadly ovate spreading lobes half as long as the tube. *Corolla* more than twice as long as the calyx, glabrous; its 5 lobes lanceolate, shorter than the stamens, their edges waved. *Anthers* lanceolate, dehiscing longitudinally; connective forming narrow marginal wings and a long apical appendage. *Style* filiform, slightly exserted; stigma clavate. *Capsule* obconic, crowned by the broadly toothed calyx, ·15 in. in diam.; *seeds* numerous, minute.

Malacca: *Griffith* (K.D.); *Maingay* (K.D.) 897; *Ridley* 3210. Perak: *Wray* 2197.—Distrib. Borneo.

19. Argostemma Wrayi, King n. sp. *Stem* procumbent, rooting at the nodes in the lower half, when dry 4-angled and somewhat thicker than a crow-quill, sparsely hairy in the upper, but glabrous in the lower part. *Leaves* of the pairs very unequal, membranous; the larger lanceolate, acuminate, narrowed and slightly unequal at the base; upper surface, when dry, dark olivaceous, glabrous, the midrib broad and depressed, the main-nerves obscure; under surface pale, reticulate, sparsely pubescent on the midrib and 6 or 7 pairs of curved ascending rather distinct main-nerves; length 2 to 3 in.; breadth ·6 to ·9 in.; petioles ·3 to ·4 in., puberulous: the smaller leaf sessile, ovate-lanceolate, ·15 to ·2 in. long. *Stipules* like the small leaf but not so large. *Cyme* terminal, shorter than the leaves, pedunculate, dichotomous, few-flowered. *Peduncle* about ·5 in. long, glabrous, with a whorl of lanceolate glabrous bracteoles at its division into the 2 short branches. *Flowers* ·25 in. long; their pedicels about as long, bracteolate at the base, pubescent. *Calyx* campanulate, puberulous, lobes deeply-lanceolate, acuminate, spreading, longer than the tube. *Corolla* nearly twice as long as the calyx, glabrous: its 5 lobes lanceolate, slightly longer than the staminal cone. *Anthers* linear-lanceolate, coherent by the narrow marginal wing

of the connective, the apex with a long flat process, stigma oblong, about as long as the anthers.

PERAK: elevation 3400 feet; *Wray* 1012.

20. ARGOSTEMMA HOOKERI, King n. sp. Stem slightly thicker than a crow-quill, decumbent and rooting in its lower part, obscurely 4-angled, 6 to 12 in. long, covered with long, soft, pale, flexuose hairs. *Leaves* thickly membranous, very unequal; the larger of each pair lanceolate, ovate-lanceolate or oblong, sub-acute or obtuse, somewhat narrowed to the unequal-sided base; upper surface (when dry) olivaceous, with a few scattered, thick, adpressed, pale hairs near the edges and on the midrib; the lower pale, glaucous; the broad midrib and somewhat prominent 5 or 6 pairs of curved spreading nerves scurfy and sparsely pubescent; length ·75 to 1·35 in.; breadth ·35 to ·6 in.; petiole ·1 to ·2 in. *Smaller leaf* ovate-lanceolate, cordate, sessile; *stipules* like the smaller leaves. *Cymes* umbellately 2–3-flowered, terminal, solitary, on slender, sparsely pubescent peduncles, about 1·5 in. long, and with a whorl of narrow bracteoles about the middle. *Flowers* ·3 in. long; their pedicels puberulous and bracteolate at the base. *Calyx* widely campanulate, tomentose outside, the 5 lobes broadly triangular, spreading, shorter than the tube. *Corolla* twice as long as the calyx, white, sparsely hairy outside; the 5 deep lobes lanceolate, acuminate, spreading or reflexed. *Anthers* lightly cohering by their exalate edges into an erect cone, lanceolate, the base acute and entire, the apex with a long, flat, minutely bifid appendage. *Style* filiform, longer than the anthers, stigma clavate. *Capsule* obconic, very hairy, ·15 in. in diam. crowned by erect calyx-lobes. *A. parvifolium*, Hook. fil. (not of Benn.) Fl. Br. Ind. III. 45.

PENANG: *King's Collector* 1747, 1756. JOHOR: *King*.

21. ARGOSTEMMA BICOLOR, King n. sp. Whole plant 3 or 4 in. high. *Stem* erect, simple, as thick as a crow-quill, pubescent. *Leaves* thickly membranous, very unequal; the larger of each pair subsessile, elliptic or oblong, tapering to the sub-acute apex and to the oblique, minutely cordate base; when dry the upper surface pale-olivaceous and bearing a few adpressed hairs on the midrib and near the margins; lower surface pale-yellowish, minutely hairy on the midrib and 5 or 6 pairs of spreading, little-curved main-nerves; length 1·5 to 2·15 in.; breadth ·65 to ·85 in.; smaller leaf only ·25 to ·3 in. long, ovate, sessile. *Stipules* broad, rounded, shorter than the smaller leaf. *Peduncles* axillary or terminal, as long as or longer than the leaves, erect, adpressed-pubescent, bearing a whorl of ovate-lanceolate bracts at or below the middle and another at the base of the terminal 3- to 6-flowered (sometimes branched) umbel. *Flower-pedicels* ·2 to ·25 in. long, densely pubescent like the calyx.

Flowers ·3 in. long. *Calyx* rotate, only ·05 in. long; its lobes triangular, spreading. *Corolla* five times as long as the calyx, glabrous, rotate, its 5 lobes broadly oblong-lanceolate, sub-acute, spreading, puberulous. *Anthers* glabrous.

PERAK: *Curtis* (without number).

12. HEDYOTIS, Linn.

Erect, decumbent or climbing herbs, or undershrubs, with 4-angled or terete stems, the stipules free or united with the petioles to form a cup, often bristly on the edge. *Leaves* sometimes whorled, often with bold nerves. *Flowers* in terminal or axillary, often much condensed cymes, 4-merous. *Calyx* with a globose ovoid or turbinate tube, and 4 acute persistent lobes without interposed teeth. *Corolla* white or lilac, funnel-shaped or campanulate; the lobes 4, valvate, ovate to linear; the throat naked or hairy. *Stamens* 4, in the tube or throat of the corolla; *anthers* dorsifixed, oblong or linear. *Disk* fleshy, inconspicuous. *Ovary* two-celled, many-ovuled, the style filiform, stigma bifid or bilobed, rarely entire; *ovules* on sessile or pedicelled placentas attached to the septum at or below the middle. *Fruit* small, membranous coriaceous or crustaceous, septi- or loculi-cidal, or splitting into two separable or united, 2- or many-seeded cocci, or indehiscent. *Seeds* plano-convex, or angled, granulate or pitted, rarely winged; embryo sub-cylindric, in horny albumen, radical short.—DISTRIB. Species about 100, chiefly Tropical Asiatic.

Cymes pedunculate, umbellate or capitate, terminal or axillary:—
  Scandent:—
    Cymes umbellate, collected in a terminal leafy panicle; flowers distinctly pedicelled ... ... 1. *H. mollis.*
    Cymes capitate, collected in a terminal leafy panicle; flowers on very short pedicels:—
      All parts pubescent; flowers ·1 in. long ... 2. *H. Prainiana.*
      All parts glabrous; flowers ·15 in. long ... 3. *H. capitellata.*
  Erect or diffuse, herbaceous:—
    Cymes capitate, solitary or in small axillary panicles shorter than the leaves; pubescent herbs ... 4. *H. vestita.*
    Cymes umbellate, in small trichotomous axillary branches shorter than the leaves; glabrous erect herbs ... ... 5. *H. glabra.*
    Cymes capitate, on slender axillary peduncles longer than the leaves; puberulous decumbent herbs ... 6. *H. stipulata.*
  Erect woody glabrous shrubs:—
    Cymes capitate, solitary, on stout peduncles much longer than the leaves ... ... 7. *H. peduncularis.*

Cymes in terminal little-branched shortly pedunculate compound umbels ... ... 8. *H. Maingayi.*

Cymes sessile, axillary, dense, capitate :—

Leaves elliptic to ovate-lanceolate, 2·5 to 6 in. long and 1·5 to 3 in. broad (about twice as long as broad) :—

Flowers 4-merous, not glaucous beneath :—

Leaves and corolla glabrous ; shrubby, with herbaceous branches ... ... 9. *H. congesta.*

Leaves rounded or abruptly narrowed at the base; main-nerves curved ; flowers only ·1 in. long ... 10. *H. macrophylla.*

Leaves gradually narrowed to the base; nerves not curved; flowers ·15 in. long ... ... 11. *H. Kunstleri.*

Leaves narrowly elliptic to elliptic-lanceolate, 1 to 2 in. long, ·3 to ·8 in. broad (about three times longer than broad) :—

Stipules with numerous filiform bristles, much longer than the sheath ; leaves subsessile, with broad bases, their main-nerves 4 or 5 pairs, very faint ... 12. *H. connata.*

Stipules with a few bristles, not much longer than the sheath ; leaves at the base petiolate :—

Main-nerves of leaves 4 to 6 pairs, straight, oblique, very prominent ... ... 13. *H. Auricularia.*

Main nerves of leaves 3 or 4 pairs, curved, faint ... 14. *H. Havilandi.*

Leaves linear-oblong or linear, many times longer than broad :—

Leaves glabrous, sessile :—

Leaves glabrous beneath; flowers ·15 in. long; calyx obovoid-campanulate with 4 lanceolate-ovate spreading lobes ; lobes of corolla short with thickened apices ; anthers broadly ovate ... ... 15. *H. tenelliflora.*

Leaves not glaucous beneath ; flowers ·2 in. long ; calyx tubular-campanulate, with 4 ovate ciliate suberect lobes ; lobes of corolla narrowly ovate, sub-acute ; anthers oblong ... ... 16. *H. nitida.*

Leaves with weak hispid hairs on the upper surface, glabrous on the lower, sessile ; capsule sparsely pubescent ... ... 17. *H. pinifolia.*

Leaves with both surfaces slightly scaberulous, shortly petiolate ; capsule coarsely pubescent ... 18. *H. hispida.*

1. HEDYOTIS MOLLIS, Wall. Cat. 859. Scandent ; the older stems terete, thickened towards the nodes, the younger 4-angled, grooved, softly but minutely pubescent like the branches of the inflorescence. *Leaves* membranous, lanceolate to elliptic-lanceolate, shortly acuminate, the base cuneate ; upper surface olivaceous when dry, glabrous or subglabrous, the midrib often puberulous ; lower surface paler and puberulous ; main-nerves 3 or 4 pairs, ascending obliquely, little curved, slightly depressed on the upper and prominent on the lower surface like

the midrib; length 1·75 to 3·5 in.; breadth ·6 to 1·15 in.; petiole ·05 in. *Stipules* pubescent, short, broad, truncate, the upper edge bearing 3 or 4 stout black erect bristles. *Inflorescence* 1 to 1·75 in. long, terminal and from the upper leaf-axils, paniculate; the branches diverging, each with a minute linear bracteole at its base and at its apex a lax few-flowered umbel ·4 in. in diam. *Flowers* about ·15 in. long, their pedicels about as long or shorter. *Calyx* narrowly campanulate, glabrous; the mouth with 4 rather broad triangular teeth. *Corolla* about twice as long as the calyx, glabrous; the tube funnel-shaped; the mouth deeply divided into 4 oblong blunt teeth. *Capsules* narrowly obovoid, glabrous, crowned by the small spreading calyx-teeth, faintly 2-grooved, under ·7 in. long. *Seeds* several in each cell, dark brown. G. Don Gen. Syst. III. 527; Hook fil. Fl. Br. Ind. III. 57.

PERAK: *Scortechini* 55; *King's Collector* 2704. PENANG: *Curtis* 1096.

VAR. *laxa.* Inflorescence 1·5 to 3 in. long, much more lax than in the type; flower-pedicels slender, often ·15 in. long; flowers ·2 in. long.

PERAK: *King's Collector* 2926. PENANG: *Curtis* 1096.

2. HEDYOTIS PRAINIANA, King n. sp. Scandent, at first green but ultimately olivaceous-brown when dry; young branches thinner than a goose-quill, broadly two-grooved, very slightly angled, uniformly clothed with short yellowish pubescence. *Leaves* thickly membranous, broadly lanceolate or narrowly elliptic, acute, the base narrowed into the petiole; both surfaces minutely pubescent; midrib prominent; main-nerves 4 or 5 pairs, rather straight, ascending; length 2 to 4 in.; breadth 1 to 1·5 in.; petioles ·3 to ·8 in. long, tomentose; the leaves of the inflorescence becoming smaller and with shorter petioles upwards, the uppermost pair sessile. *Stipules* broad at the base, the mouth with numerous long linear or lanceolate unequal lobes. *Inflorescence* a narrow panicle 6 to 15 in. long, with short simple or ternate spreading umbel-bearing branches ·75 to 2·5 in. long, everywhere clothed with rather dense yellowish pubescence. *Umbels* capituliform, ·3 to ·5 in. in diam. when dry, bi-bracteolate at the base, 10- to 12-flowered. *Flowers* rather more than ·1 in. long, on short pedicels about as long as their acute bracteoles. *Calyx* narrowly campanulate, with 4 long erect lanceolate lobes, pubescent outside like the corolla. *Corolla* slightly exserted, tubular, with 4 short broad teeth. *Stamens* 4, included; anthers narrowly ovate, filaments short. Fruit oblong, pubescent, the cocci plano-convex, each containing a large placenta and 2 or 3 large compressed seeds.

PENANG: *Curtis* 977.

Allied to *H. capitellata*, Wall., but pubescent and with flowers only half as large. Scortechini (Herb. 34) collected in Perak specimens in advanced fruit which may belong to this.

3. Hedyotis capitellata, Wall. Cat. 837 (in part). Scandent, glabrous, greenish when dry; young branches slender, 4-angled, the older usually terete. *Leaves* thickly membranous, lanceolate or elliptic-lanceolate, acuminate, the base more or less cuneate; lower surface darker than the upper; main-nerves 3 or 4 pairs, ascending, very little curved, rather prominent (like the midrib) beneath length 1·5 to 2·75 in.; breadth ·75 to 1·25 in.; petiole ·1 to ·15 in. *Stipules* short, broad, with long coarse teeth. *Inflorescence* panicled, pedunculate, mostly terminal; the primary branches trichotomous; the secondary branches divaricate, each bearing a linear reflexed bracteole at its base and at its apex a dense capitulum of flowers. *Flowers* ·4 in. long, sub-sessile. *Calyx* a little more than ·1 in. long, campanulate, ribbed; the mouth with 4 broad, ovate, lanceolate, acute spreading teeth, with a few hairs on their edges. *Corolla* tubular in bud, deeply divided into 4 narrowly oblong blunt spreading lobes, glabrous outside but with many coarse hairs inside. *Capsule* narrowly obovoid, sub-compressed, grooved, glabrous, a little more than ·1 in long. *Seeds* several in each cell, black. G. Don Gen. Syst. III. 527; Kurz in Journ. As. Soc. Beng. 1877, II. 135 (excl. var. 7). Hook. fil. Fl. Br. Ind. III. 57. *Oldenlandia rubioides*, Miq. Fl. Ind. Bat. II. 353. *H. Finlaysoniana*, Wall. Cat. 6189.

In all the provinces; common.—Distrib. Malay Archipelago.

4. Hedyotis vestita, R. Br. in Wall. Cat. 847. A diffuse little-branched herb 1 to 4 feet long, all parts, except the upper surfaces of the leaves, softly pubescent; stems and branches slender, 4-angled and 4-grooved when dry. *Leaves* membranous, narrowly elliptic-lanceolate, more or less acuminate, the base narrowed; upper surface sparsely adpressed-pubescent; main-nerves 5 or 6 pairs, ascending obliquely, almost straight, depressed on the upper and prominent on the lower surface; length 2 to 3·5 in; breadth ·6 to 1 in.; petiole ·15 to ·25 in.; *Stipules* short, broad, crowned by one to three bristly or subulate processes. *Inflorescence* axillary, consisting of few-flowered head-like umbellate cymes, on simple peduncles or in small panicles, bracteolate. *Flowers* about ·05 in. long, sessile or sub-sessile. *Calyx* cupular, with 4 deltoid or lanceolate, spreading, narrow acuminate lobes. *Corolla* blue or violet, funnel-shaped, hairy externally and in the throat, its lobes recurved. *Fruit* dry, sub-indehiscent, broadly turbinate or obovate, less than ·05 in. long; *seeds* numerous, compressed. G. Don Gen. Syst. III. 526; Hook. fil. Fl. Br. Ind. III. 58. *H. costata*, Kurz in Journ. As. Soc. 1877, II. 135 (not of R. Br.) *H. cœrulea*, Korth. in Ned. Kruidk. Arch. II. 160. *H. capituliflora*, Miq. Fl. Ind. Bat. II. 183. *Metabolus cœruleus*, Bl. Bijd. 992; DC. Prod. IV. 435. *M. lineatus*, Bartl. in DC. Prod. l.c. *Spermacoce costata*, Roxb. Fl. Beng. 10; Fl. Ind. I. 370.

In all the Provinces.—DISTRIB. Sub-tropical Himalaya; Assam; Malay Archipelago.

5. HEDYOTIS GLABRA, R. Br. Wall. Cat. 848. A glabrous erect herb, 18 to 24 in. high; stems woody at the base, terete even when dry, slightly striate, thicker than a crow-quill, somewhat smaller near the nodes. *Leaves* linear-lanceolate tapering much to each end, when dry pale yellowish-olivaceous and with recurved edges; main-nerves 3 or 4 pairs, straight, oblique, ascending, prominent like the midrib on the lower and depressed on the upper surface, length 1·75 to 3 in.; breadth ·15 to ·4 in.; petiole ·1 to ·15 in. long. *Stipules* adnate to the petioles to form a campanulate cup with truncate mouth bearing a few long bristles. *Cymes* in small trichotomous axillary pedunculate panicles from ·35 to 1·25 in. long, minutely puberulous, and minutely bracteolate. *Flowers* less than ·1 in. long, on short pedicels of varying length. *Calyx* narrowly campanulate; the lobes spreading, triangular, sub-acute. *Corolla* tubular, its lobes oblong, blunt, sub-erect. *Fruit* globular, crowned by the calyx-lobes, about ·1 in. in diam. Miq. Fl. Ind. Bat. II. 183; Hook fil. Fl. Br. Ind. III. 59. *Spermacoce glabra*, Roxb. Fl. Ind. I. 368. *Knoxia glabra*, DC. Prod. IV. 569.

PENANG: *Schomburgh, King, Deschamps, Ridley* 5749; *King's Collector* 1370. MALACCA: *Maingay* (K.D.) 892; *Griffith* (K.D.) 2885.—DISTRIB. British India.

6. HEDYOTIS STIPULATA, R. Br. in Wall. Cat. 6195 and 863*a*. *Stems* herbaceous decumbent, rooting, less than a foot high, branching; branches (when dry) slightly compressed, deeply 2-grooved, slightly 4-angled, puberulous. *Leaves* membranous, ovate to narrowly elliptic-oblong, the apex sub-acute, the base much narrowed to the short winged petiole; both surfaces olivaceous brown when dry; the upper glabrous; the lower paler, sparsely pubescent on the 3 or 4 pairs of spreading slightly curved little prominent main-nerves; length ·75 to 1·75 in.; breadth ·4 to ·8 in.; petioles ·2 to ·3 in. *Stipules* cupular, short, the mouth wavy and bearing a few short bristles. *Peduncles* axillary and terminal, from half as long to as long as the leaves, each bearing a dense 3- to 6-flowered head about ·35 in. in diam. (when dry). *Flowers* ·15 in. long, sub-sessile. *Calyx* compressed, obovoid, glabrous, the lobes deep lanceolate, acuminate, spreading. *Corolla* short tubular, with oblong blunt broad lobes. *Anthers* oblong, large, sessile. *Capsules* longer than the flowers, broadly obovoid, almost reniform, compressed, glabrous, crowned by the enlarged triangular acuminate recurved calyx-lobes, dehiscent by apical valves; *seeds* numerous, brown. Hook. fil. Fl. Br. Ind. III. 63. *H. Lindleyana*, Hook. MSS. in W. & A. Prod. 409. *Oldenlandia japonica*, Miq. in Ann. Mus. Lugd. Bot. II. 194. *O. hirsuta*,

Linn. fil. Suppl. 127; DC. Prod. IV. 127. ?*Anotis capitata*, Korth in Ned. Kruidk. Nat. Gesch. II. 151.

PERAK: at 2000 feet, *Wray* 1450. PAHANG: *Ridley* 2233.—DISTRIB. Java; British India.

7. HEDYOTIS PEDUNCULARIS, King n. sp. A low glabrous undershrub; young branches slender, angled, slightly winged, shining, pale brown. *Leaves* coriaceous, linear-lanceolate, tapering acutely to each end, nerveless, the midrib strong; length 1·5 to 2·5 in.; breadth ·2 to ·35 in.; petiole ·15 to ·4 in., winged. *Stipules* with broad triangular bases, much acuminate, sparsely glandular hairy. *Peduncle* solitary, terminal, 2 to 4 in. long, bearing usually a single terminal dense, many-flowered capitulum ·75 in. in diam., sometimes with smaller capitules in the upper leaf axils; the terminal capitule with two deflexed leaf-like linear bracts. *Flowers* sessile or nearly so. *Calyx* ·15 in. long, coriaceous; its 4 lobes lanceolate, spreading, persistent in fruit. *Fruit* obovoid, ·1 in. long, the two cocci with tough integuments.

KEDAH: *Ridley* 5546.

8. HEDYOTIS MAINGAYI, Hook. fil. Fl. Br. Ind. III. 49. A low branching glabrous shrub; young branches slender, angled, slightly winged, greenish when dry. *Leaves* coriaceous, lanceolate, acute, the base rounded or slightly narrowed, nerves obsolete, the midrib bold; length 1·5 to 1·75 in.; breadth ·4 to ·6 in.; petiole ·05 to ·1 in. *Stipules* broadly triangular, acute, not acuminate, thick, persistent. *Cymes* terminal and axillary, on slender peduncles varying from ·25 to 1 in. in length; the terminal ones the longest; bracteoles thick, lanceolate; branches of inflorescence and flower-pedicels slightly winged. *Flowers* ·3 in. long, their pedicels under ·1 in. *Calyx* campanulate, deeply divided into 4 linear-lanceolate, acuminate, spreading lobes. *Corolla* salver-shaped; the limb extending beyond the calyx, divided into 4 oblong, blunt lobes. *Capsules* ovoid-globular, less than ·1 in. long, ridged, crowned by the deflexed calyx-lobes.

MALACCA: *Griffith; Lobb, Cuming* 2348; *Maingay* (K.D.) 887; *Ridley* 3211; *Derry* 619; *Hullett* 796. JOHOR: *Ridley.*

9. HEDYOTIS CONGESTA, R. Br. in Wall. Cat. 844. Shrubby glabrous, much-branched; branches thinner than a goose-quill, acutely 4-angled. *Leaves* thinly coriaceous, lanceolate ovate-lanceolate or elliptic, shortly acuminate, the base rounded or slightly cuneate, both surfaces pale brown tinged with yellow or green when dry: main-nerves 5 or 6 pairs, curved, spreading, indistinct on both surfaces when dry; length 2·5 to 5 in.; breadth 1·5 (rarely ·75) to 2 in.; petioles ·15 to ·35 in. *Stipules* triangular, much acuminate, nearly as long as the petioles, with many linear lobes, the middle one pectinate. *Cymes* sessile, axillary,

dense, many-flowered. *Flowers* under ·15 in. long, surrounded by numerous scarious broad acute bracteoles. *Calyx* campanulate, ·15 in. long, the mouth wide and divided into 4 large triangular sub-acute ciliate lobes. *Corolla* tubular, connected by the calyx-lobes, glabrous, the mouth with 4 lanceolate sub-acute much reflexed lobes. *Fruit* oblong, crowned by the large incurved calyx-lobes, glabrous, ·15 in. long; *seeds* numerous. G. Don Gen. Syst. III. 525; Hook. fil. Fl. Br. Ind. III. 61. *H. argentea*, Wall. Cat. 858.

In all the provinces, common.—Distrib. Borneo; Sumatra.

Var. *nicobarica.* Leaves narrowly elliptic, 3·5 to 5·5 in. long and ·8 to 1·4 in. broad, much tapered at either end; the petioles ·3 or ·4 in. long; cymes half as long as the petioles, with fewer flowers than in the type. *? H. carnosa*, Korth. in Ned. Kruidk. II. 161.

Nicobar Islands: *King's Collector* 506.

10. Hedyotis macrophylla, Wall. in W. & A. Prodr. 408 (excl. syn.) A low shrub; stem short, as thick as a swan-quill; branches thinner than a goose-quill, pale when dry, acutely 4-angled and sometimes winged, glabrous. *Leaves* membranous, shortly petioled, ovate or ovate-lanceolate, shortly acuminate or acute, the base broad, narrowed, or rounded; upper surface olivaceous when dry, glabrous, sometimes scaberulous; the lower pale brown, glabrous, sometimes puberulous on the midrib and nerves; main-nerves 6 or 7 pairs, curved, ascending, rather distinct; length 3 to 6 in.; breadth 1·5 to 3 in.; petiole ·3 to ·7 in. *Stipules* cupular, hairy, truncate, with 8 to 10 stout erect pubescent bristles. *Cymes* axillary, sessile, globular, many-flowered, densely crowded, ·5 in. across. *Flowers* ·1 in. long, sessile or shortly pedicelled, mixed with linear hairy bracteoles some of them longer than themselves. *Calyx* compressed, narrowly funnel-shaped, pubescent, the 4 lanceolate lobes as long as the tube. *Corolla* pubescent, shorter than the calyx-lobes; its lobes 4, broad, blunt. *Capsule* many-seeded, ovoid, hairy, not longer than the persistent calyx-lobes. Wall. Cat. 841; Hook. fil. Fl. Br. Ind. III. 54 (excl. syn.) *H. nodiflora*, Wall.

Malacca: *Griffith* (K.D.) 2889 in part. Penang: *Wallich.*

The description given above is founded on the Penang plant on which Wight and Arnot based the species. In the Kew Herbarium the species issued by Wallich as *H. nodiflora* (Cat. 855) has been put with this, the latter seems, however, to be a totally different species with much narrower leaves and smaller heads with fewer flowers.

11. Hedyotis Kunstleri, King n. sp. Herbaceous, erect, 12 to 18 in. high; stems glabrous, thinner than a goose-quill, acutely 4-angled. *Leaves* membranous, oblong-elliptic, tapering to each end but more gradually to the apex than to the base, both surfaces glabrous,

olivaceous, the lower paler, the upper slightly scaberulous; main-nerves 5 or 6 pairs, ascending obliquely, almost straight, slightly prominent on the lower surface; length 3·5 to 4·5 in.; breadth 1·5 to 2 in.; petiole ·5 or ·6 in. *Stipules* shallow cupular, with numerous erect long subulate pubescent teeth ·3 in. in length. *Cymes* axillary sessile, glomerulate, many-flowered, dense, shorter than the petioles, hispidulous-puberulous in all parts. *Flowers* ·15 in. long, on short bracteolate pedicels. *Calyx* with narrow tube and 4 long lanceolate spreading lobes. *Corolla* shorter than the calyx, tubular, with 4 spreading oblong short lobes. *Anthers* 4, oblong, sessile, brown. *Fruit* ovoid, slightly 2-grooved, crowned by the calyx-lobes, less than ·1 in. long, separating into two cartilaginous many-seeded cocci. *Seeds* numerous, angular, brown.

PERAK: *King's Collector* 8728.

A species allied to *H. macrophylla*, Wall., but herbaceous and with narrower leaves, the main-nerves not curved, much narrowed to the base; slightly longer flowers (·15 in. as against ·1 in.) Closely allied also to the Ceylon *H. Thwaitesii*, Hook. fil., but with more acutely angled stems, shorter petioles and smaller less numerous flowers. The calyx-teeth of this are also smaller and narrower and the capsules have numerous seeds.

12. HEDYOTIS CONNATA, Wall. Cat. 856. Herbaceous, glabrous, diffuse, the stems as thick as a crow-quill, terete, wiry, smooth, decumbent near the base and rooting at the nodes, the younger somewhat compressed, grooved and 4-angled when dry. *Leaves* membranous, narrowly oblong to elliptic-oblong, acute or shortly acuminate rather abruptly narrowed at the base to the short petiole; upper surface olivaceous, glabrous; the lower pale, glabrous except the rather bold puberulous midrib; main-nerves 4 or 5 pairs, rather straight, oblique, invisible on the upper surface and faint on the lower; length 1·75 to 2·75; breadth ·35 to ·75 in.; petiole about ·1 in., puberulous. *Stipules* campanulate, the mouth rounded, bearing about 10 spreading erect, filiform scabrid bristles often ·45 in. long. Hook. fil. Fl. Br. Ind. III. 62. *H. merguensis*, Hook. fil. in Gen. Plant. II. 57.

PERAK: *Scortechini.* LANKAWI: *Curtis.*—DISTRIB. Burma.

13. HEDYOTIS AURICULARIA, Linn. Sp. Pl. 101. Herbaceous, diffuse or erect; young branches thicker than a crow-quill, slightly compressed and 4-angled when dry, shortly and softly pubescent. *Leaves* lanceolate or narrowly elliptic-lanceolate, acute or shortly acuminate, the base rather abruptly cuneate; both surfaces olivaceous when dry, the upper sparsely scaberulous-pubescent, the lower paler and more pubescent; both surfaces sometimes glabrous and more or less smooth; main-nerves 4 to 6 pairs, rather straight, obliquely ascending, depressed above and prominent beneath; length 1·5 to 2·25 in.; breadth ·35 to ·85 in.;

petioles ·2 to ·35 in., pubescent. *Stipules* adnate to the petioles to form a campanulate cup with acuminate 2- or 3-bristled mouth. *Cymes* almost sessile, many-flowered, condensed. *Flowers* nearly sessile, less than ·1 in. long. *Calyx* hairy, campanulate, with 4 spreading ovate or lanceolate acute lobes. *Corolla* longer than the calyx, salver-shaped, the lobes narrow. *Fruit* globular-turbinate, crowned by the spreading calyx-lobes, shortly hairy. *Seeds* numerous, dark brown. Prod. IV. 420; Roxb. Fl. Ind. I. 365; ed. Carey & Wall. I. 369; W. & A. Prod. Fl. Penins. Ind. 412; Hook. fil. Fl. Br. Ind. III. 58. *H. nervosa*, Wall. Cat. 857 (? not of Lam.) *H. procumbens*, Wall. Cat. 861. *H. lineata*, Wall. Cat. 6198 (not of Roxb.) *H. costata*, R. Br. in Wall. Cat. 849; G. Don. Gen. Syst. III. 526. *H. multicaulis*, Schldl. Pl. Hohen. No. 845. *H. venosa*, Korth. in Ned. Kruidk. Arch. II. 160. *Metabolus venosus*, Bl.; DC. Prod. IV. 435. *Spermacoce hispida*, Miq. Pl. Hohen. No. 44. Rheede Hort. Malab. X. t. 32.

Perak: *Scortechini* 110, 113; *Wray* 3078, 3085; *King's Collector* 88. Pahang: *Ridley* 1185, 2674. Singapore: *Ridley* 2863. Kedah: *Ridley* 5547. Malacca: *Maingay* (K.D.) 891.—Distrib. British India; tropical Australia.

14. Hedyotis Havilandi, n. sp. King. Herbaceous, often rooting at the lower nodes, woody at the base, green when dry; stems thicker than a crow-quill, acutely 4-angled and broadly grooved, deciduously scurfy-hairy especially near the nodes, but afterwards glabrous. *Leaves* membranous, elliptic, tapering to each end, acute, the edges finely undulate when dry; both surfaces, but especially the upper, minutely hispid; main-nerves 3 or 4 pairs, curving upwards, faint on both surfaces (when dry), the midrib pale and prominent on the lower; length 1 to 1·5 in.; breadth ·5 to ·7 in.; petiole ·3 to ·5 in. *Stipules* triangular, rather shorter than the cymes, much acuminate and with several long lateral teeth, pilose externally. *Cymes* axillary, sessile, crowded, many-flowered, about ·25 in. in diam. *Flowers* ·1 in. long, on short hairy pedicels with a few bracteoles between them. *Calyx* pubescent, campanulate; the tube narrow, its mouth with linear-lanceolate acuminate spreading teeth as long as the tube. *Corolla* not much exceeding the calyx-lobes, tubular with 4 broad oblong lobes. *Anthers* oblong, on rather long filaments. *Capsule* narrowly ovoid, crowned by the spreading calyx-lobes, thin-walled, sparsely hispid or glabrous, dehiscent, with several brown seeds in each cell.

Perak: *Scortechini; King's Collector* 10254; *Wray* 4062. Penang: *Curtis.*—Distrib. Burma; Borneo, *Haviland and Hose*, 3450 C.

15. Hedyotis tenelliflora, Blume Bijdr. 971. Herbaceous, erect, glabrous, a foot or more in height, little-branched. *Stems* and *branches*

about as thick as a crow-quill, when dry dark-coloured, the older sub-terete, the younger deeply 2-grooved and slightly 4-angled. *Leaves* often in whorls of 4 or 6, coriaceous, sessile, linear, sub-acute, the bases passing into the stipules. *Stipules* cupular, short, the mouth truncate, with about 6 erect flat stout bristles; length 1 to 1·5 in.; breadth ·1 to ·15 in. *Cymes* very short (under ·2 in. long), axillary, crowded. *Flowers* ·15 in. long, sessile, surrounded by numerous bracteoles bearing long erect bristles. *Calyx* compressed, obovoid-campanulate, pilose towards the apex; the mouth with 4 lanceolate, acute, spreading, deciduous lobes. *Corolla* slightly exceeding the calyx-lobes, sub-tubular; lobes of the mouth short with thickened apices. *Anthers* broadly ovoid, sessile. DC. Prod. IV. 419; Hook. fil. Fl. Br. Ind. III. 60. *H. angustifolia*, Cham. & Schlect. in Linnæa IV. 153. *H. approximata*, Wall. Cat. 852. *? Spermacoce tubularis*, Br. in Wall. Cat. 836. *Scleromitron tenelliflorum*, Korth. in Ned. Kruidk. Arch. II, 155. *S. tetraquetrum*, Miq. Fl. Ind. Bot. II. 186. *Oldenlandia angustifolia*, Benth. Fl. Hongk. 151.

PENANG: *Ridley* 7097. PROVINCE WELLESLEY: *Curtis* 2236. MALACCA: *Hervey*.

16. HEDYOTIS NITIDA, W. & A. Prod. Fl. Penins. Ind. 412. Diffuse, sometimes with woody roots; stems about as thick as a crow-quill, 2-grooved, sharply 4-angled, the angles often minutely hispid. *Leaves* coriaceous, sessile, narrowly lanceolate or linear, the edges much recurved, nerves none, but the midrib prominent beneath; the upper surface olivaceous when dry, shining and minutely pitted, quite glabrous; the lower dull pale brown; length ·6 to 1 in.; breadth ·1 to ·25 in. *Stipules* continuous with the bases of the leaves, deeply campanulate, pubescent outside, the mouth bearing 6 to 8 long erect shining bristles. *Inflorescence* axillary, sub-sessile, 2- to 4-flowered. *Flowers* ·2 in. long, minutely bracteolate, sessile or on very short pedicels. *Calyx* tubular-campanulate, shortly hispid; the mouth with 4 deep, ovate-acute, ciliate, sub-erect lobes. *Corolla* included in the calyx, pubescent, tubular, its mouth with 4 narrowly ovate sub-acute erect lobes. *Anthers* oblong, sessile. *Capsule* ovoid, crowned by the long erect stiff calyx-lobes, dehiscing by apical valves, sub-glabrous; seeds numerous, brown. Hook. fil. Fl. Br. Ind. III. 61. *H. Neesiana*, Arn. Pugill. 23. *H. glabella*, Br. in. Wall. Cat. 886, Bedd. Ic. Pl. t. 36.

PERAK: *Scortechini; Wray* 3680. PENANG: *King*.—DISTRIB. British India; Ceylon.

This species, which closely resembles *H. hispida*, Retz., and *H. tenelliflora*, Bl., has not hitherto been recorded from the Malay Peninsula or Islands. The specimens from Penang and Perak have smaller leaves than the majority of those from British India and Ceylon, but otherwise they agree.

17. Hedyotis pinifolia, Wall. Cat. 850; Hook. fil. Fl. Br. Ind. III. 60. Diffuse, sometimes with a woody root; stems as thick as a crow-quill or thicker, terete when old, angled and grooved when dry, glabrous. *Leaves* sessile, sub-coriaceous, linear, acute, the margins revolute, the bases adnate to the short truncate stipules, puberulous on the upper but glabrous on the lower surface, nerves obscure, midrib distinct; length ·5 to 1·5 in.; breadth ·05 to ·1 in. *Stipules* cupular, glabrous, with a few small bristles on the mouth. *Cymes* axillary and terminal, sessile, 1- to 4-flowered. *Flowers* ·1 in. long, on pedicels shorter than themselves. *Calyx* sparsely hispid, ovoid-campanulate, with 4 narrow spreading acute lobes nearly as long as the tube. *Corolla* with a cylindrical tube exceeding the calyx-lobes; its lobes 4, lanceolate, acute. *Stamens* exserted. *Capsule* sparsely pubescent, membranous, broadly ovoid, ridged, crowned by the calyx-teeth, dehiscing by apical valves, several seeded. G. Don Gen. Syst. III. 525; *Scleromitrion rigidum*, Kurz in Journ. As. Soc. Beng. 1877 II. 136 (excl. syn. Miq.)

Perak: *Ridley* 3070, 7203; *Scortechini* 1012. Province Wellesley: *King*. Singapore: *Ridley* 8924, 8925; *Hullett* 564. Johor: *Ridley* 11141. Pahang: *Ridley* 1623. Kedah: *Curtis*. Malacca: *Griffith* (K.D.) 2895/2.—Distrib. British India.

18. Hedyotis hispida, Retz Obs. IV. 23. Herbaceous, slightly branched; stems thicker than a crow-quill, sub-terete when old, deeply two-grooved, compressed and 4-angled when young, sparsely and softly pubescent, especially near the nodes. *Leaves* thinly coriaceous, narrowly oblong-lanceolate, acute, the base somewhat narrowed; both surfaces slightly scaberulous, olivaceous-green when dry, and the edges recurved; main-nerves obscure, midrib prominent below; length ·8 to 2 in.; breadth ·25 to ·5 in.; petiole ·1 in. or less. *Stipules* adnate to the petiole to form a campanulate pubescent cup with 6 to 8 bristles on its mouth. *Cymes* few-flowered, sessile, axillary. *Flowers* ·2 in. long, sessile. *Calyx* campanulate, hispid, its lobes linear, erect, as long as the tube. *Corolla* as long as the calyx-lobes, tubular; its lobes lanceolate, acuminate, hairy. *Capsule* ·1 in. long, ovoid, coarsely pubescent, ribbed, crowned by the erect linear calyx-teeth. *Seeds* numerous, dark brown. Roxb. Fl. Ind. I. 364; Wall. Cat. 845; Hook. fil. Fl. Br. Ind. III. 61. *Scleromitrion hispidum*, Korth. in Miq. Fl. Ind. Bot. II. 185. *Oldenlandia hispida*, Benth. Fl. Hongk. 150.

Perak: *Scortechini* 47, 201. Penang: *Deschamps; Curtis* 1847.—Distrib. British India.

13. Oldenlandia, Linn.

Slender erect or diffuse much-branched herbs. *Leaves* usually small, stipules acute or bristly. *Flowers* small, often white, in axillary or terminal dichotomous often paniculate cymes, sometimes solitary. *Calyx* obovoid or turbinate; the mouth 4- rarely 5-toothed; the teeth in fruit erect, often distant and sometimes with interposed processes. *Corolla* funnel- or salver-shaped, with a long or short tube, or rotate: its lobes 4, rarely 5, obtuse, valvate. *Ovary* 2-celled; ovules numerous, the placentas attached to the septum; style filiform; stigmas 2, oblong. *Capsule* small, crowned by the calyx-teeth, usually membranous, sub-globular, often compressed, didymous or ridged, loculicidal at the apex, many-seeded, rarely indehiscent. *Seeds* globose or angled, not winged, smooth or pitted; embryo clavate, in fleshy albumen.—Distrib. Species about 80; tropical and sub-tropical, mostly Asiatic.

Leaves in one or more whorls near the base of the stem, elliptic, blunt ... ... 1. *O. nudicaulis.*
Leaves scattered along the whole length of the stem:—
  Flowers in terminal or axillary few-flowered cymes not much longer than the elliptic-oblong sub-acute leaves: ripe capsules about ·15 in. in diam. ... ... 2. *O. paniculata.*
  Flowers in terminal or axillary dichotomous lax cymes, the branches and flower-pedicels long and filiform; leaves narrowly oblong-lanceolate, much narrowed to the base and apex: ripe capsules less than ·1 in. in diam. ... 3. *O. dichotoma.*
  Flowers 2 to 4 on a slender axillary pedicels or solitary on long pedicels; capsule more than ·1 in. broad; leaves linear ... ... 4. *O. corymbosa.*
  Flowers solitary in the leaf-axils:—
    Some of the flowers solitary, always on long slender pedicels; leaves linear ... ... 4. *O. corymbosa.*
    All the flowers solitary and on long slender pedicels, leaves linear ... ... 5. *O. Heynei.*
    All the flowers sessile:—
      Leaves narrow, many times longer than broad ... 6. *O. diffusa.*
      Leaves rotund-ovate to elliptic not much longer than broad ... ... 7. *O. trinervia.*

1. Oldenlandia nudicaulis, Roth Nov. Sp. 95. A small erect glabrous annual, 4 to 6 inches high, drying green; stem very slender, an inch or two long, minutely scurfy-puberulous, bearing several whorls of 3 or 4 thin, sparsely and minutely scaly, elliptic, rather blunt leaves abruptly narrowed at the base and inserted on the stipules by very short broad petioles, and with about 4 pairs of faint ascending main-nerves, from ·7 to 1·5 in. long and from ·35 to ·65 in. broad. *Cymes* long, slender, laxly corymbose, simple or branched, minutely bracteolate, solitary or several together from the apex of the stem, 1·5 to 3·5 in. long (half of the length being peduncle). *Flowers* ·15 in. long, on capillary

pedicels ·2 to ·5 in. long. *Calyx* cylindric or campanulate with small lanceolate acute spreading teeth. *Corolla* much exceeding the calyx, deeply cut into 4 oblong, blunt, nerved lobes. *Stamens* slightly shorter than the corolla; *anthers* linear, as long as the slender filament. *Capsule* turbinate, the top broad, the persistent calyx-teeth small. *Seeds* numerous. Hook. fil. Fl. Br. Ind. III. 70. *O. rotundifolia*, G. Don Syst. III. 530. *O. ovalifolia* and *O. spergulacea*, DC. Prod. IV. 427, 428. *Hedyotis scapigera*, R. Br. in Wall. Cat. 881. *H. nudicaulis*, W. & A. Prod. 416; Bedd. Ic. Pl. Ind. Or. t. 34. *H. ovalifolia* Cav. Ic. 573. *H. rotundifolia*, Ham. in Wall. Cat. 6190 (not of DC.) *H. spergulacea*, Kurz in Journal As. Soc. Beng. 1877, II. 134.

MALACCA: *Griffith* (K.D.) 2898. KEDAH: *Curtis* 2669.—DISTRIB. British India; Java; Philippines.

2. OLDENLANDIA PANICULATA, Linn. Sp. Pl. 1667. Herbaceous, annual, glabrous, drying a pale olivaceous colour, erect or diffuse, much branched; young branches acutely 4-angled, sometimes narrowly winged, about as thick as a crow-quill. *Leaves* membranous, elliptic or elliptic-oblong, sub-acute, narrowed gradually at the base to the short petiole, both surfaces dull when dry, the nerves indistinct; linear with the midrib distinct; length ·4 to ·75 in.; breadth ·2 to ·3 in.; petiole ·1 to ·2 in. *Stipules* short, cupular, truncate, without bristles or with only 1 or 2 in the middle. *Cymes* in the upper axils or terminal, on peduncles as long as or not more than twice as long as the leaves, lax, few-flowered, minutely bracteolate. *Flowers* under ·1 in. long, on thin pedicels two or three times longer than themselves. *Calyx* campanulate, with 4 rather distinct narrow teeth. *Corolla* not much exceeding the calyx-teeth. *Capsule* slightly compressed, turbinate, more than ·1 in. diam.; crowned by the small spreading calyx-teeth; seeds numerous, black. Burm. Fl. Ind. 38, t. 15, f. 1; DC. Prod. IV. 427; Hook. fil. Fl. Br. Ind. III. 69. *O. alata*, Roxb. Fl. Ind. I. 421 (*not of Koenig*). *Hedyotis racemosa*, W. & A. Prod. 414; Wight Ic. t. 312; Wall. Cat. 875 (*in part*). *H. paniculata*, Lam. Encyc. III. 79; Kurz in Journ. As. Soc. Beng. 1877 II. 134. *H. minima*, Heyne, Wall. Cat. 877.

MALACCA: *Griffith* (K.D.) 2902. PERAK: *Scortechini* 1107.—DISTRIB. British India; Malay and Philippine Islands; China; Polynesia.

3. OLDENLANDIA DICHOTOMA, Hook. fil. Fl. Br. Ind. III. 67. Annual, herbaceous, erect, branching; stems glabrous or very sparsely and minutely hispidulous, as thick as a crow-quill, obscurely 4-angled, pale brown when dry. *Leaves* membranous, narrowly oblong-lanceolate, tapering to both ends; upper surface olivaceous, somewhat scaberulous, sparsely and minutely hispidulous; the lower pale, glabrous, nerves invisible, midrib broad and distinct on the lower surface; length ·75 to

1·25 in.; breadth ·1 to ·2 in.; petiole ·05 in. to 0. *Stipules* cupular, very short, with small obscure teeth not bristly. *Cymes* axillary and terminal, with many long slender dichotomous few-flowered, angular, sub-hispidulous branches; the lateral cymes 1 to 2 in. long, the terminal one 3 to 5 in., with leaf-like linear bracts varying from ·25 to ·5 in. in length. *Flowers* ·2 in. long, clavate in bud, solitary at the ends of the ultimate hair-like branchlets. *Calyx* campanulate; the lobes 4, lanceolate, sub-erect, sub-glabrous, often with smaller lobes interposed. *Corolla* twice as long as the calyx, funnel-shaped, the tube long and narrow; the limb wide, with 4 spreading lanceolate teeth, glabrous. *Capsules* less than ·1 in. in diam., sub-globular, crowned by the small distant erect calyx-teeth, glabrous, dehiscent. *Seeds* numerous, brown. *Hedyotis dichotoma*, Koen. ex Roth Nov. Sp. 93; Wall. Cat. 6204 (*in part*); W. & A. Prod. 416 (*excl. some synonyms*). *H. affinis*, Roem. & Sch. Syst. 194. *H. Heynei*, Bedd. Ic. Pl. In. Or. t. 33 (not of Brown). *H. brachiata*, Wall. Cat. 6201 (*in part*) not of Wight.

PENANG: *King's Collector* 1282; *Curtis* 494; *Deschamps*. PROVINCE WELLESLEY: *King*. MALACCA: *Ridley* 1717. JOHOR: *Ridley* 11146.

4. OLDENLANDIA CORYMBOSA, Linn. Sp. Pl. 119. Rather stouter and more branched than *O. dichotoma*, and the branches more boldly angled. *Leaves* usually rather shorter, many of them not exceeding ·5 in. in length. *Flowers* solitary, on pedicels not more than half as long as in *O. dichotoma*, or in pedunculate 3- to 4-flowered corymbs, otherwise as in *O. dichotoma*. Hiern Flora Trop. Afric. III. 62; Hook. fil. Fl. Br. Ind. III. 64; Trim. Fl. Cey. I. 314. *O. biflora*, Lam. Encyc. IV. 533 (*not of Linn.*); Roxb. Fl. Ind. I. 423. *O. ramosa*, Roxb. l. c. 424. *O. herbacea*, DC. Prod. IV. 425 (*not of Linn.*) *O. scabrida*, DC. l.c. *Hedyotis Burmanniana*, Br. in Wall. Cat. 868 *in part;* W. & A. Prod. Fl. Pen. Ind. 415. *H. biflora*, Roth Nov. Spec. 92; Kurz in Journ. As. Soc. Beng. 1877, II. 133. *H. ramosa*, Bl. Bijdr. 973; ? Wight Ic. t. 822. *H. intermedia*, W. & A. Prod. 415. *H. alsinæfolia*, Br. in Wall. Cat. 873. *H. graminicola*, Kurz in Timen's Journ. Bot. 1875, 326. *Gerontogea biflora*, Cham. & Schl. in Linnæa. IV. 155.—Rheede Hort. Mal. x. t. 38.

JOHOR: *Ridley* 2861, 11142. SINGAPORE: *King's Collector* 27; *Ridley*. PENANG: *Curtis* 494, 1849, 1988. PROVINCE WELLESLEY: *King*. ANDAMANS: *King's Collector*.—DISTRIB. British India; Malay Archipelago; tropical Africa and America.

5. OLDENLANDIA HEYNEI, G. Don Gen. Syst. III. 531. Stouter and taller than *O. dichotoma* and drying (especially as regards the under surfaces of the leaves) of a darker colour, and the stems more boldly 4-angular; the *flowers* solitary but on equally long pedicels as in *O. dichotoma*, the capsules slightly larger and wider at the base. Hook. fil.

Fl. Br. Ind. III. 65. *O. herbacea*, Roxb. Fl. Ind. I. 424. *O. linearis*, *O. linifolia* and *O. asperula*, DC. Prod. IV. 425. *Hedyotis Heynii*, W. & A. Prod. 416; Wall. Cat. 867 (*in part*).

PENANG: *Curtis* 1848, 3399; *King; Deschamps.* PROVINCE WELLESLEY: *King.* PERAK: *Ridley* 10313; *Wray* 1931. SINGAPORE: *Ridley* 10916.—DISTRIB. Malay Archipelago; Tropical Africa.

This passes into *O. dichotoma* as regards its inflorescence there being some specimens in which, by reason of the smallness of the leaves, the inflorescence resembles a lax panicle.

6. OLDENLANDIA DIFFUSA, Roxb. Hort. Beng. 11; Fl. Ind. I. 423. Annual, diffuse, much-branched, dark brown when dry; glabrous. *Stems* about as thick as a crow-quill when dry, compressed, obscurely 4-angled, striate. *Leaves* linear-oblong, tapering to each end, the bases continuous with the stipules, the edges recurved, rather pale on the undersurface and the midrib prominent; length ·5 to 1·5 in.; breadth ·05 to ·1 in. *Stipules* cupular, the edges with a few short bristles towards the middle. *Flowers* ·15 in. long, solitary, axillary, sub-sessile or on peduncles ·05 to ·1 in. long, reflexed. *Calyx* widely campanulate, with 4 erect triangular acute 1-nerved teeth. *Corolla* longer than the calyx, widely campanulate, the mouth with 4 erect rather short broad triangular teeth. *Anthers* shorter than the style, small, narrowly ovoid; filaments rather short. *Stigma* with 2 divergent lobes. *Capsule* depressed globular, crowned by the small calyx-teeth, slightly more than ·1 in. in diam., many-seeded. DC. Prod. IV. 426; Hook. fil. Fl. Br. Ind. III. 64; Trim. Fl. Ceyl. II. 315. *O. brachypoda*, DC. l.c. 424; Wall. Cat. 874. *Hedyotis ramosissima*, Kurz in Journ. As. Soc. 1877 II. 133. *H. diffusa*, Willd. Sp. Pl. I. 566; Wall. Cat. 868 (*in part*). *H. extensa*, Wall. Cat. 869. *H. polygonoides*, Wall. Cat. 872.

In all the provinces except the Andamans; common.—DISTRIB. Tropical Asia; Japan.

7. OLDENLANDIA TRINERVIA, Retz Obs. IV. 23. Annual, herbaceous, glabrous or hairy, procumbent, greenish brown when dry. *Stems* very slender, grooved, 4-angled, sparsely hairy, often rooting at the nodes. *Leaves* ovate-rotund to rotund or elliptic, thickly membranous, midrib distinct below but the 1 or 2 pairs of nerves obscure, both surfaces glabrous or sub-glabrous; length ·2 to ·3 in.; breadth under ·05 or over; petiole usually under ·05 in. long. *Stipules* scarious, campanulate with a few bristles. *Flowers* ·05 in. long, solitary, axillary, on short reflexed pedicels. *Calyx* campanulate, with 4 acute spreading teeth, sparsely pilose. *Corolla* slightly exceeding the calyx, with 4 broad, ovate, sub-acute lobes, glabrous. *Capsules* somewhat compressed, broadly ovate, truncate at the apex, crowned by the small calyx-lobes, dehiscing at

the apex; *seeds* numerous, angled, black. Hook. fil. Fl. Br. Ind. III. 66; Trim. Flora Ceylon III. 316. *O. repens*, Burm. Fl. Ind. t. 15, f. 2? *Hedyotis trinervia*, W. & A. Prod. 414; Dalz. & Gibs. Fl. Bomb. 115; Bedd. Ic. Pl. Ind. Or. t. 29. *H. rotundifolia*, DC. Prod. IV. 420. *H. serphyllifolia*, Poir. in DC. l.c. 421. *H. orbiculata*, Heyne, Wall. Cat. 6191.

SINGAPORE: *Ridley* 8047. PAHANG: *Ridley* 1492. PENANG: *Curtis* 1844.—DISTRIB. British India; Sumatra; Java,; Borneo; Philippines; Ceylon; Tropical Africa.

14. OPHIORRHIZA, Linn.

Decumbent creeping or erect herbs (rarely under-shrubs), with slender terete branches. *Leaves* usually elliptic-lanceolate, often unequal; *stipules* caducous, very often small. *Flowers* rather small, white, pink or greenish, secund in dichotomously branched axillary or terminal cymes; bracts and bracteoles various or absent. *Calyx* short, usually cylindric or campanulate, becoming obreniform or obcordate in fruit, the lobes small and persistent. *Corolla* tubular or funnel-shaped, the tube inside glabrous or hairy; the lobes 5, short, valvate in bud, often winged on the back, and with a fold in the sinus between neighbouring lobes. *Stamens* 5, inserted on the tube; *anthers* linear. *Disk* large, fleshy, 2-lobed. *Ovary* 2-celled; style filiform; stigmas 2, linear or broad; *ovules* numerous, inserted on placentas ascending from the bases of the cells. *Capsules* coriaceous, compressed obreniform or obcordate, dehiscing at the apex by 2 broad gaping valves; placentas divaricating, many-seeded. *Seeds* minute, angled, the testa crustaceous; embryo clavate, in fleshy albumen.—DISTRIB. Species about 50, tropical Asiatic.

Leaves quite glabrous:—
  Stipules lanceolate; leaves elliptic or elliptic-oblong, 1 to 1·5 in. broad ... ... 1. *O. discolor.*
  Stipules reduced to rugulose bands; leaves elliptic, 1·5 to 4 in. broad ... ... 2. *O. erubescens.*
Leaves glabrous except their nerves:—
  Larger leaves 5 or 6 in. long and 1·5 to 2 in. broad, midrib nerves and reticulations puberulous ... ... 3. *O. fasciculata.*
  Larger leaves 2 to 3 in. long and ·65 to 1 in. broad; nerves and midrib beneath with dense pale pubescence ... 4. *O. hispidula.*
Leaves glabrous on the upper surface, glabrous or puberulous and usually stained with red on the lower when dry, elliptic or oblong-elliptic, 2 to 5 in. long and 1 or 2 in. broad ... ... 5. *O. Mungos.*
Leaves slightly puberulous:—
  Stipules forming a broadly triangular very shallow cup,

the mouth sub-truncate; leaves puberulous above on and near the edges and on midrib; ·5 to ·75 in. broad ... 6. *O. Harrisiana* var. *argentea.*
Stipules forming a short cup with its mouth obscurely toothed; leaves minutely puberulous on midrib and nerves beneath, ·5 to 1 in. broad ... ... 7. *O. tenella.*
Stipules lanceolate with long filiform points; larger leaves 3 or 4 in. long and ·75 to 1·25 in. broad, glabrous but for a few scattered thick hairs ... ... 8. *O. rugosa.*
Leaves hairy everywhere on both surfaces :—
Larger leaves 2·5 to 4 in. long, both surfaces with white hispidulous hairs, narrowly elliptic, ·75 to 1·25 in. broad... 9. *O. tomentosa.*
Leaves elliptic or ovate-elliptic, 3·5 to 5 in. long and 1·75 to 2·5 in. broad, sparsely strigose above, hispidulous beneath ... ... 10. *O. Kunstleri.*

1. Ophiorhiza discolor, R. Br. in Wall. Cat. 6232 A. *Stem* erect, woody in its lower part, dark-coloured, terete, glabrous. *Leaves* of the pairs unequal, but not greatly so, membranous, narrowly elliptic or elliptic-oblong, much acuminate and narrowed from below the base to the long rather slender petiole; both surfaces quite glabrous; the upper dark brown, slightly tinged with purple; the lower pale minutely reticulate and much tinged with purple; main-nerves 7 to 12 pairs, curved, spreading, faint on the upper surface and but little prominent on the lower; length 2·5 to 4·5 in.; breadth 1 to 1·5 in.; petioles ·35 to 1 in. *Stipules* linear-lanceolate, ·1 to ·2 in. long, deciduous. *Cymes* solitary, terminal, an inch or two in length; few-branched, ebracteolate; the peduncle and branches minutely puberulous. *Flowers* ·25 in. long, secund in a single row, on very short pedicels which lengthen in fruit. *Calyx* narrowly campanulate; the teeth short, broad, boldly 1-nerved. *Corolla* clavate in bud, ·2 in. long; tube cylindric, slightly inflated in the upper half; the teeth shorter than the tube, obtuse, erect. *Capsule* narrowly obreniform, the sinus almost obsolete, glabrous, ·3 in. across. G. Don Gen. Syst. Bot. III. 522; Hook. fil. Fl. Br. Ind. III. 79. *O. villosa*, Wall. Cat. 6230 (*not of Roxb.*)

Johor: *Ridley.* Penang: *Deschamps.*

2. Ophiorhiza erubescens, Wall. Cat. 6233. Glabrous except the puberulous inflorescence; stem 1 to 3 feet high, woody, as thick as a goose-quill, the bark whitish, striate, corky. *Leaves* of each pair subequal, thinly membranous, elliptic-lanceolate, elliptic-oblanceolate or narrowly elliptic, somewhat oblique, acuminate, the base much narrowed; upper surface greenish when dry, the midrib prominent but the nerves faint; lower surface pale greenish-white, reticulate, the 10 to 14 pairs of rather straight spreading main-nerves rather flat and prominent like the midrib; length 4 to 9 in.; breadth 1·5 to 4 in.;

petioles ·35 to 1·2 in.; *stipules* (dried specimens) reduced to rugulose transverse bands. *Cymes* terminal, solitary, pedunculate, in flower much shorter than, but in fruit half as long as, the leaves or even more; the branches divaricate, slender, many-flowered, in fruit often as much as 2·5 in. long. *Flowers* ·35 in. long, secund, on short puberulous pedicels, very narrow in bud. *Calyx* cylindric, ·05 in. long; its teeth broadly triangular, sub-acute, 1-nerved. *Corolla* ·3 in. long, narrowly cylindric; the mouth with 5 short blunt reflexed teeth. *Anthers* 5, linear, cordate at the base. *Capsules* narrowly rhomboid, the upper edge marginate, glabrous, ·3 in. across. Hook. fil. Fl. Br. Ind. III. 84 as a doubtful species.

PERAK: *Scortechini* 1313; *Wray* 3731, 4050; *King's Collector* 2187, 7119, 5853, 7186, 7119; *Curtis.*—DISTRIB. Burma.

3. OPHIORHIZA FASCICULATA, Don Prod. Fl. Nep. 136. Stem 10 to 14 in. high, erect, little-branched, woody, and nearly as thick as a goose-quill below, puberulous. *Leaves* of a pair very unequal in size, membranous, narrowly elliptic or oblong-elliptic, sub-acute, the base cuneate; upper surface very dark olivaceous when dry, glabrous, the nerves and midrib pale and prominent; lower surface pale yellowish-brown, puberulous on the midrib and 9 to 11 pairs of boldly curved spreading dark-coloured main-nerves; the reticulations also puberulous, their interspaces glabrous; length of the larger leaves 5 or 6 in.; breadth 1·5 to 2 in.; the smaller leaves of the pairs ·8 to 2·5 in. long and ·85 to 1·5 in. broad; petioles ·2 to ·8 in. long. *Stipules* ·15 in. long, subulate with dilated bases. *Cymes* usually solitary, but sometimes 2 or 3 together, terminal, pedunculate, usually less than half as long as the leaves even when in fruit, puberulous everywhere, ebracteate; branches shorter than the peduncles. *Flowers* small (rather less than ·25 in. long), on short puberulous pedicels. *Calyx* narrowly campanulate, densely puberulous, boldly ribbed; the teeth shorter than the tube, triangular, acute, erect. *Corolla* ·2 in. long, cylindric, inflated in the lower part and expanded at the mouth; the 5 lobes short, blunt. *Anthers* narrowly linear, on short filaments. *Capsules* obreniform, the sinus shallow, glabrous, ·25 in. across. Hook. fil. Fl. Br. Ind. III. 83. *O. bracteolata*, R. Br. in. Wall. Cat. 6228.

PERAK: *King's Collector* 2205; *Wray* 1989.—DISTRIB. Himalaya and Khasia.

4. OPHIORHIZA HISPIDULA, Wall. Cat. 6234. Erect, little-branched, slender, pubescent, thicker than a crow-quill. *Leaves* of the pair unequal, membranous, ovate-lanceolate, sub-acute, cuneate (sometimes abruptly so) at the base; upper surface (when dry) olivaceous, glabrous, the midrib prominent but the nerves rather obscure; lower surface pale olivaceous, otherwise sub-glabrous but the bold midrib and 6 or 7 pairs

of spreading main-nerves covered with minute dense white pubescence; length ·75 to 2 in.; breadth ·4 to 1 in.; petioles ·15 to ·6 in. *Stipules* narrowly linear-lanceolate from broad bases, ·1 to ·2 in. long. *Cymes* terminal, solitary, pedunculate, shorter than the leaves, ebracteate, everywhere shortly pubescent; branches few, shorter than the peduncles. *Flowers* ·25 in. long, few but crowded, sessile or on short pedicels. *Calyx* rather under ·1 in. long, cylindric, with 5 narrow erect teeth shorter than the tube, puberulous outside like the corolla. *Corolla* cylindric, somewhat inflated in the lower half; the mouth with 5 narrowly oblong sub-acute erect short lobes. *Capsules* obreniform with a shallow sinus, shortly and coarsely pubescent, ·2 in. across. *O. trichocarpa*, Hook. fil. Fl. Br. Ind. III. 78 (not of Blume).

PAHANG: *Ridley* 2199, 2200; *Yapp* 536.

5. OPHIORHIZA MUNGOS, Linn. Sp. Pl. 150. Glabrous in all its parts, or puberulous on the stems, under surfaces of the leaves, and on the inflorescence. *Stems* from a few inches to a foot and a half high, erect, little branched, thicker than a crow-quill, woody near the base. *Leaves* membranous, one of each pair slightly larger than the other, elliptic or oblong-elliptic, the apex shortly acuminate, the base narrowed and sometimes slightly oblique; upper surface always glabrous and shining, when young dark green, when dry dark-brown, the nerves indistinct; lower surface glabrous or puberulous, when fresh whitish beneath and the nerves red, when dry reddish, and the nerves dark; main-nerves 7 to 15 pairs, curved, spreading; length 2 to 5 in.; breadth ·7 to 2·25 in.; petioles ·3 to 1 in. *Stipules* linear or subulate from broad bases, ·15 to ·2 in. long, fugacious. *Cymes* terminal, much shorter than the leaves, with spreading branches 1 to 3 in. in diam., ebracteolate, glabrous or puberulous, the peduncles ·35 to 1·5 in. long. *Flowers* on short pedicels, sub-secund, glabrous or puberulous, ·6 in. long. *Calyx* rather more than ·1 in. long, wide, cylindric with 5 acute triangular dorsally ridged erect teeth. *Corolla* four times as long as the calyx, cylindric, widening somewhat towards the 5 short broad blunt lobes of the mouth. *Capsule* narrowly obreniform, ·25 in. across, glabrous or pubescent, prominently 5-ridged. *Seeds* numerous, small, brown. Gaertn. Fruct. I. t. 55; Roxb. Fl. Ind. I. 701; W. & A. Prod. Fl. Pen. Ind. 404; Hook. fil. Fl. Br. Ind. III. 77.

In all the provinces, common and variable in size and pubescence.—DISTRIB. British India; Ceylon; Sumatra; Java.

6. OPHIORHIZA HARRISIANA, Heyne, var. ARGENTEA, Hook. fil. Fl. Br. Ind. III. 78. *Stems* woody below, 6 to 18 in. high, branching, terete, glabrous, dark-coloured when dry. *Leaves* unequal, membranous, narrowly oblong-lanceolate, much tapered to each end, the base narrow

and somewhat oblique; upper surface dark olivaceous-brown when dry, sparsely puberulous or glabrous, the main-nerves obscure; the lower pale (glaucous), pinkish, glabrous except for a few scattered hairs on the prominent midrib and 6 to 10 pairs of oblique slightly curved dark-coloured broad main-nerves; length 1·5 to 3·5 in.; breadth ·65 to ·85 in.; petioles ·15 to ·5 in. *Stipules* lanceolate or oblong, ·25 in. long. *Cymes* terminal, solitary or several together on the apices of the branches and stem, shorter than the leaves, the branches shorter than the peduncle, puberulous. *Flowers* ·35 in. long, sessile or on short pedicels, secund. *Calyx* ·1 in. long, cylindric, with 5 erect triangular acute teeth much shorter than the tube. *Corolla* ·3 in. long, puberulous externally like the calyx, cylindric, slightly widened near at the apex; lobes 5, short, broad, 1-nerved. *Capsules* obreniform with very shallow sinus, glabrous, ·15 to ·25 in. across. *O. argentea*, Wall. Cat. 6229.

PERAK: *Scortechini* 432 (in part) 634; *Wray* 1984, 3647; *Curtis* 3147; *Yapp* 539. PAHANG: *Ridley* 2202. SELANGOR: *Kelsall* 1989.—DISTRIB. Khasia Hills.

7. OPHIORHIZA TENELLA, King n. sp. Erect or decumbent, 6 to 12 in. high. *Stem* slender, much branched, covered with minute yellowish pubescence. *Leaves* membranous, those in a pair sub-equal, elliptic-ovate to ovate-lanceolate, sub-acute, sometimes rounded but usually rather abruptly narrowed at the base; upper surface olivaceous when dry, glabrous except for a very few scattered short thick hairs; lower surface pale greenish-yellow, minutely puberulous on the broad midrib and 6 to 8 pairs of spreading rather straight main-nerves; length 1 to 2 in.; breadth ·5 to 1 in.; petiole ·1 to ·25 in., puberulous. *Stipules* short, cupular, obscurely toothed, less than ·1 in. deep. *Cymes* solitary, terminal, few-flowered, pedunculate, shorter than the leaves. *Flowers* ·3 in. long, almost sessile. *Calyx* less than ·1 in. long, cylindric with 5 lanceolate spreading 1-nerved lobes shorter than the tube, covered with short coarse hair. *Corolla* ·25 in. long, funnel-shaped; the tube slightly dilated near the base; the 5 lobes ovate-lanceolate, sub-acute, spreading, sub-reflexed. *Capsule* narrowly obreniform, sub-glabrous, ·25 in. across.

PERAK: *King's Collector* 499, 546. PAHANG: *Ridley* 2201.—DISTRIB. Burma.

8. OPHIORHIZA RUGOSA, Wall. Cat. 6235. Herbaceous, sub-erect, 4 to 6 in. high, the stem unbranched, thicker than a crow-quill, tomentose. *Leaves* unequal, membranous, oblong-oblanceolate, or oblong, sub-acute, or shortly and bluntly acuminate, the base narrowed; upper surface dark olivaceous when dry, glabrous or with few scattered short thick hairs, the nerves and midrib inconspicuous; lower surface pale olivaceous, with coarse short pubescence on the midrib, reticulations and 12 to

14 pairs of thick curved spreading nerves; length 1 to 3·5 in.; breadth ·5 to 1·25 in.; petioles ·2 to ·4 in., pubescent. *Stipules* narrowly linear-lanceolate from a broad base, ·2 in. long. *Cymes* solitary, terminal or from the upper axils, pedunculate, shorter than the leaves; branches few, short, in dichotomous umbels an inch or less across; peduncles pubescent like the branches. *Flowers* less than ·05 in. long (? cleistogamic) in groups of 3 or 4 enveloped in oblong blunt, pubescent bracts longer than themselves. *Calyx* cylindric, 5-toothed. *Corolla* slightly exceeding the calyx, cylindric, 5-toothed. *Anthers* 5, oblong, short, included. *Capsules* oblong-reniform with shallow sinus, pubescent, ·2 in. across. *O. Harrisiana*, Heyne, var. *rugosa*, Hook. fil. Fl. Br. Ind. III. 78.

PERAK: at 3900 feet, *Wray* 1482.—DISTRIB. Nepal and Sikkim Himalaya.

9. OPHIORHIZA TOMENTOSA, Jack in Roxb. Fl. Ind. ed Carey & Wall. II. 546. Erect, 8 to 12 in. high; stem woody near the base, thinner than a goose-quill, sparsely clothed with flexuose hairs. *Leaves* membranous, the two of a pair unequal in size, narrowly elliptic to elliptic-oblong, acute, the base narrowed, slightly oblique; upper surface olivaceous-green when dry, with sparse curved white stiff hairs; the lower pale, with numerous white hispidulous hairs between the main-nerves, the hairs on the broad prominent midrib and 8 to 12 pairs of curved spreading main-nerves brown; length 1·75 to 3·75 in.; breadth ·75 to 1·25 in.; petioles ·2 to ·8 in., stout, pubescent. *Stipules* linear, curved, about ·1 in. long, deciduous. *Cymes* terminal, solitary, pedunculate; shorter than the leaves, few-branched; peduncles 1 to 2 in. long, pubescent. *Flowers* ·25 in. long, on pubescent pedicels shorter than themselves. *Calyx* tubular, about ·05 in. long, obscurely toothed. *Corolla* salver-shaped; the tube narrow, the lobes blunt. *Capsules* obreniform, puberulous, rather less than ·2 in. across. Wall. Cat. 6231; Hook. fil. Fl. Br. Ind. III. 79; Miq. Fl. Ind. Bat. II. 174.

PENANG: *King; Curtis* 907; *King's Collector* 1314. PERAK: *King's Collector* 4846; *Curtis* 3257.

10. OPHIORHIZA KUNSTLERI, King n. sp. Stem erect, woody at the base, not branched, about a foot high, dark-coloured, deciduously rusty-puberulous. *Leaves* membranous, sub-equal, elliptic or ovate-elliptic, shortly and abruptly acuminate, the base rounded or slightly cuneate; upper surface dark-brown, sparsely strigose, the midrib distinct but the main-nerves faint; lower pale yellowish-brown, hispidulous chiefly on the stout prominent midrib and 10 to 14 pairs of spreading slightly curved rather bold nerves; the edges minutely ciliate; length 3·5 to 5 in.; breadth 1·75 to 2·5 in.; petioles ·5 to 1·75 in., bearing a few scattered hairs. *Stipules* lanceolate, acuminate, ·2 in. long, hairy,

deciduous. *Cymes* solitary in the axils of the upper leaves or terminal, pedunculate, much shorter (peduncle included) than the leaves when in flower and rather more than half as long in fruit, everywhere rusty-pubescent, the branches few, obliquely umbellate. *Flowers* numerous, in two secund rows on the branches, rather more than ·1 in. long, on short hirsute pedicels, and intermixed with lanceolate hirsute or ciliate bracteoles. *Calyx* campanulate, with truncate entire mouth. *Corolla* scarcely longer than the calyx, widely cylindric. *Anthers* 5, oblong, versatile, dorsified. *Capsule* obreniform, the sinus large, rusty-pubescent, ·2 in. across.

PERAK: *King's Collector* 8247.

A species allied to *O. tomentosa*, Jack. var. *glabrata* and *O. trichocarpa*, Bl., but the leaves of this are larger and much broader and the hairs on them are larger and more yellow in colour.

15. LUCINAEA, DC.

Erect shrubs or epiphytic climbers, glabrous or nearly so. *Leaves* usually coriaceous. *Flowers* in axillary or terminal, solitary or panicled, pedunculate heads. *Calyx-tube* turbinate; the limb annular or cupular, entire, persistent. *Corolla* funnel-shaped, white; the tube densely pilose inside; the limb coriaceous, with 4 or 5 oblong-lanceolate valvate lobes. *Stamens* 4 or 5, inserted in the tube on short villous filaments or sessile; *anthers* dorsifixed, linear-oblong, included. *Ovary* 2-celled; *style* filiform or thickened below the middle; stigmas 2, linear or spathulate; *ovules* numerous, on fleshy peltate placentas. *Fruits* baccate, surmounted by the truncate calyx-limb, sub-confluent. *Seeds* compressed; the testa smooth, coriaceous; embryo minute, in fleshy albumen.—DISTRIB. Species about 18, all Malayan.

Flower heads in a terminal panicle ... ... 1. *L. paniculata.*
Flower heads solitary or in fascicles of three:—
  All parts quite glabrous; corolla ·75 in. long ... 2. *L. Ridleyi.*
  Young branches and inflorescence pubescent:—
    Leaves membranous, much narrowed at the base; flowers 5-merous ... ... 3. *L. membranacea.*
    Leaves coriaceous, with broad rounded bases, flowers 4-merous ... ... 4. *L. Morinda.*

1. LUCINAEA PANICULATA, King n. sp. Glabrous; young branches thinner than a goose-quill, glabrous, brown when dry. *Leaves* oblanceolate to elliptic, shortly and rather abruptly acuminate, the base narrowed to the rather stout petiole; both surfaces glabrous, brown when dry, the lower paler and with the reticulations visible; midrib strong on both surfaces; main-nerves about 10 pairs, spreading slightly ascending and little curved; length 6 to 10 in.; breadth 2·25 to 4·25 in.; petioles

·8 to 1·5 in.; stipules ovate-lanceolate, vaginate in the lower half, ·4 to ·8 in. long. *Heads* in a pedunculate terminal panicle 5 or 6 in. long, its branches about half an inch to one inch long, thick, each bearing at its apex a head of three or four sessile flowers confluent by their bases; the common peduncle of the panicle with a sheathing basal bract ·5 in. long. *Calyx* truncate. *Fruit* unknown.

PERAK: *Scortechini; King's Collector* 2164.

2. LUCINAEA RIDLEYI, King n. sp. Epiphytal; young branches thinner than a goose-quill, terete, glabrous, dark-brown when dry. *Leaves* thinly coriaceous, quite glabrous, obovoid-oblong to narrowly elliptic, acute or shortly and abruptly acuminate, much narrowed at the base; upper surface brown when dry, the lower paler minutely punctate, reticulate; main-nerves 6 to 8 pairs, spreading, faint, the intermediate almost as prominent, the midrib bold; length 4 to 6 in.; breadth 1·5 to 2·5 in.; petioles ·75 to 1 in. *Stipules* lanceolate, oblong, sub-acute, connate and cartilaginous at the base, ·5 to ·75 in. long. *Peduncle* solitary, terminal, about ·1 in. long, each bearing a dense head about 1 in. in diam. (when dry), consisting of 8 to 12 sessile flowers. *Calyx* sub-quadrangular, the limb truncate. *Corolla* ·75 in. long, thick, ovate-oblong in bud, the narrowly oblong lobes as long as the tube. *Fruit* ·4 to ·6 in. long, crowned by the wide truncate calyx-limb.

SINGAPORE: *Lobb.* PERAK: *Scortechini* 306, 639; *Wray* 446; *Ridley* 2923; *King's Collector* 2162, 5052, 7836.—DISTRIB. Borneo, *Beccari* 3505.

3. LUCINAEA MEMBRANACEA, King n. sp. An epiphytic woody shrub; young branches terete, thinner than a goose-quill, covered with a dense coat of minute rusty deciduous pubescence. *Leaves* membranous, oblong-elliptic or narrowly elliptic, acute or shortly acuminate, narrowed (rarely rounded) at the base, upper surface quite glabrous, brown when dry; the lower paler, puberulous on the midrib; main-nerves 8 or 9 pairs, faint, spreading; length 3·5 to 5 in.; breadth 1·25 to 2·25 in.; petioles ·1 to ·15 in.; stipules broadly ovate, carinate, pubescent, and vaginate near the base, ·5 to ·75 in. long. *Peduncles* unequal, terminal or in fascicles of 2 or 3, the longer 1 in. long, the shorter as little as ·2 in. long, all dilated at the apex and pubescent, and each bearing a head about ·75 in. in diam. consisting of 8 to 10 sessile flowers. *Calyx*-limb truncate. *Corolla* thick; the tube cylindrical, ·15 in. long, hairy inside in its upper half; the limb with 5 lanceolate reflexed glabrous lobes shorter than the tube, the tips of the lobes incurved; *anthers* 5, sessile, linear. *Style* exserted, hairy in the upper half. *Fruits* subglobular, confluent at the base, ·15 in. in diam.

PERAK: *Scortechini* 283; *Curtis* 2016; *Ridley* 5543; *Wray* 832, 177, 3998; *Scortechini* 47, 283, 603; *King's Collector* 762, 10152.—Distrib. Borneo.

Allied to *L. Morinda*, DC., but the leaves of that species are more coriaceous, have more main-nerves and broader bases. The flowers moreover of this are 5-merous and of that 4-merous.

4. Lucinaea Morinda, DC. Prod. IV. 368. Young branches thinner than a goose-quill, puberulous but ultimately glabrous. *Leaves* coriaceous, glabrous, lanceolate to elliptic-oblong, rarely somewhat obovate, brown when dry; apex acute or sub-acute, the base rounded or minutely cordate; main-nerves 8 to 12 pairs, faint, spreading, slightly curved; length 1·5 to 2·5 in.; breadth ·9 to 1·25 in.; petiole ·15 to ·25 in., slender; *stipules* triangular. *Peduncles* solitary or in fascicles of three, usually terminal but sometimes axillary, pubescent, about 1 in. long. *Heads* ·75 in. in diam., 8- to 10-flowered. *Calyx* with a short truncate limb. *Corolla* ·2 in. long, sessile. *Berries* crowded, broadly turbinate, glabrous. Wall. Cat. 8437. *Morinda polysperma*, Jack. in Mal. Misc. I. 14; Roxb. Fl. Ind. ed. Carey & Wall. II. 204; Hook. fil. Fl. Br. Ind. III. 93.

Malacca: *Griffith* (K.D.) 2954; *Ridley* 1598; *Maingay* (K.D.) 875. Penang: *Wallich* 8437. Perak: *Curtis* 1337. Selangor: *Ridley* 3819. Pahang: *Ridley* 1093. Perak: *Scortechini* 283; *Wray* 2405, 4211; *King's Collector* 4645, 5498, 8482. Singapore: *Jack.*—Distrib. Malay Archipelago. Always littoral.

16. Lecananthus, Jack.

A small glabrous shrub. *Flowers* crowded in involucrate axillary, sessile or pedunculate, nodding heads. *Calyx-tube* ovoid or turbinate; the limb oblique, campanulate, with 2 to 4 short obtuse unequal lobes, or 2-lipped, persistent. *Corolla* funnel-shaped; the tube inflated below; the limb with 5 thick obtuse bearded lobes, valvate in bud. *Stamens* 5, inserted by short filaments in the throat of the corolla; *anthers* bifid below. *Disk* urn-shaped. *Ovary* 2-celled; style slender, with 2 linear or oblong stigmas; ovules numerous; placentas spongy, attached to the septum. *Fruit* membranous, 2-celled, pulpy, many-seeded, placentas thick. *Seeds* obtusely angled, the testa smooth, thick; embryo small, in fleshy albumen.—A single species.

Lecananthus erubescens Jack in Mal. Misc. II. 83. Glabrous everywhere except the calyx. *Stem* with 4 angles, two of them acute, 12 to 18 in. high. *Leaves* thickly membranous, ovate-elliptic to narrowly oblong, shortly acuminate, tapering below to the short petiole; main-nerves about 7 pairs, curved, ascending, faint, the veins distinct; length 3 to 8 in.; breadth 1·25 to 3 in. *Stipules* ovate-lanceolate, acuminate, 3 or 4 in. long. *Heads* sub-globular, ·75 to 1 in. in diam. (when dry). *Flowers* sessile, pale red. *Calyx* coloured, pubescent, wider than the corolla, those of the outer flowers 2-lipped and imbricate. Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II. 319; Wall. Cat. 6224; DC. Prod. IV. 620; Miq. Fl. Ind. Bat. II. 153, 199; Ann. Mus. Lugd. Bat. IV. 132; Hook. fil. Fl. Br. Ind. III. 100. *Lecananthus* sp. Griff. Notul. IV. 272.

Singapore: *Wallich, Lobb, Ridley* 384. Selangor: *Ridley.* Perak: *King's Collector* 1949, 2135, 10153; *Scortechini* 1275; *Wray* 1936, 2649. Pangkor: *Curtis* 1640. Penang: *Curtis* 1643. Malacca: *Griffith* (K.D.) 2784; *Maingay* (K.D.) 912.—Distrib. Borneo; Sumatra.

17. Coptophyllum, Korthals.

Small erect simple shrubs with oblanceolate sparsely hairy leaves and ciliate stipules. *Flowers* pentamerous, crowded in bracteate capitules the outer bracts large and forming an involucre. *Calyx*-tube ovoid, its limb with 5 oblong ciliate lobes. *Corolla-tube* subinfundibuliform, its throat naked; the limb with 5 rather blunt lobes. *Stamens* 5, inserted below the middle of the corolla; *anthers* short, included. *Disk* annular, glandular. *Ovary* 2-celled, with numerous ovules on hemispheric placentas; *style* with 2 truncate arms. *Capsule* membranous, 2-celled. *Seeds* sub-rhomboid, scrobiculate; albumen fleshy; embryo clavate.—Two or three species; Malayan.

Coptophyllum capitatum, Miq. Fl. Ind. Bat. II. 348. Herbaceous; stems compressed, thinner than a goose-quill, covered with short coarse rusty pubescence. *Leaves* membranous, oblanceolate, with a short blunt abrupt apiculus, the base much narrowed; upper surface dark-brown, sparsely and coarsely strigose, the lower paler brown, coarsely puberulous on the midrib nerves and transverse reticulations, otherwise glabrous; main-nerves 9 or 10 pairs, curved, ascending; length 5·5 to 7·5 in.; breadth 1·5 to 2·5 in.; petiole ·5 to 1·25 in. *Stipules* ·4 in. long, lanceolate with broad bases, the apices very acuminate, glabrous but the edges ciliate. *Peduncles* solitary, axillary, slender, compressed, sparsely hispid, 2 to 3 in. long, bearing at their apices single involucrate capitules. Involucre of 4 or more broadly ovate, sub-acute boldly 3-nerved bracts 4 in. long, the nerves and edges hispid. *Flowers* ·2 in. long, glabrous, numerous, crowded, mixed with linear or spathulate fimbriate bracteoles about as long as themselves; pedicels short. *Calyx* with cylindric campanulate tube; the mouth with 5 linear fimbriate-ciliate lobes longer than the tube. *Capsule* narrowly ovoid, crowned by the persistent calyx-lobes and within these by a mamillate disc, 2-celled, the placentas with rather numerous large shining brown pitted seeds.

JOHOR: *Ridley* 4179. SELANGOR: *Ridley* 8539. PERAK: *King's Collector* 10334.—DISTRIB. Sumatra.

Ridley's specimen collected in Johor (Herb. Ridley 4179) has stipules with blunt lobes and the bracts of the involucre are more numerous. It may be a new species.

18. MUSSAENDA, Linn.

Erect or scandent shrubs or undershrubs, rarely herbs. *Leaves* opposite or in whorls of three, membranous. *Stipules* solitary or in pairs between the petioles, free or connate, usually deciduous. *Flowers* in terminal cymes, the bracts and bracteoles deciduous. *Calyx-tube* oblong or turbinate; the limb with 5 mostly deciduous lobes, one of them however sometimes large petiolate petaloid (white or coloured), and persistent. *Corolla* funnel-shaped; the tube elongate, often sericeous outside, the throat always villous, the limb with 5 valvate lobes. *Stamens* 5, inserted on the throat or below it on short filaments; *anthers* linear. *Ovary* 2-celled, style filiform; *stigmas* 2, linear; *ovules* numerous, on peltate fleshy placentas. *Fruit* baccate, crowned by the scar of the deciduous calyx. *Seeds* minute, the testa pitted; embryo small, in dense fleshy albumen.—DISTRIB. Species about 40, in the tropics of Asia and of Africa, and in Polynesia.

None of the calyx-lobes petaloid ... ... 1. *M. mutabilis.*
One of the calyx-lobes sometimes petaloid:—
  Lobes of the calyx persistent in the fruit:—
    Leaves conspicuously hairy on both surfaces:—
      Corolla not much longer than the calyx:—
        Whole plant densely covered with long soft hair 2. *M. Wrayi.*
  Lobes of the calyx not persistent in the fruit:—
    Leaves conspicuously hairy on both surfaces:—
      Corolla much longer than the calyx:—
        An erect shrub; leaves slightly narrowed to the base; petioles less than ·5 in. long ... 3. *M. macrophylla.*
        Scandent; leaves much narrowed to the base; petioles often as much as 1 in. long ... 4. *M. villosa.*
    Leaves glabrous or nearly so:—
      Leaves oblong or lanceolate, much longer than broad:—
        Leaves with broad rounded or cordate bases ... 5. *M. cordifolia.*
        Leaves much narrowed to the base:—
          Main-nerves 9 or 10 pairs ... ... 6. *M. polyneura.*
          Main-nerves 5 or 6 pairs ... ... 7. *M. glabra.*
      Leaves obovate-oblong to elliptic-oblong, about twice as long as broad:—
        Calyx and corolla glabrous or nearly so ... 8. *M. oblonga.*
        Calyx and corolla pubescent ... ... 9. *M. Teysmanniana.*
Imperfectly known species ... ... 10. *M. membranacea.*

1. Mussaenda mutabilis, Hook. fil. Ic. Plant 1718. A climber, 15 to 40 feet long; young branches thinner than a goose-quill, terete, glabrous. *Leaves* membranous, on rather long petioles, broadly elliptic to elliptic-rotund from near the base; apiculate or shortly triangular acuminate at the apex, both surfaces glabrous; main-nerves 7 to 9 pairs, curving upwards, thin but prominent on the lower surface when dry; the reticulations open and transverse; length 5 to 7 in.; breadth 3 to 4·5 in.; petiole ·75 to 1·25 in. *Stipules* forming an irregularly toothed pubescent ring of teeth of an inch or less in depth. *Cymes* terminal, much shorter than the leaves even in fruit, 2-branched, the stipules shorter than those of the stem. *Flowers* 1·5 to 2 in. long, from 8 to 12; bracteoles few, like the calyx-lobes but smaller. *Calyx-lobes* equal, lanceolate sometimes linear-lanceolate, acuminate, sparsely strigose externally, tomentose within, less than half as long as the corolla-tube, deciduous in the fruit. *Corolla* orange red, the limb about 2 in. across when fresh, the lobes elliptic-oblong, acute, with short coarse hairs on both surfaces; the tube cylindric, ·1 in. wide, very slightly expanded towards the apex, adpressed-pilose externally, pubescent internally. *Fruit* cylindric sub-clavate, glabrous, faintly ridged, the apex blunt, narrowed at the base to the short pedicels; length ·5 to ·7 in.; diameter about ·3 in. *Mussaenda Kintaensis*, Brace MSS. in Herb. Calc. *Acranthera Maingayi*, Hook. fil. Fl. Br. Ind. III. 192. *A. mutabilis*, Hems. Journ. Bot. 1877, 204. *Mussaenda Maingayi*, Stapf Trans. Linn. Soc. IV. 172.

Perak: *King's Collector* 91, 855, 1856, 3276, 4255, 4999; *Wray* 1846; *Scortechini* 770; *Curtis* 2023. Penang: *Ridley* 2187. Johor: *King* 559. Malacca: *Derry* 1214. Singapore: *Ridley* 1643.

var. *hirsuta*; under surfaces of leaves and young stems pubescent; all parts of the inflorescence villose-pubescent; stipules apiculate and twice as long as in the type.

Perak: *King's Collector* 225. Malacca: *Derry* 253. Singapore: *Ridley* 1643.

2. Mussaenda Wrayi, King n. sp. A climber or occasionally a spreading shrub; young stems thinner than a goose-quill, covered like the leaves inflorescence and flowers with stiff more or less rusty hairs. *Leaves* membranous, elliptic or obovate-elliptic, much narrowed to the base, the apex shortly acuminate; main-nerves 9 to 14 pairs, curving upwards, thin but prominent on the lower surface; length ·4 to ·8 in.; breadth 1·75 to 4 in.; petiole ·35 to ·75 in.; stipules free, lanceolate-acuminate, about ·25 in. long. *Cymes* solitary, terminal, condensed in flower, spreading in fruit, shorter than the leaves, the bracts lanceolate. *Calyx* densely pilose, infundibuliform, ·5 to ·7 in. long; the mouth with 5 deep lanceolate usually equal teeth, occasionally one of the teeth petaloid,

white, veined with green, narrowly elliptic or oblanceolate, acute, tapered to a short petiole, 3-nerved and with prominent reticulations, sparsely strigose, under 2 in. in length and less than half as broad. *Corolla* slightly longer than calyx, red, very pilose; the tube cylindric; the limb ·4 or ·5 in. across, with 5 broad short blunt lobes. *Fruit* oblong-ovoid, sparsely pilose, about ·5 in. long and ·3 in. in diam., crowned by the long persistent calyx-lobes.

PERAK: *Wray* 40, 1788, 2583; *King's Collector* 685, 1960, 10943, 5353? *Scortechini; Curtis* 1024. PENANG: *Curtis* 2730, 3304.

3. MUSSAENDA MACROPHYLLA, Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II. 228. A shrub; young branches thinner than a goose-quill, rusty-pilose. *Leaves* thickly membranous, elliptic-oblong, slightly narrowed at the base, the apex shortly acuminate; upper surface sparsely strigose, the midrib rusty-pilose, the lower rusty-pilose especially on the midrib and nerves; main-nerves 9 to 11 pairs, slightly curved, ascending, prominent on the lower less so on the upper surface when dry; length 3 to 5 in.; breadth 1·5 to 2 in.; petiole ·2 in.; stipules triangular, densely pilose, about ·25 in. long. *Cymes* solitary, terminal, shorter than the leaves and condensed when in flower, many-flowered. *Calyx* about ·5 in. long, narrowly infundibuliform, cut half way down into equal lanceolate teeth, pilose outside especially on the tube: enlarged lobe ovate, acuminate, 2 or 3 in. long, sparsely pubescent, with greenish ascending nerves; its petiole slender, about 1 in. long. *Corolla* yellow, twice as long as the calyx, densely pilose outside; the tube cylindric, widening in its upper half; the limb ·3 or ·4 in. in diam. with broad blunt lobes. *Fruit* unknown. Wall. Pl. As. Rar. II. 77, t. 180; Bot. Reg. XXXII. t. 24; DC. Prod. IV. 370. Wall. Cat. 6255. *M. hispida*, Don Prod. 139; DC. Prod. l.c. *M. frondosa*, Wall. Cat. 6250 A.

PERAK: *King's Collector* 6016. MALACCA: *Maingay* (K.D.) 835/2, 941.—DISTRIB. British India; Philippine Islands.

I follow the Flora of British India in referring this plant to *M. macrophylla*, Wall., but I have some doubt as to the accuracy of this view. The plant here described approaches, *M. villosa* very closely, and it is difficult to distinguish the two by words although specimens of the two look very different.

4. MUSSAENDA VILLOSA, Wall. Cat. 6254. A climber; young branches much thinner than a goose-quill, deciduously rusty-pilose. *Leaves* membranous, oblong, elliptic-ovate or -acute, much narrowed to the base, the apex shortly acuminate or acute, both surfaces (but especially the lower) sparsely pilose; main-nerves 9 to 12 pairs, thin but prominent on the lower surface (when dry), slightly curved, ascending; length 3 to 5 in.; breadth 1·25 to 2·25 in.; petiole ·25 to 1 in., pilose; stipules lanceolate, caudate-acuminate, pilose, ·4 in. long. *Cymes* ter-

minal and axillary, condensed when in flower, the branches very pilose; bracts narrowly oblong, ·3 in. long. *Calyx* ·3 to ·4 in. long, pilose, the tube narrowly campanulate, shorter than the linear-lanceolate acuminate teeth; the odd lobe occasionally petaloid, ovate-rotund, bluntly acuminate, slightly narrowed to the long petiole, 5-nerved, glabrous above, pubescent below on the nerves, shorter than the leaves. *Corolla* yellow, ·75 in. long, more than three times as long as the calyx, narrowly cylindric in its lower half, slightly wider in the upper half; the limb only about ·25 in. in diam., its lobes short, broad; the mouth closed by a mass of thick short hairs. *Fruit* oblong-clavate, with lax deciduous white hairs, about ·5 in. long and ·25 in. in diam. Hook. fil. Fl. Br. Ind. III. 191 (*among doubtful species*).

PERAK: *Scortechini* 240, 243; *Yapp* 213, 341; *Schomburgk* 17; *Curtis* 1024. PENANG: *King* 600; *King's Collector* 1755; *Curtis* 289, 1934. LANKAWI: *Curtis* 2871. PAHANG: *Ridley* 2188. KEDAH: *Curtis* 2521.

This species was (no doubt from want of good specimens) treated in the Flora of British India as a doubtful one. Since the Flora was written better specimens have been obtained.

VAR. *Herveyana*, King; *leaves* broadly ovate or elliptic, shortly and abruptly acuminate, smaller than in the typical form and densely clothed on the lower (less so on the upper) surface with soft white hairs; the young branches and inflorescence with smaller hairs.

MALACCA: *Hervey.*

5. MUSSAENDA CORDIFOLIA, Wall. Cat. 6260. A climber 20 to 60 feet long; young branches thinner than a goose-quill, terete, glabrous. *Leaves* thinly coriaceous, oblong, acute or shortly and bluntly acuminate, only slightly narrowed to the rounded, often slightly cordate base (occasionally narrowed to the base); both surfaces quite glabrous, the lower with distinct transverse reticulations; main-nerves about 8 pairs, curved, ascending, thin, slightly depressed on the upper surface and prominent on the lower; length 5 to 6·5 in.; breadth 1·75 to 2·5 in.; petiole ·2 to ·25 in.; rusty adpressed-pilose; stipules free, lanceolate, much acuminate, deciduously hirsute at the base. *Cymes* terminal and axillary, on long slender peduncles, many-flowered, rather lax, sparsely adpressed rusty-pubescent; bracts few, about ·15 in. long. *Calyx* ·2 in. long, cylindric-campanulate, the lobes linear-lanceolate, shorter than the tube, spreading, one occasionally enlarged (2 to 2·5 in. long) and petaloid, ovate-oblong, creamy white, glabrous, with 5 or 6 pairs of ascending puberulous nerves, its petiole slender, ·5 to ·75 in. long. *Corolla* nearly 1 in. long, adpressed-pubescent outside, the tube narrowly cylindric, slightly widening upwards, the limb only ·2 in. wide, its lobes ovate,

acute, spreading, pubescent on both surfaces. *Fruit* broadly sub-ovoid, glabrous, crowned by the small cicatrix of the deciduous calyx-lobes, ·35 in. long and about ·25 in. in diam. *M. glabra*, Wall. Cat. 6251 sheets B. and C. *M. glabra*, Hook. fil. (not of Vahl) Fl. Br. Ind. III. 91 var. 4 and part of vars. 2 and 3.

PENANG: *King* 603; *Curtis* 116; *Deschamps*. PERAK: *King's Collector* 4859, 5216; *Scortechini* 458; *Maingay* (K.D.) 834. MALACCA: *Griffith* (K.D.) 2778 (in part).—DISTRIB. Mergui *Griffith* Herb. prop. 160.

The Wallichian No. 6260 consists of a single gathering from Penang and it was issued under this name. The same species forms, however, part of the Wallichian material distributed under the name *M. glabra*, the remarks under which may be read in the present connection.

6. MUSSAENDA POLYNEURA, King n. sp. Resembling *M. glabra*, Vahl, but having leaves with 9 or 10 pairs of little-curved ascending main-nerves with deciduous adpressed rufous hairs; the inflorescence and flowers, including the enlarged calyx-lobe, rusty pubescent. *M. glabra*, Wall. Cat. 6251 A. Hook. fil. Fl. Br. Ind. III. var. 4 *in part*.

MALACCA: *Griffith* (K.D.) 2776. PERAK: *King's Collector* 5775; *Wray* 1424.

This is one of the three species included under Wall. Cat. 6251 A.

7. MUSSAENDA GLABRA, Vahl Symb. Bot. III. 38. A climber; young shoots much thinner than a goose-quill, angled, with dark-coloured glabrous lenticellate bark. *Leaves* oblong-lanceolate, sometimes elliptic, the base narrowed and the apex shortly acuminate, glabrous except for some pubescence on the midrib and nerves; main-nerves 5 or 6 pairs curving upwards, thin but prominent on the lower surface when dry; length 2·5 to 3·5 in., breadth ·5 in to 1·6 in., rarely 2 in.; petiole about ·2 in.; stipules free, broad, bifid, the lobes acuminate, ·2 to ·3 in. long, puberulous. *Cymes* solitary on the apices of the terminal and lateral branches, longer than the leaves, their branches at first sometimes crowded but in fruit always lax, many-flowered, softly puberulous; bracts few, lanceolate, ·2 in. long. *Calyx* narrowly campanulate, ·2 in. long, the mouth with short spreading linear-lanceolate pubescent teeth; the tube sub-glabrous; occasionally one lobe petaloid (white), glabrous, ovate-acute, rounded at the base or narrowed to the long petiole with about 5 nerves radiating from the base, smaller than the leaves. *Corolla* yellow, pubescent, about four times longer than the calyx, narrowly cylindric but somewhat dilated in its upper fourth; the limb only ·2 in. across, its lobes spreading, triangular. *Fruit* oblong, slightly narrowed at the base and apex, the latter crowned by the scar of the deciduous calyx-lobes,

·5 in. long and ·3 in. in diam. when dry. DC. Prod. IV. 370; Wall. Cat. 6251 sheet A only and in part; Kurz. For. Fl. Burm. II. 56; Hook. fil. Fl. Br. Ind. III. 90 (*in part*).

MALACCA: *Maingay* (K.D.) 834; *Griffith* (K.D.) 2779. SINGAPORE: *Ridley* 116. MALACCA: *Derry* 31.—DISTRIB. British India.

VAR. *puberula*, upper surface of leaves glabrous except the puberulous midrib and nerves; lower surface puberulous or pubescent on the reticulations and sometimes on the interspaces also. *M. glabra* Vahl, VAR. 2: Hook. fil. l.c. 91.

SINGAPORE: *Walker* 65; *Anderson* 77; *Schomburgk* 43; *Ridley* 116*a*, 846*a*, 3651.

Under the No. 6251 and the name *M. glabra*, Wallich issued three gatherings bearing the letters A, B, and C. The gathering B was received from Herb. Finlayson, and the locality of its collection is unknown. Gathering C was received from Penang. Both these are the same as the plant issued as *M. cordifolia* and as No. 6260. The remaining gathering (A), as preserved in the Wallichian Herbarium in possession of the Linnean Society of London consist of three twigs, for one of which with almost glabrous flowers the name *M. glabra* is arbitrarily retained. Of the other two one has been referred by Sir Joseph Hooker to *M. Wallichii*, G. Don, and the third belongs to the species which I have named *M. polyneura*.

8. MUSSAENDA OBLONGA, King n. sp. A shrub 6 to 8 feet high; young branches as thick as a goose-quill, angled, somewhat compressed, pale, striate, sparsely lenticellate, glabrous. *Leaves* membranous, elliptic- or obovate-oblong or obovate-lanceolate, much narrowed to the base, the apex shortly and rather abruptly caudate-acuminate; both surfaces glabrous, the lower pale (when dry); main-nerves 6 to 9 pairs, curved-ascending, slightly conspicuous; length 5·5 to 9·5 in.; breadth 1·75 to 3·5 in.; petiole ·4 to ·8 in., puberulous or glabrous; stipules triangular, linear-acuminate, glabrous, ·25 to ·4 in. long. *Cymes* solitary, terminal, shortly pedunculate, much shorter than the leaves even when in fruit, umbellate, lax, wide-spreading; the branches somewhat compressed, glabrous; bracts linear-lanceolate, ·2 in. long. *Calyx* ·3 to ·4 in. long, glabrous; the tube cylindric, slightly expanded above the base, its mouth with linear erect teeth shorter than or as long as the tube. *Corolla* pale yellow, twice as long as the calyx; the tube cylindric; the limb ·4 in. in diam., its lobes narrowly lanceolate. *Fruit* globular-ovoid, sometimes sub-obovoid, the apex broad, crowned by the cicatrix of the deciduous calyx. *M. longifolia*, Wall. Cat. 6258, (not of Lam.) *M. Wallichii*, G. Don, Hook. fil. Fl. Br. Ind. III. 88 (not of Don).

PERAK: *King's Collector* 1935, 3542; *Curtis* 3303.

9. MUSSAENDA TEYSMANNIANA, Miq. Fl. Ind. Bat. II. 213. A climber; young branches somewhat thinner than a goose-quill, terete, deciduously adpressed rusty-pilose, and with elongated lenticels. *Leaves*

membranous, broadly elliptic to obovate-oblong, shortly acuminate, more or less narrowed at the base; both surfaces of the young leaves (but especially the paler lower one) with minute adpressed rusty hair, the older glabrous except on the midrib and 7 or 8 pairs of slightly curved ascending rather short main-nerves; the connecting nerves wide and transverse; length 5 to 7 in.; breadth 2 to 3 in.; petiole ·25 to ·5 in. long, deciduously villous; stipules free, lanceolate, with broad bases and long linear apices, pilose, ·15 to ·2 in. long. *Cymes* terminal, lax, longer than the leaves, spreading, much branched, umbellately many-flowered; the branches minutely pubescent, the bracts at their divisions short and cup-like, those near the base of the flowers much longer (·1 to ·2 in.) oblong, free. *Calyx* ·15 to ·3 in. long, sparsely pilose; the tube sub-cylindric shorter than the 5 narrowly lanceolate acuminate spreading teeth, one of the lobes occasionally petaloid and larger than the leaves, elliptic to elliptic-rotund, shortly apiculate, much narrowed to the long hairy petiole, puberulous on both surfaces, pubescent on the 5 radiating nerves. *Corolla* about three times as long as the calyx, its tube narrowly cylindric, slightly widened in its upper third and minutely strigose; the limb ·25 in. across (when dry); its lobes broad, sub-acute. *Fruit* (unripe) cylindric, sub-clavate, crowned by the scars of the deciduous calyx-lobes.

PERAK; *King's Collector* 731, 855, 1910, 3276, 10345.—DISTRIB. Bali, *Teysmann.*

Imperfectly known species.

10. MUSSAENDA MEMBRANACEA, King n. sp. A climber; young branches thinner than a goose-quill, angled, dark-coloured, glabrous. *Leaves* membranous, broadly elliptic, sometimes slightly obovate, the apex shortly, broadly, and abruptly acuminate, the base gradually narrowed; both surfaces glabrous; main-nerves 5 to 7 pairs, little-curved, faint, spreading; length 2·75 to 4 in.; breadth 1·5 to 2 in.; petiole ·6 to ·8 in., stipules united to form a short glabrous cap. *Cymes* solitary, on a peduncle longer than the leaves, few-flowered, dichotomous, spreading, sub-glabrous, the bracts minute, subulate.

SINGAPORE: *Ridley* 1639.

This is only known by leaf-specimens. It is a very distinct species differing in form and texture of its leaves from any other *Mussaenda* in the Provinces. Its nearest ally seems to be *M. glabra*, Wall., and it much resembles a Tonquin species (hitherto unnamed) collected by Balansa (Herb. 624).

19. TRISCIADIA, Hook. fil.

A glabrous woody climber. *Leaves* coriaceous, few-nerved; stipules short, broad, connate below, 2-toothed, caducous, leaving an annular scar. *Flowers* in panicled or ternate compound terminal umbels; bracts and bracteoles 0 (or if any caducous). *Calyx-tube* campanulate; limb coriaceous, tubular, minutely 5-toothed, ciliate, deciduous. *Corolla* coriacecus, salver-shaped; its tube short, glabrous everywhere; lobes of the limb as long as the tube, narrowly oblong, blunt, reflexed valvate in bud, their tips incurved. *Anthers* 5, linear, dorsifixed by short filaments on the throat of the corolla, versatile, exserted. *Ovary* 2-celled; style filiform; stigmas 2, linear-lanceolate; ovules 2 or more in each cell sunk in a fleshy placenta adnate to the septum. *Fruit* large, baccate, globular with leathery pericarp; seeds large compressed.—DISTRIB. A single Malayan species.

TRISCIADIA TRUNCATA, Hook. fil. in Benth. & Hook. fil. Gen. Plantar. II. 69. Young branches thinner than a goose-quill, pale-brown when dry. *Leaves* broadly elliptic to sub-rotund, obtuse or bluntly cuspidate, both surfaces olivaceous-brown when dry, the upper shining; the lower paler, dull; main-nerves 4 to 6 pairs, slightly curved, ascending, prominent on the lower surface; length 2·5 to 4 in.; petioles ·3 to ·5 in., stipules forming a tube only ·1 in. deep. *Umbels* 2·5 to 4 in. long, and about as much across. *Flowers* ·5 in. long, their pedicels about ·1 in. long. *Calyx* ·1 in. long, truncate, the limb minutely toothed. *Corolla* ·4 in. long, coriaceous, tubular, slightly expanded at the mouth and divided into 5 narrowly oblong, blunt, reflexed lobes about as long as the tube. *Fruit* globular, crowned by the large flat calyx-scar, about 1 in. in diam. *Webera truncata*, Roxb. Fl. Ind. ed. Carey and Wall. II. 538. *Stylocoryne truncata*, Wall. Cat. 8403. *Gupia truncata*, DC. Prod. IV. 394. *Pseudixora truncata*, Miq. Fl. Ind. Bat. II. 210.

PENANG: *Wallich.* PERAK: *Wray* 2104, 3271; *Scortechini; Ridley* 8374; *King's Collector* 5508, 6431, 6545.—DISTRIB. Andaman Islands; Sumatra; Java, *Forbes* 2504.

20. AULACODISCUS, Hook. fil.

Small glabrous trees. *Leaves* coriaceous; the stipules narrowly triangular, long-acuminate, caducous. *Flowers* small, polygamous, in axillary pedunculate many-flowered paniculate or umbellate cymes. *Calyx-tube* broadly hemispheric; the limb short and truncate-sinuate. *Corolla* coriaceous, rotate, the throat hairy; the limb with triangular-lanceolate, valvate, incurved lobes. *Stamens* 8 or 16, the alternate row imperfect; filaments flexuous; *anthers* dorsified, small, didymous. *Disk* large and prominent, 8- to 16-lobed. *Ovary* 6- to 16-celled; *ovules* numerous, on prominent placentas in the inner angles of the cells. *Berry* small, globose, areolate at the apex, usually 8- to 16-celled. *Seeds* numerous, minute, sub-globose; the texta thick, crustaceous, pitted;

embryo pyriform, in fleshy albumen.—DISTRIB. Two species, both Malayan.

A genus closely allied to Urophyllum.

Flowers in long-peduncled cymes with leafy bracts at the bases of branches; calyx a shallow cup; leaves acute	1. *A. premnoides.*
Flowers in shortly peduncled panicles without leafy bracts; calyx a deep cup; leaves acuminate ...	2. *A. Maingayi.*

1. AULACODISCUS PREMNOIDES, Hook. fil. in Gen. Plantar. II. 71. Young branches dark-coloured, 4-angled, glabrous. *Leaves* thinly coriaceous, oblong, shortly acuminate, the base slightly narrowed, both surfaces olivaceous-brown when dry, glabrous; the upper shining, the lower paler, dull and transversely reticulate; main-nerves 14 to 16 pairs, spreading to slightly curved; length 5·5 to 7 in.; breadth 1·25 to 1·65 in.; petiole ·2 to ·35 in. *Cymes* about 1·25 in. long and 1·5 in. in diam., pedunculate, axillary, trichotomously umbellate, rusty-puberulous; the common peduncle 1 in. long, the secondary half as long, each bearing at its base a leafy ovate-rotund petiolate bract ·3 to ·4 in. long. *Flowers* about ·1 in. long, their pedicels longer. *Calyx* shallow, cupular, indistinctly toothed. *Corolla* much depressed in bud, the mouth with 8 inflexed lobes, hairy outside. Perfect *stamens* 8, included, broadly ovate, on short filaments. *Disc* large, convex, hairy, deeply 8-grooved. Hook. fil. Fl. Br. Ind. III. 97 *in part.* *Axanthes enneandra*, Wight in Calc. Journ. Nat. Hist. VIII. 144.

MALACCA: *Griffith* (K.D.) 2938.

2. AULACODISCUS MAINGAYI, King & Gamble n. sp. A tree; young branches as thick as a goose- or swan-quill, dark-coloured, obtusely 4-angled. *Leaves* thinly coriaceous, pale-brown when dry, oblong or oblong-elliptic, acute, slightly narrowed at the base; both surfaces shining, olivaceous-brown, the lower slightly paler; main-nerves 12 to 14 pairs, curved, spreading, thin but prominent beneath; length 6 to 8 in.; breadth 2 to 2·5 in.; petiole ·25 to ·5 in. *Panicles* pedunculate, cymose, with no leafy bracts at the bases of the branches, many-flowered, 1 to 1·5 in. in diam., slightly puberulous and with a few small bracteoles, the peduncles less than ·5 in. long. *Flowers* ·1 in. long, their pedicels longer. *Calyx* deeply cupular; sub-glabrous; its mouth truncate, entire. *Corolla* twice as long as the calyx, with 8 deep lanceolate reflexed lobes. *Style* long, reflexed over the disc.; *stigma* large. *Fruit* ·25 in. in diam. *Aulacodiscus premnoides*, Hook. fil. in Fl. Br. Ind. III. 97 *in part.*

MALACCA: *Maingay* (K.D.) 938. SELANGOR: *Curtis* 2343. PERAK: *Scortechini* 2004; *King's Collector* 1086.—DISTRIB. Sumatra.

This is one of the two plants referred to *A. premnoides* by Sir Joseph Hooker in F.B.I. l.c. It appears to us to differ sufficiently from the other one (*Griffith* K.D.

2938) to deserve specific rank. It agrees with a Sumatra plant in Herb. Calcutta bearing the MSS. name *A. peltastigma*, Miq. But we can find no description of the species.

21. UROPHYLLUM, Wall.

Small trees or shrubs with terete slender branches. *Leaves* petiolate, usually elongate and acuminate. *Stipules* elongate small, rarely large. *Flowers* small (sometimes unisexual) in small axillary, sessile or pedunculate cymes or fascicles; their pedicels usually short, bracteolate at the base. *Calyx-tube* short, sub-globose or obconic, the limb cupular, persistent, usually 5-lobed (rarely 4- to 7-lobed). *Corolla* coriaceous, with a short tube and villous throat; the limb with 5 (rarely 4 to 7) erect or spreading triangular valvate lobes. *Stamens* 5 (rarely 4 to 7), inserted by short filaments in the throat. *Anthers* linear, acute, dorsifixed. *Disc* tumid, sulcate. *Ovary* 5 (rarely 4- to 7-celled); *style* short, often tumid at the base; *stigma* ovoid or clavate entire or notched. *Ovules* numerous, on axillary placentas. *Fruit* a small 4- to 5-celled many-seeded berry. *Seeds* minute, sub-globose; the testa pitted, crustaceous; the embryo clavate, in fleshy albumen.—DISTRIB. about 35 species; tropical Asiatic and African and one in Japan.

Leaves more or less hairy :—
  The whole of the under surface of the leaves more or less pubescent :—
    Leaves elliptic-oblong, 6 to 10 in. long :—
      Cymes with large permanent bracts ... 1. *U. villosum.*
      Cymes ebracteate or with small deciduous bracts 2. *U. macrophyllum.*
    Leaves oblong-lanceolate, 2·5 to 5 in. long :—
      Pubescence of leaves, young branches and fruit cinereous ... ... 3. *U. hirsutum.*
      Pubescence of leaves and young branches warm-ferrugineous, fruit glabrous ... ... 4. *U. ferrugineum.*
  Under surfaces of the leaves pubescent only on the midrib and nerves :—
    Leaves 8 to 10 in. long :—
      Flowers on bracteolate pedunculate, trichotomously umbellate cymes several inches across ... 2. *U. macrophyllum,* var. *corymbosa.*
    Leaves 3 to 5 in. long :—
      Flowers in dense many-flowered sessile cymes or in few-flowered shortly pedunculate umbels; fruit sparingly hairy or sub-glabrous; leaves not bullate ... ... 5. *U. streptopodium.*
Leaves everywhere glabrous :—
  Flowers 5-merous :—
    Umbels simple; flowers glabrous, on slender pedicels :—
      Umbels 10- to 12-flowered; leaves caudate-acu-

minate, shining when dry, the main-nerves very prominent ... ... 6. *U. glabrum.*
Umbels 4- to 6-flowered; leaves shortly acuminate, dull when dry; nerves not prominent ... 5. *U. streptopodium.*
Flowers 4-merous:—
Umbels compound, trichotomous; flowers pedicelled, with hirsute permanent bracteoles; corolla puberulous outside, hirsute inside ... ... 7. *U. trifurcum.*
Cymes 8- to 10-flowered; flowers sessile puberulous ... ... 8. *U. potatorum.*

1. UROPHYLLUM VILLOSUM, Jack & Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II. 185. A shrub to 10 feet high; young branches nearly as thick as a goose-quill, covered with adpressed yellowish hair. *Leaves* coriaceous, pale, yellowish-green when dry, oblong-elliptic, caudate-acuminate, the base slightly narrowed or rounded; upper surface glabrous; the lower boldly reticulate and bearing many pale sub-adpressed hairs especially on the nerves and veins; midrib prominent, tomentose; main-nerves 10 or 11 pairs, much curved, ascending, bold on the lower surface; length 7 to 10 in.; breadth 2·75 to 3·25 in.; petiole ·3 in., tomentose. *Stipules* narrowly oblong-lanceolate, blunt, tomentose below, ·8 in. long. *Cymes* ·4 to ·8 in. long, on pedicels of the same length, about ·8 in. in diam., condensed; bracts numerous, narrowly oblong, blunt, pilose, persistent. *Flowers* densely crowded, their pedicels short, pubescent. *Calyx* campanulate, ·25 in. long, with 5 triangular blunt spreading lobes, pubescent on both surfaces. *Corolla* longer than the calyx, cylindric-campanulate, thick, deeply divided into 5 oblong concave lobes, the throat densely pilose; *stamens* linear, glabrous. *Fruit* sub-globular, truncate at the apex and crowned by the short triangular calyx-teeth, sparsely villous, 3 in. in diam. when dry. Wall. Cat. 8314; DC. Prod. IV. 441; Hook. fil. Fl. Br. Ind. III. 99.

PENANG: *Wallich; King; Maingay* (K.D.) 884; *Curtis* 178, 7201. PERAK: *Wray* 2634; *Scortechini* 1983; *King's Collector* 526, 2563; *Ridley* 9711. SINGAPORE: *Lobb* 322.

2. UROPHYLLUM MACROPHYLLUM, Korth. Young branches slender, obtusely 4-angled, at first densely and minutely pubescent, sometimes becoming ultimately almost glabrous. *Leaves* membranous, elliptic-oblong, sometimes obovate-elliptic, shortly and rather abruptly acuminate, the base cuneate; upper surface olivaceous-green when dry, glabrous except the depressed-pubescent midrib; the lower pale-olivaceous, the midrib and 9 to 11 pairs of curved ascending main-nerves prominent and pale pubescent, the interspaces and rather distinct transverse veins also pubescent; length 6 to 10 in.; breadth 1·75 to 3 in.; petiole ·4 to ·6 in.; stipules lanceolate, adpressed-pubescent, ·4 to ·6 in. long

Cymes 8- to 10-flowered, ebracteate or bracts small and fugacious, when in flower not much exceeding the petioles in length; the peduncles much shorter (longer in var. *corymbosa*) than the pubescent pedicels. *Flowers* ·15 in. long, their pedicels ·3 to ·4 in. long. *Calyx* a shallow truncate adpressed-hairy cup, its mouth with 5 short triangular teeth. *Corolla* longer than the calyx, glabrous. *Fruit* globular, glabrescent, crowned by the calyx-lobes, ·15 in. in diam. Koord. & Valet. Bijdr. 8, 68. *Axanthes longifolia*, Wight in Calc. Journ. Nat. Hist. VII. 145 t. 2, f. 1. *U. strigosum*, Kurz Fl. Burm. II. 53 (*not of Korthals*). *U. longifolium*, Hook. fil. Fl. Br. Ind. III. 99.

PENANG: *Curtis* 2753. SELANGOR: *Ridley* 7440, 8576. PERAK: *Wray* 2201, 3511; *Scortechini* 267, 715; *King's Collector* 2838, 2948, 2964.

VAR. *corymbosa;* cymes 1 or 2 in the axils of the leaves, often as much as 3·5 in. long (including the long peduncle), trichotomously corymbose; stipules longer than the petioles, broadly oblong lanceolate, sometimes auricled at the base, pubescent. *Urophyllum corymbosum*, Korth. Ned. Kruidk. Arch. II. 194; Koord. & Valet. Bijdr. 8, 73.

PERAK: *Scortechini. King's Collector*, 2263, 2298, 2409, 5723. JOHOR: *King.*—DISTRIB. Sumatra, Java.

3. UROPHYLLUM HIRSUTUM, Hook. fil. Fl. Br. Ind., II. 98. Young branches slender, softly cinereous-tomentose like the stipules, petioles, and inflorescence. *Leaves* membranous, oblong-lanceolate or narrowly elliptic, acuminate, the base rounded or sometimes narrowed; upper surface glabrous, rarely sub-glabrous; the lower with pale soft spreading hairs especially on the midrib and nerves; main-nerves 8 to 10 pairs, curved, ascending; length 3 to 5 in.; breadth 1 to 2 in.; petiole ·15 to ·25 in.; *stipules* much longer than the petioles, linear-lanceolate. *Cymes* small, capitate, sessile, few-flowered, with a few ovate-lanceolate bracts. *Calyx* hairy, on a short stalk; the tube very short; the limb with 5 broad triangular spreading lobes. *Corolla* hairy. *Fruit* depressed-globose, the apex truncate, crowned by the small remains of the calyx, sparsely pubescent, ·15 to ·2 in. in diam. when dry. *Axanthes hirsuta*, Wight in Calc. Journ. Nat. Hist. VII. 148. *Wendlandia bifaria*, Wall. Cat. 6278.

MALACCA: *Maingay* (K.D.) 873; *Griffith* (K.D.) 2939; *Wallich, Goodenough.* PENANG: *Ridley* 10251. SELANGOR: *Ridley* 7442. NEGRI SEMBILAN: *Ridley* 10100. SINGAPORE: *Ridley* 3906, 4913, 8428. JOHOR: *Ridley* 4912, 11173, 11174. PERAK: *Scortechini* 84; *Wray* 152, 1305, 2488; *King's Collector* 199, 10494. PAHANG: *Ridley* 2204, 2206.

This species varies considerably as to the amount of hair on the leaves and as to the number of the main-nerves. I refer to it with some hesitation Ridley 11176 from Johor, No. 8577 from Selangor, Scortechini 267 from Perak.

4. Urophyllum ferrugineum, King and Gamble n. sp. A slender small tree. Young stems softy, minutely, and rather sparsely rusty-tomentose. *Leaves* membranous, narrowly oblong-lanceolate, caudate-acuminate, the base slightly narrowed or rounded; upper surface glabrous, the midrib distinct, depressed, the main-nerves faint when dry; lower paler, sparsely rusty-sericeous between the nerves; the main-nerves themselves about 7 pairs, curved, ascending, distinct and, like the midrib, densely rusty-sericeous; length 2·5 to 3·5 in.; breadth ·5 to 1 in.; petioles ·15 to ·4 in., tomentose; stipules more than twice as long as the petioles, narrowly oblong-lanceolate, rusty-sericeous. *Cymes* not much exceeding the petioles, almost sessile, few-flowered, with a few small lanceolate bracts at their bases. *Flowers* on pubescent pedicels equal to or longer than themselves. *Calyx* shortly campanulate, with 5 broad short pointed teeth, almost glabrous. *Corolla* white, glabrous, larger than the calyx, the tube shortly cylindric; the teeth 5, rather large, triangular, acute. *Fruit* depressed globular, truncate at the apex and bearing the small calyx-teeth, glabrous, ·2 in. in diam.

Perak: *Ridley* 2930, 9736; *Curtis* 2017; *Wray* 2065, 3933; *King's Collector* 780, 4112; *Scortechini* 205. Kedah: *Ridley.*

A species near *U. streptopodium*, Wall., but readily distinguished by its soft silky hair. This is closely allied to a Bornean species collected by Beccari, P.B. 1840, and by Ridley, 2781, which has however longer pedicelled flowers and hairy fruit.

5. Urophyllum streptopodium, Wall. Cat. 8317; Hook. fil. Fl. Br. Ind. III. 99. A shrub or small tree; young branches less than half as thick as a goose-quill, yellowish-brown, at first minutely adpressed-pubescent, ultimately often glabrous. *Leaves* thinly coriaceous, elliptic-oblong to oblanceolate, shortly acuminate, much narrowed from near the middle to the base, both surfaces greenish-yellow to pale olivaceous-brown when dry, the upper glabrous; the lower paler, transversely reticulate, minutely scaly, glabrous, or finely pubescent on the midrib and 5 to 8 pairs of curved, ascending main-nerves and also sometimes on the transverse veins; length 2·5 to 6 in.; breadth ·8 to 2 in.; petioles ·25 to ·5 in., adpressed-pubescent or glabrous. *Stipules* narrowly oblong-lanceolate, acute or blunt, sparsely adpressed-pubescent or sub-glabrous, slightly longer (some twice as long) as the petioles. *Cymes* axillary, from as long to twice as long as the petioles, many-flowered dense and sessile, or umbellate on short bracteolate peduncles and few-flowered. *Flowers* about ·15 in. long, on pubescent pedicels lengthening in fruit to ·1 to ·2 in. *Calyx* sub-glabrous, cupular-campanulate, the mouth with 5 (occasionally 6) small, more or less acute triangular lobes. *Corolla* one and a half to nearly three times as long as the calyx, campanulate, with 5 deep oblong blunt, sub-erect or reflexed lobes, often hairy on the

inner surface. *Fruit* sub-globular, depressed, the apex truncate and crowned by the minute remains of the calyx, glabrous or sparsely hairy, ·1 to ·2 in. in diam. *U. parviflorum*, Wall. Cat. 8320; *U. glabrum*, Wall. Cat. 8316 *in part*. *Urophyllum*, Wall. Cat. 8315? *U. Blumeanum*, Hook. fil. Fl. Br. Ind. III. 99. *U. umbellulatum*, Miq. Fl. Ind. Bat. Suppl. 542; Hook. fil. Fl. Br. Ind. III. *Geniostomum acuminatum*, Wall. in Roxb. Fl. Ind., ed. Carey & Wall. II. 316; Wall. Cat. 9067. *Timonius acuminatus*, Wall. Cat. 6218. *Axanthes Blumeanus*, Wight in Calc. Journ. Nat. Hist. IV. 145.

In all the provinces; a common and variable plant passing into *U. glabrum* and doubtfully distinct therefrom.

6. Urophyllum glabrum, Wall. in Roxb. Fl. Ind., ed. Carey and Wall. II. 186. A shrub; or small tree 15 to 20 feet high; young branches half as thick as a goose-quill, obtusely 4-angled and grooved, puberulous, becoming glabrous. *Leaves* thinly coriaceous, elliptic, oblong-elliptic, or oblong, shortly acuminate, slightly narrowed or rounded at the base; both surfaces pale yellowish- or olivaceous-brown when dry, glabrous and reticulate, the midrib bold, depressed on the upper surface but prominent on the lower, like the 7 to 12 pairs of curved, spreading, main-nerves; length 4 to 9 in.; breadth 1·5 to 3 in.; petioles ·3 to ·5 or sometimes 1 in. long, puberulous or glabrous; *stipules* linear-oblong, blunt; adpressed-pubescent, somewhat longer than the petioles. *Umbels* axillary, 10- to 12-flowered, bracteolate, on peduncles varying from ·25 to ·5 in. or even 1 in. in length, rarely sub-sessile. *Flowers* ·15 in. long, on slender pedicels ·2 to ·3 in. long. *Calyx* widely cupular, truncate or minutely toothed, glabrous. *Corolla* glabrous, longer than the calyx, its mouth with 5 deeply triangular lobes. *Anthers* ovate, surrounded by long hairs. *Fruit* depressed-globular, crowned by the wavy calyx, ·2 in. in diam. Wall. Cat. 8316 (excl. B); DC. Prod. IV. 441; Kurz Fl. Burm. II. 53. Hook. fil. Fl. Br. Ind. II. 98. Koord. & Valet Bijdr. 8, 66. *Urophyllum*, Wall. Cat. 8318, 8319, 8322. *U. arboreum*, Korth. in Ned. Krindk. Arch. II. 194. *U. repandulum*, Miq. Fl. Ind. Bat. II. 353. *Axanthes arborea*, Blume Bijdr. 1603. *Wallichia arborea*, Reinw. ex Blume in Flora 1825, 107. *Urophyllum Griffithianum*, Hook. fil. Fl. Br. Ind. III. 98. *Axanthes Griffithiana*, Wight in Calc. Journ. Nat. Hist. VII. 147.

In all the provinces; very common.

7. Urophyllum trifurcum, H. H. W. Pearson MSS. Young branches terete, dark-coloured, glabrous, half as thick as a goose-quill. *Leaves* coriaceous, oblong-elliptic, shortly acuminate, the base rounded or slightly narrowed; both surfaces glabrous except the depressed pubescent midrib and nerves on the upper, the lower reticulate, shining; main-

nerves 10 to 12 pairs, curved, spreading, very prominent beneath; length ·6 to ·8 in.; breadth 2·5 to 3·25 in.; petioles ·5 to ·75 in. stout. *Flowers* in pedunculate trichotomous axillary compound umbels, the common peduncle 1 to 1·25 in. long, rusty-puberulous; the secondary umbels on short peduncles 6- to 8-flowered, with broadly ovate hirsute deciduous bracteoles at their bases. *Flowers* ·25 in. long, on rusty-pubescent pedicels shorter than themselves. *Calyx* cupular; its mouth truncate, undulate. *Corolla* as long as the calyx; its 4 lobes broad, blunt, puberulous outside, hirsute inside. *Fruit* unknown.

JOHOR: *Ridley* 4084, 7441; *Scortechini.* SELANGOR: *Ridley* 7441, 7435, 8540. PAHANG: *Ridley* 11180.

8. UROPHYLLUM POTATORUM, King n. sp. A small tree; all parts except the flowers glabrous; young branches thinner than a goose-quill, terete, pale-brown when dry. *Leaves* coriaceous, elliptic-oblong, caudate-acuminate, the base cuneate, both surfaces brown tinged with olivaceous when dry, dull; main-nerves 5 to 9 pairs prominent like the midrib on the lower surface and depressed on the upper, veins faint on both; length 4 to 8 in.; breadth 1·25 to 1·75 in.; petiole ·2 to ·25 in. stout; *stipules* ovate, much acuminate. *Cymes* axillary, longer than the petioles, 8- to 10-flowered. *Flowers* crowded, puberulous externally. *Calyx* sessile, cylindric, the limb obscurely toothed, ·2 in. long. *Corolla* longer than the calyx; the 4 lobes oblong, blunt, reflexed. *Fruit* unknown.

MALACCA: on Mount Ophir. *Hullett* 104; *Wray* 756. PERAK: *King's Collector* 3211.

The flowers in the only three specimens which I have seen are in bad condition, but they appear to be those of *Urophyllum.* According to Mr. Wray's field note, the flower is whitish-green and the fruit is orange or yellow when ripe. The leaves of the plant are used by the Malays to make a decoction which they drink as a beverage that appears to have some of the physiological effects of tea.

NOTE.—In addition to the foregoing species from the Malay Peninsula we take this opportunity of describing the following very distinct species which has hitherto been collected only in the Andaman Islands.

UROPHYLLUM ANDAMANICUM, King & Gamble n. sp. Young branches brown, thinner than a goose-quill, glabrous but for a very few scattered hairs near the nodes. *Leaves* oblanceolate, shortly and rather abruptly acuminate, narrowed from above the middle to the short petiole; upper surface pale olivaceous when dry, glabrous; the lower paler, glabrous, except the rusty adpressed-pilose midrib and nerves, transversely reticulate; main-nerves 10 to 12 pairs, ascending, very slightly curved; length 5 to 7·5 in.; breadth 1·5 to 2·25 in.; petiole ·25 to ·35 in. *Stipules* lanceolate, much acuminate, densely rusty-pilose on the lower surface. *Cymes* 1 to 3 in a leaf-axile, on slender *peduncles* much longer than the petioles, densely umbellate, many-flowered, the flowers on coarsely rusty-pubescent pedicels, mostly longer than themselves. *Flowers* ·15 in. long. *Calyx* deeply cupular, pubescent outside like the pedicels; the mouth truncate and usually entire, sometimes minutely toothed. *Corolla* twice as long as the calyx, glabrous except the densely pilose throat; the lobes deep, broadly lanceolate, acute. *Fruit* sub-globular, truncate, the top bearing the wide-cupular calyx-limb, puberulous, ·15 in. in diam.

ANDAMAN ISLANDS: *King, Prain.*

22. ADENOSACME, Wall.

Shrubs with terete brittle branches. *Leaves* membranous, with many pinnate nerves; *stipules* lanceolate, sometimes toothed. *Flowers* in axillary or terminal paniculate, spreading cymes, bracts often glandular. *Calyx-tube* globose or hemispheric, with 4 to 6 persistent lobes. *Corolla* tubular; its lobes 4 to 6, triangular or oblong, valvate in bud, their edges everted. *Stamens* 4 to 6, inserted by short filaments on the tube. *Ovary* 2- or 5-6-celled; *style* slender or thickened above; *stigmas* 2 or 5-6, linear; *ovules* very numerous, on fleshy peltate placentas. *Fruit* a globose berry, with coriaceous or fleshy epicarp, crowned by the remains of the calyx, 2- to 5-6-celled, indehiscent or dehiscing loculicidally at the apex; seeds many on sub-globose placentas. *Seeds* small, angled, dotted; embryo minute in fleshy albumen.—DISTRIB. Species about 6; Indian and Malayan.

Flowers ·15 in. long, numerous, in much-branched paniculate cymes 2 to 6 in. long ... ... 1. *A. longifolia.*
Flowers ·6 in. long, few, in small pedunculate cymes not exceeding 1 inch in length ... ... 2. *A. Scortechinii.*

1. ADENOSACME LONGIFOLIA, Wall. Cat. 6280. Two or three feet high; stems as thick as a goose- or swan-quill, straw-coloured, shining, glabrous. *Leaves* elliptic-lanceolate, elliptic-oblanceolate or elliptic, apex rather shortly acuminate, the base much narrowed from above or below the middle to the usually elongate petiole, upper surface dark olivaceous when dry, glabrous, puberulous or pubescent; lower surface always paler and usually more pubescent than the upper; main-nerves 10 to 24 pairs, curved, spreading, thin but distinct on both surfaces; length 6 to 12 in.; breadth 1·5 to 4·5. *Stipules* oblong, blunt, about ·3 in. long. *Cymes* paniculate, from 2 to 6 in. across, never more than half as long as the leaves and usually much shorter, solitary, many-flowered, branching from the base or on short peduncles, the branches slender, angled, glabrous or puberulous, the smaller ones zig-zagged and very thin. *Flowers* ·15 in. long, shorter than their pedicels, solitary or in fascicles of 2 or 3. *Calyx* almost globular, sparsely pubescent outside; the 5 or 6 lobes spreading, their edges with a few thick elongate glands. *Corolla* not much exceeding the calyx, densely hirsute outside, glabrous inside; the lobes erect, oblong, blunt. *Stamens* subsessile. *Capsule* turbinate, transversely elongated, ·2 in. in diam., faintly 2-lobed, with many vertical lines, the epicarp brittle, sub-glabrous, pure white. Miq. Fl. Ind. Bat.

II. 217; Kurz For. Fl. Burm. II. 160; Hook. fil. Fl. Br. Ind. III. 95. *A. Malayana*, Wall. Cat. 6282. *Bertiera javanica*, and *B. fasciculata*, Blume Bijdr. 987; DC. Prod. IV. 392. *Mycetia javanica*, Reinw. *Rondeletia longifolia*, Wall. in Roxb. Fl. Ind. ed. Carey and Wall. II. 137; Don Prodr. Fl. Nep. 138. *Wendlandia longifolia*, DC. l.c. 412. *W. Malayana*, G. Don Gen. Syst. III. 519.

In all the provinces, more or less common.

Varying considerably as to the length of the leaves and petioles and as to the breadth of the former. The flowers are 2- or 3-morphic in the matter of style and stamens.

2. Adenosacme Scortechinii, King & Gamble n. sp. A shrub 6 to 8 feet high; branches as thick as the little finger, the youngest much thinner; bark corky, at first pubescent and brown, but afterwards exfoliating, and very pale and deeply grooved. *Leaves* obovate-elliptic or broadly oblanceolate, shortly and abruptly acuminate, much narrowed to the base; upper surface brown and glabrous, the lower paler, puberulous on the midrib, main-nerves and rather distinct transverse veins; main-nerves 16 to 18 pairs, sub-horizontal, prominent beneath; length 8 to 13 in,; breadth 3 to 5 in.; petiole ·5 to 1·25 in., pubescent; *stipules* shorter than the petioles, triangular, acute. *Cymes* several from the axils of fallen leaves, under 1 in. in length including the short peduncle, minutely rusty-tomentose, with a pair of lanceolate bracts ·15 in. long at the apex of the peduncle and a few minute bracteoles on the branchlets. *Flowers* about ·6 in. long. *Calyx* campanulate, ·15 in. long; the teeth 5, narrowly lanceolate, longer than the tube. *Corolla* four times as long as the calyx, tubular, inflated at the base and contracted below the limb; lobes of limb 5, lanceolate. *Anthers* 5, sessile at the base of the tube, linear, acute. *Style* shorter than the corolla-tube, filiform, divided into 5 linear puberulous stigmatic arms; *ovary* 2-celled, with numerous ovules from 2 placentas attached to the septum. *Capsule* unknown.

Perak: *Scortechini; King's Collector* 2223; *Wray* 1474. Selangor: *Ridley* 7400.

23. Brachytome, Hook. fil.

Glabrous shrubs with petiolate membranous leaves; *stipules* triangular, acuminate, persistent. *Flowers* small, polygamo-dioecious, in small slender cymose panicles from the axils of undeveloped leaves, bracts minute. *Calyx* with an ovoid or oblong tube (short in the male) and a cupular, 5-toothed persistent limb. *Corolla* glabrous, widely funnel-shaped, the limb with 5 short lobes, twisted in bud. *Anthers* sub-sessile on the throat of the corolla, included, linear-oblong, imperfect in the female flowers. *Disc* small and annular in the male flower; cupular and larger in the female. *Ovary* 2-celled; *style* filiform (short in the male); *stigmas* 2, short, oblong, obtuse, grooved; *ovules* very numerous, borne on the surface of peltate tumid placentas. *Berry* small, globular or ovoid, 2-celled, many-seeded. *Seeds* cuneate, compressed, with thin reticulate testa, and fleshy albumen; embryo small, sub-cylindric.—DISTRIB. Two species; one Eastern Himalaya and one Malayan.

BRACHYTOME SCORTECHINII, King & Gamble n. sp. A shrub 6 to 12 feet high; young branches twice as thick as a crow-quill, somewhat compressed. *Leaves* thinly membranous, narrowly elliptic, tapering about equally to each end, the apex acuminate, both surfaces pale olivaceous when dry, the lower tinged with brown; main-nerves 10 to 14 pairs, spreading, curving slightly upwards, prominent on the lower surface; length 4 to 8 in.; breadth 1·5 to 2·5 in.; petiole ·2 to ·25 in.; *stipules* shorter than the petioles, broadly triangular, keeled, acuminate. *Cymes* 1 to 1·5 in. long, with few, spreading, lax branches. *Flowers* ·35 in. long. *Calyx* about the same length as the corolla; its tube ovoid, constricted below the short, obscurely 5-toothed limb. *Berry* globular, ·3 in. in diam., smooth, crowned by the short calyx-limb.

PERAK: at elevations of 3,000 to 4,000 feet; *Scortechini* 14, 237, 1215; *King's Collector* 2136, 2930; *Wray* 950, 2812, 2999.

This resembles *B. Wallichii*, Hook. fil., the only other species of the genus as yet described; but that has leaves of thicker texture, more numerous flowers, and ellipsoid fruit.

24. STYLOCORYNA, Cav.

Trees or shrubs, with pubescent or glabrous usually membranous leaves and ovate-triangular, usually deciduous stipules. *Flowers* in terminal corymbose bracteolate cymes, 5-merous. *Calyx-tube* ovoid or campanulate; the limb short or long, always 5-cleft. *Corolla* funnel-shaped, its tube varying in length, the throat glabrous; the limb 5-lobed, narrow, reflexed or spreading. *Stamens* 5, on the mouth of the corolla, sessile or on short filaments; the *anthers* narrow, exserted. *Ovary* 2-celled; *style* stout; *stigma* long, usually thicker than the style; fusiform or clavate; *ovules* numerous, rarely 2 in each cell, often immersed in the peltate placentas. *Fruit* globose, baccate, without pulp, 2-celled; cells 2- or many-seeded. *Seeds* angled; albumen fleshy or horny; embryo small; cotyledons small, leafy.—DISTRIB. Probably about 15 species; tropical Asiatic.

The above definition is limited so as to include only the pentamerous many-seeded species which in Hooker's Flora of British India are included in the genus *Webera* of Schreber (founded in 1791). Some recent authors refer these species to *Tarenna* a genus established by Gaertner in 1788 for *T. Zeylanica* (Gaerter. Fruct.

I. 139, t. 28). Gaertner however, defines and figures *Tarenna* as tetramerous. We therefore for these pentamerous species revive the genus *Stylocoryna* (established in 1797 by Cavanilles; Cav. *Ic.* IV. 46, t. 368) which that author describes as pentamerous and many-seeded. For the genus *Webera* of Schreber we reserve in the present work certain tetramerous uni-ovulate plants which in external characters resemble *Ixora* and *Pavetta*. In Engler's Pflanzen-familien *Webera*, Schreb., is reduced to *Chomelia*, a genus founded by Linnæus in 1737. This name *Webera* was subsequently adopted by two botanists, Jacquin and Vellosa, for two distinct genera. There is thus much confusion connected with it.

Leaves much longer than broad, tapering about equally to apex and base; cymes contracted :—
- Main nerves of leaves faint on both surfaces :—
  - Leaves oblong-lanceolate quite glabrous; calyx puberulous, its lobes long, linear ... ... 1. *S. angustifolia.*
  - Leaves narrowly elliptic-oblong; lower surfaces minutely adpressed-hairy; the upper glabrous except the midrib; calyx pubescent, its lobes very short, acute ... ... 2. *S. adpressa.*
- Main nerves prominent on the lower surface :—
  - Leaves hispid on the upper surface, softly pubescent on the lower; calyx densely covered with long stiff pale hairs; its lobes long, linear... 3. *S. Maingayi.*

Leaves about twice (rarely three times) as long as broad; cymes spreading; main-nerves 10 to 12 (rarely so few as 6) pairs, bold and prominent on the lower surface :—
- Leaves obovate, glabrous except for tufts of hair in the nerve axils beneath ... ... 4. *S. costata.*
- Leaves elliptic-oblong to elliptic-lanceolate or elliptic :—
  - Both surfaces of the leaves glabrous except for a few hairs on the midrib ... ... 5. *S. fragrans.*
  - Upper surface of the leaves hispidulous, the lower softly pubescent ... ... 6. *S. mollis.*

1. Stylocoryna angustifolia, King n. sp. A shrub 4 to 6 feet high, glabrous except the inflorescence; young branches striate, thinner than a goose-quill. *Leaves* coriaceous, narrowly oblong-oblanceolate, much but rather bluntly acuminate, gradually narrowed from the middle to the petiole, the edges (when dry) much recurved; both surfaces blackish when dry, shining, the midrib deeply depressed on the upper, bold and prominent on the lower surface; main-nerves 5 or 6 pairs, oblique, ascending, indistinct on both surfaces; length 2·5 to 3·5 in.; breadth ·75 to 1 in.; petiole ·2 to ·35 in. *Stipules* broad, transversely oblong, abruptly acuminate, ·25 in. long. *Cymes* less than 1 in. in diam., solitary, terminal, shortly pedunculate, not (even including the peduncles) half so long as the leaves, the branches few, ascending, compressed, puberulous with lanceolate spreading bracteoles; 3- to 5-flowered.

Flowers ·35 in. long, puberulous externally, on short pedicels bracteolate at the base. *Calyx* puberulous, campanulate, with short tube and 5 long narrowly linear-lanceolate spreading lobes. *Corolla* not much exceeding the calyx, with a short tube and 5 imbricate oblong acute lobes united only at the sericeous bases, minutely pubescent on the outer surface, glaberulous on the inner. *Anthers* 5, linear, united into a tube round the long cylindric style, the filaments free, dorsifixed. *Ovary* sunk in the calyx tube and attached to it, 2-celled, the placentas infolded, several seeded. *Fruit* un nown.

PERAK: *King's Collector* 8265. Only once collected. A very distinct species.

2. STYLOCORYNA ADPRESSA, King n. sp. A shrub; young branches thinner than a goose-quill, obtusely 4-angled, covered with short rusty deciduous tomentum. *Leaves* thinly coriaceous, narrowly elliptic-oblong, often slightly oblanceolate, shortly and sharply acuminate, the base much narrowed; both surfaces dark olivaceous when dry, the upper glabrous and minutely reticulate; lower surface and especially the midrib with short sparse stiff adpressed pale hairs; main-nerves 6 to 10 pairs, curved, spreading, faint on the upper surface, distinct on the lower; the midrib stout, channelled above; length 4 to 8 in.; breadth ·75 to 1·75 in.; petioles ·25 to ·4 in. *Stipules* ovate, acute, ·15 in. long, deciduous. *Cymes* solitary, terminal, about 1 in. long (including the short peduncle), dichotomous, few-flowered; the branches divergent, densely tomentose. *Flower*-pedicels short, bi-bracteolate at the base. *Flower* about ·6 in. long. *Calyx* urceolate ·1 in. long, with 5 short acute teeth. *Corolla-tube* ·35 in. long, minutely pubescent without like the calyx, twice as long as the oblong, blunt lobes of the limb. *Anthers* linear, subsessile. *Fruit* pisiform, the apex with the small scar of the calyx, glabrous; seeds two in each cell, many-angled.

In all the provinces; common.

VAR. *papillulosa.* *Leaves* 3·5 to 4 in. long, coriaceous, lower surface with numerous minute dark-brown papillæ, the pubescence rusty.

SINGAPORE: *Ridley* 3885, 4960. JOHOR: *Ridley* 2879. PAHANG: *Ridley* 1087.

The only specimens of this which I have as yet seen are rather imperfect. It is quite possible that it will have to be treated as a species when fuller material is obtained.

3. STYLOCORYNA MAINGAYI, King. A shrub; young branches thinner than a goose-quill, densely tawny or rusty-tomentose. *Leaves* thickly membranous, elliptic-lanceolate to elliptic-ovate, shortly caudate-acuminate, the base cuneate; upper surface sparsely hispid-pubescent; the lower softly pubescent; main-nerves 8 or 9 pairs, spreading, curved,

depressed like the midrib on the upper surface when dry and prominent on the lower; length 3 to 6·5 in.; breadth 1·5 to 3 in.; petiole ·25 to ·35 in. *Stipules* lanceolate with long filiformly acuminate apices, rusty-pubescent, ·5 in. long. *Cymes* in condensed sub-globular panicles 1·5 to 3 in. in diam.; the branches short, covered like the calyces externally with long pale soft hairs and bearing many long filiform pubescent bracteoles. *Flowers* ·7 in. long (excluding the style) on slender short pedicels. *Calyx* flask-shaped, ·15 in. long, the mouth with 5 long linear, recurved stiffly pubescent lobes. *Corolla* with cylindic pubescent tube more than twice as long as the blunt oblong lobes of the limb. *Ovary* 2-celled, each cell with several triangular ovules, disk thick cushion like. *Fruit* the size of a large pea, glabrous, the calyx-scar small. *Seeds* several, angled. *Webera Maingayi*, Hook. fil. Fl. Br. Ind. III. 103.

MALACCA: *Griffith* (K.D.) 3081; *Maingay* (K.D.) 932; *Ridley* 323. PERAK: *King's Collector* 1021, 2526, 4610, 5902, 10754. NEGRI SEMBILAN: *Ridley* 10102. JOHOR: *Ridley* 11169.

Resembling *Pavetta naucleiflora*, Wall., in externals, and varying somewhat as to the amount of the pubescence. Griffith No. 3082 (K.D.) seems to be a form of this with the upper surfaces of the leaves almost glabrous and the lower with minute scanty pubescence.

4. STYLOCORYNA COSTATA, Miq. Fl. Ind. Bat. Suppl. 218. A tree; young branches as thick as a goose-quill, bluntly 4-angled, rusty-pubescent. *Leaves* thickly membranous, obovate, the apex broad, obtuse, or with an abrupt small apiculus, the base much narrowed; upper surface dark-brown and shining when dry, glabrous; the lower paler, dull, glabrous except for tufts of coarse rusty hair in the axils of the 10 to 12 bold spreading slightly curved main-nerves; length 6 to 8 in.; breadth 3·5 to 4·5 in.; petiole ·6 to ·8 in.; stipules of the stem-leaves not seen, those at the base of the cyme short, broad, blunt. *Cymes* crowded at the apices of the branches, each individual pedunculate, corymbose, densely many-flowered, everywhere minutely and densely pubescent like the flowers and their pedicels, 1 to 1·5 in. in diam., bracteoles minute. *Flowers* ·65 in. long; the calyx about ·15 in. long, campanulate, bluntly 5-lobed. *Corolla-tube* narrowly cylindric, twice as long as the blunt oblong lobes of the limb. *Fruit* the size of a small pea, glabrous, many-seeded. *Webera costata*, Hook. fil. in Fl. Br. Ind. III. 103.

MALACCA: *Griffith* (K.D.) 2791; *Maingay* (K.D.) 945. SELANGOR: *Curtis* 2345.—DISTRIB. Sumatra.

Closely allied to *S. fragrans*, but arboreous and with obovate leaves.

5. STYLOCORYNA FRAGRANS, Blume Bijdr. 982. A shrub or small tree; young branches 4-angled, sparsely and deciduously strigose, thinner than a goose-quill. *Leaves* thinly coriaceous, elliptic (often narrowly so),

elliptic-oblong, or oblanceolate, acute or shortly acuminate, the base cuneate; both surfaces olivaceous-brown when dry, (the lower paler), glabrous except for a few stout hairs on the midrib and sometimes also on the 6 to 12 pairs of curved ascending slightly prominent main-nerves; length 3 to 7 in.; breadth 1·25 to 2·5 in.; petiole ·2 to ·5 in.; stipules ovate-lanceolate, acuminate, shorter than the petioles, deciduous; those of the inflorescence permanent, the uppermost often linear. *Cymes* terminal, corymbose, many-flowered, shortly pedunculate, 2 to 4 in. in diam., often several together, the short branches, flower-pedicels, and calyces hispidulous, puberulous, or sub-glabrous. *Flowers* 1 in. long. *Calyx* campanulate-urceolate, only ·15 in. long; its lobes sub-erect, oblong, blunt. *Corolla* densely adpressed-pubescent outside; the tube cylindric, ·7 in. long, the limb clavate in bud, its 5 lobes short, oblong or sub-spathulate, blunt, ·2 in. long. *Style* much exserted. *Fruit* pisiform, glabrous, the scar of the calyx small. DC. Prod. IV. 377. *S. laxiflora*, Blume Bijdr. 983; DC. Prod. IV. 377. *S. lucida*, Miq. Fl. Ind. Bat. Suppl. 541. *Rondeletia lucida*, Wall. Cat. 8453. *Ceriscus fragrans*, Nees in Flora, 1825, 116. *Wahlenbergia fragrans*, Blume Cat. Hort. Bot. Brit. 13. *Webera fragrans*, Hook. fil. Fl. Br. Ind. III. 103. *Tarenna fragrans*, Koord. & Valet. Bijdr. 8, p. 77.

In all the provinces; common.—Distrib. Malay Archipelago.

6. Stylocoryna mollis, Wall. Cat. 8454. A small tree; young branches thinner than a goose-quill, 4-angled, rusty pilose. *Leaves* thickly membranous, oblong-oblanceolate or oblong-obovate, or elliptic, acute or shortly acuminate, much narrowed at the base; upper surface dark-brown when dry, sparsely and minutely hispidulous; lower surface paler brown rusty- or tawny-pubescent especially on the midrib and 10 to 12 pairs of stout curved spreading main-nerves; length 4·5 to 6·5 in.; breadth 1·75 to 2·75, petioles ·3 to ·5 in.; stipules ovate-lanceolate, acuminate hooked, about as long as or longer than the petioles, deciduous, those of the inflorescence larger (·75 in. long) and persistent. *Cymes* terminal, corymbose, pedunculate, shorter than the leaves, many-flowered, spreading, 1·5 to 3 in. in diam., sometimes in fascicles of 2 or 3; branches, flower-pedicels and calyces rusty-hispid. *Flowers* ·5 or ·6 in. long (excluding the style). *Calyx* ·1 in. long, campanulate, the limb with 5 broad oblong blunt lobes as long as the tube. *Corolla* cylindric, slightly tapering to the base, minutely adpressed-pubescent, more than twice as long as the 5 oblong blunt lobes. *Style* much exserted. *Fruit* the size of a small pea, glabrous, many-seeded. *Webera mollis*, Hook. fil. Fl. Br. Ind. III. 104.

Singapore: *Wallich; Ridley* 4915, 5678; *Cantlay* 76. Penang: *Maingay* (K.D.) 894; *Curtis* 745, 9362; *King's Collector* 1336. Johor: *Ridley*

4171. PERAK: *Wray* 1276, 2994; *King's Collector* 2955, 5725, 6589.—DISTRIB. Sumatra.

25. RANDIA, Linn.

Shrubs or trees, unarmed or with axillary or supra-axillary spines. *Leaves* usually coriaceous, sometimes one of a pair larger than the other or absent; stipules short, free or connate. *Flowers* in axillary or (where one leaf of a pair has aborted) leaf-opposed cymes, or solitary or in fascicles or corymbs, rarely terminal, usually white or yellowish. *Calyx-tube* ovoid, obovoid, or turbinate, smooth or ribbed; the limb often tubular, truncate or variously lobed. *Corolla* funnel- or salver-shaped or campanulate, the throat glabrous or hairy; limb with usually not more than 5 short or long lobes twisted in bud. *Stamens* 5; anthers narrow with short filaments or sessile. *Disk* annular or cushion-like. *Ovary* 2- rarely 4-celled; style usually stout sub-fusiform; stigma usually fusiform or clavate, entire or bifid; ovules usually numerous, sunk in placentas attached to the septum. *Fruit* more or less baccate, ovate, ellipsoid or globose, 2-celled, many-seeded. *Seeds* usually immersed in pulp; testa thin, albumen horny, cotyledons orbicular.—DISTRIB. Species about 90, all tropical.

Flowers under ·5 in. long, in small fascicles or cymes less than 1 in. in diam., or solitary; corolla with a very short tube, almost rotate; leaves of the pairs equal in size:—
  Armed erect shrubs with stout straight spines. Flowers ·4 in. long, solitary or in fascicles of 2 or 3 ... 1. *R. dumetorum.*
  Unarmed:—
    Erect or scandent; flowers ·5 in. long, tube short, lobes long, calyx 4-toothed; corolla 4-lobed, its tube hairy within; anthers linear, sessile; ovary with 4 placentas; fruit not ridged; main-nerves of leaves 10 to 12 pairs ... ... 2. *R. binata.*
    Scandent; flowers ·3 to ·35 in. long; calyx 5- or 6-toothed; corolla 5- or 6-toothed, its tube glabrous within; anthers broadly ovate, apiculate with filaments as long as themselves; ovary with 2 placentas; fruit with 10 to 12 vertical ridges; main-nerves of leaves 7 or 8 pairs ... 3. *R. impressinervis.*
Flowers under 1 in. long, in short much-branched many-flowered cymes from the axils of fallen leaves; corolla salver-shaped; leaves of the pairs equal in size; fruit like a pepper-corn (unknown in No. 6):—
  Scandent, glabrous:—
  Unarmed:—
    Leaves on short petioles or sub-sessile, their bases slightly oblique and auricled, main-nerves 6 to 8

pairs; flowers ·4 or ·5 in. long; calyx truncate, entire or minutely 5-toothed ... ... 4. *R. auriculata.*

Leaves on petioles ·5 or ·6 in. long, narrowed and slightly oblique at the base but not auricled; main-nerves 5 to 7 pairs; flowers nearly 1 in. long; calyx minutely 5-toothed ... ... 5. *R. Forbesii.*

Armed:—

Leaves on petioles ·3 to ·5 in. long, cuneate at the base; main-nerves 7 to 11 pairs, very bold beneath; flowers ·75 in. long; calyx with 5 triangular teeth 6. *R. Curtisii.*

Trees or large shrubs; leaves on petioles ·2 to ·3 in. long, not obovate, cuneate but not oblique at the base; main-nerves 7 to 9 pairs; flowers ·4 in. long; anthers as long as the corolla-lobes, exserted. ... ... 7. *R. densiflora.*

Flowers ·75 to 1 in. long, cylindric, coriaceous; leaves of the pairs unequal in size, obovate or oblanceolate, with 10 to 14 pairs of main-nerves; cymes very condensed, many-flowered; fruit large, (1 in. or more in diam.) more or less compressed:—

Leaves tomentose beneath; cymes rusty-tomentose everywhere ... ... 8. *R. anisophylla.*

Leaves glabrous except the midrib and main-nerves beneath; cymes puberulous everywhere ... 9. *R. Scortechinii.*

Flowers about 1 in. long, axillary, solitary or in pairs, shrubs with straight spines and glabrous thinly coriaceous equal leaves with 6 or 7 pairs of main-nerves; calyx tubular ·35 in. long with 5 minute triangular teeth; fruit nearly 2 in. in diam. ... ... 10. *R. perakensis.*

Flowers 1·5 to 3 in. long, salver-shaped:—

Leaves pubescent on the nerves beneath:—

Shrubs with slender straight spines; calyx ·35 in. long, its lobes 5, long, subulate, persisting on the fruit ... ... 11. *R. fasciculata.*

Leaves glabrous:—

Shrubs erect or sub-scandent with stout recurved spines; calyx ·25 in. long, its lobes lanceolate acuminate, not persisting in the fruit ... ... 12. *R. longiflora.*

Unarmed; leaves thickly coriaceous, 4 to 6 in. long, and 1·75 to 2·25 in. broad; calyx about ·9 in. long, corolla-tube about 1 in. long, both coriaceous, throat glabrous, limb 1·5 in. in diam.; anthers included, not apiculate, lobes of stigma short, broad ... ... 13. *R. Clarkei.*

Unarmed; leaves thinly coriaceous, 3·5 to 4·5 in. long and 1·5 to 2·5 in. broad; calyx about 4 in. long; corolla about 1 in. long, its throat pubescent; limb 1 to 1·25 in. across; anthers with a dark-coloured apical appendage; lobes of stigma spathulate, reflexed ... ... 14. *R. penangiana.*

Flowers 2 to 8 in. long, the corolla with a short cylindric tube and inflated funnel-shaped limb; fruit ovoid-globular	15.	*R. exaltata.*
Flowers 4 to 5 in. long, funnel-shaped, 4 in. wide at the mouth; fruit narrowly ellipsoid crowned by the long narrow calyx-teeth	16.	*R. macrophylla.*
Imperfectly known species	17.	*R. Kunstleri.*

1. Randia dumetorum, Lam. Ill. t. 156, f. 4. A shrub or small tree, unarmed or with straight horizontal opposite axillary or slightly supra-axillary spines on the thin sub-quadrangular pale puberulous young branches. *Leaves* membranous, oblong, oblong-oblanceolate or obovate-lanceolate, acute or sub-acute, narrowed to the base, both surfaces glabrous, only the midrib always hairy and sometimes also the 6 or 7 pairs of spreading faint main-nerves; length 1·5 to 3·5 in.; breadth ·6 to 1·25 in.; petioles ·1 in. or less long; stipules ovate, acuminate. *Flowers* ·4 in. long, 1 to 3 together on a short minutely bracteolate peduncle, sub-sessile. *Calyx* cylindric-campanulate, strigose outside; the mouth with 5 broad erect lobes varying from ovate to spathulate, often acute at the apex. *Corolla* with a short wide tube constricted and hirsute below the wide broadly 5-lobed limb. *Anthers* linear, sub-sessile, included within the villous throat. *Style* thick, stigma with 2 thick, short lobes hardly exserted. *Fruit* globose or ovoid, obscurely ribbed, ·75 to 1·5 in. long, glabrous or pubescent, smooth, or obscurely ribbed, yellowish; the pericarp thick. *Seeds* numerous, small, oval, compressed, embedded in pulp. W. & A. Prod. 397; Wight Ic. 580; Brand. For. Flora 273; Miq. Fl. Ind. Bat. II. 226; Koord. & Valet. Bijdr. VIII. 96; Hook. fil. Fl. Br. Ind. III. 110. *R. nutans, longispina*, DC. and W. & A., Kurz For. Fl. Burm. II. 45; Wight Ic. 581, 582, 583; Miq. l.c. 227. *R. Rottleri*, W. & A. l.c. *R. stipulosa*, Miq. Fl. Ind. Bat. II. 228. *R. spinosa*, Blume Bijdr. 981. *R. malabarica*, Wall. Cat. 8255*E*. *Gardenia nutans*, Roxb. Hort. Beng. 15; Wall. Cat. 8290. *G. spinosa*, Linn. fil. *G. longispina* and *floribunda*, Roxb. *G. dumetorum*, Retz. Roxb. Corom. pl. t. 136; Wall. Cat. 8259. *G. glabra* and *G. propinqua*, Br. in Wall. Cat. 8258, 8260. *Posoqueria dumetorum*, *P. nutans*, *P. longispina*, and *P. floribunda*, Roxb. Fl. Ind. I. 713 to 719.

Langkawi: *Curtis* 2799. Kedah: *Curtis* 2585. Perak: *Wray* 2599; *King's Collector* 3168, 6495; *Scortechini* 95, 98, 175, 1017, 1933.—Distrib. Java; Sumatra; British India.

Var. *pubescens*, King & Gamble. *Leaves* more or less densely pubescent on both surfaces; spines sometimes ·65 in. long; fruit obpyriform.

Kedah: *Curtis* 2585. Langkawi: *Curtis* 2799.

2. Randia binata, King & Gamble n. sp. A shrub occasionally scandent, glabrous, unarmed; young branches thicker than a crow-quill,

angled, pale-brown or cinereous when dry. *Leaves* coriaceous, oblong-elliptic, gradually but rather bluntly acuminate, rounded and somewhat unequal-sided or narrowed; both surfaces dull-brown when dry, opaque, the midrib very prominent on the lower surface; main-nerves 10 to 12 pairs, curved, spreading, more prominent on the lower than on the upper surface; length 6 to 9 in.; breadth 2 to 2·75 in.; petioles ·1 in. or less; stipules triangular, keeled, acute, about as long as the petioles, sometimes forming a connate 4-toothed tube. *Flowers* about ·5 in. long; their pedicels about ·3 in., collected in fascicles on tubercle-like, very shortly branched, minutely bracteolate cymes in the axils of fallen leaves. *Calyx* narrowly campanulate, constricted about the middle; the mouth truncate but with 4 minute sharp teeth. *Corolla* slightly longer than the calyx, salver-shaped; the tube cylindric, hairy within, shorter than the 4 oblong obtuse spreading lobes of the limb. *Anthers* linear, sessile, exserted. *Stigma* exserted, with 2 ovate-oblong spreading thick lobes. *Ovary* 2-celled, with numerous ovules on 4 placentas. *Fruit* the size and shape of a pepper-corn, smooth; seeds numerous, triangular, somewhat compressed; the testa pitted, shining, pale-brown.

PERAK: *Wray* 2134; *King's Collector* 4007, 5620, 5631, 7504.

3. RANDIA IMPRESSINERVIS, King & Gamble n. sp. A climber; young branches twice as thick as a crow-quill, dark-brown, minutely pubescent. *Leaves* subsessile, coriaceous, elliptic-oblong or elliptic, shortly acuminate, somewhat narrowed to the rounded or acute base; both surfaces brown, the upper tinged with olivaceous and shining, the lower paler, dull; main-nerves 7 or 8 pairs, spreading, curved, and interarching at some distance from the edge, depressed on the upper surface and raised on the lower, the veins rather prominent on the lower; length 3·25 to 4·5 in.; breadth 1 to 1·75 in.; petioles under ·1 in.; stipules about ·15 in. long, broadly triangular at the base with a long acuminate apex, pubescent. *Flowers* ·3 to ·35 in. long, on pubescent pedicels from ·5 to ·15 in. long, in short cymes from the axils of fallen leaves, sub-globular and less than 1 in. in diam.; the branches very short, and with small bracteoles. *Calyx* pubescent outside, campanulate; the limb as long as the tube, truncate but with 5 or 6 minute teeth. *Corolla*-tube ·125 in. long, glabrous within, the limb longer than the tube with 5 or 6 oblong blunt spreading lobes. *Anthers* broadly ovate, apiculate, exserted, on filaments as long as themselves. *Stigma* exserted, clavate, separating into 2 broad lobes; *ovary* 2-celled with many ovules on 2 placentas. *Fruit* like a small peppercorn, with 10 to 12 vertical ridges, glabrous; *seeds* compressed, triangular, grooved.

PERAK: *Wray* 2158; *Scortechini* 254; *King's Collector* 3336, 4894 10399, 10821.—DISTRIB. Borneo, *Haviland* 1895, 2969.

4. Randia auriculata, K. Schumann in Engl. Pflanzen fam. Teil. IV. Abt. 4, p. 75. Scandent, sometimes shrubby, glabrous, unarmed; young branches thinner than a goose-quill, compressed, dark-brown. *Leaves* coriaceous, brown when dry, elliptic, elliptic-oblong or oblong, subacute or obtuse; the base slightly oblique, somewhat auricled; upper surface shining, the lower dull and usually paler; main-nerves 6 to 8 pairs, spreading, slightly curved, thin but prominent on the lower surface; length 4 to 6·5 in.; breadth 1·5 to 3·5 in.; petioles ·05 to ·15 in.; stipules triangular acuminate, slightly longer than the petiole, deciduous. *Cymes* from the axils of fallen leaves or terminal, pedunculate, trichotomous, from 2 to 4 in. across, many-flowered, puberulous, and with many small triangular persistent bracteoles; the peduncles compressed, from 1 to 1·5 in. long. *Flowers* from ·4 to ·5 in. long, sub-sessile, almost coriaceous, mostly with a pair of connate minute bracteoles at the base. *Calyx* funnel-shaped, the mouth wide, sub-truncate or minutely 5-toothed. *Corolla* tubular, deeply divided into 6 oblong reflexed lobes twisted in bud; the throat densely pubescent. *Anthers* ·2 in. long, linear, with acute tips. *Style* ·3 in. long, with 2 free ribbed arms. *Fruit* the size of a pepper-corn, its apex crowned at first by the deciduous short calyx, glabrous, 2-celled, with many minute seeds. *Anomanthodia auriculata*, Hook. fil. in Bth. and Hook fil. Gen. Plant. II. 87; Fl. Br. Ind. III. 108. *Webera auriculata*, Wall. in Roxb. Fl. Ind. ed. Carey. & Wall. II. 537. *Stylocoryna auriculata*, Wall. Cat. 8402. *Cupia auriculata*, DC. Prod. IV. 394. *Pseudixora? auriculata*, Miq. Fl. Ind. Bat. II. 210. *Psychotria?* Wall. Cat. 8338. *Randia corymbosa*, Benth. MSS. (name only) Koord. & Valet. Bijdr. VIII. 88.

In all the provinces common.—Distrib. Malayan Archipelago.

In inflorescence this closely resembles *R. densiflora.*

5. Randia Forbesii, King & Gamble n. sp. A large climber 60 to 80 feet long, all parts except the branches of the cyme and the outside of the calyx glabrous; young branches twice as thick as a crow-quill, dark when dry; unarmed. *Leaves* coriaceous, elliptic to ovate, acute or shortly acuminate, narrow and slightly oblique but not auriculate at the base; both surfaces brown when dry, the lower paler; main-nerves 5 to 7 pairs, spreading, prominent on the lower surface, depressed on the upper; length 4·5 to 7 in.; breadth 2 to 3 in.; petioles ·5 to ·6 in., rather slender; stipules triangular-subulate, ·2 in. long. *Cymes* from the axils of fallen leaves, pedunculate, about half as long as the leaves, many-flowered; the branches spreading and puberulous, 3 or 4 in. in diam.; bracteoles minute, ovate, acute, lanceolate, persistent; peduncle ·75 to 1 in. long. *Flowers* nearly 1 in. long, on short pedicels often bracteolate at the base. *Calyx* tubular, slightly widened at

the minutely and acutely 5-toothed mouth, puberulous outside, ·25 in. long. *Corolla* salver-shaped, about 3 times as long as the calyx; the tube narrow; the limb with 5 rather blunt oblong lobes twisted in bud. *Stamens* 5 linear, notched at the apex, included in the tube and slightly longer than its lobes. *Style* half as long as the corolla, slender, the stigmatic lobes thick, reflexed. *Fruit* like a pepper-corn, glabrous, surmounted by the scar of the deciduous calyx, many-seeded.

PENANG: *Curtis* 818. SINGAPORE: *Ridley* 3664, 5662. PERAK: *Scortechini* 1308; *King's Collector* 8273, 10001.—DISTRIB. Lampongs, Sumatra, *Forbes* 1659; Andaman Islands, *King's Collector.*

6. RANDIA CURTISII, King & Gamble n. sp. A large climber, all parts except the calyx and flower-pedicels glabrous; young branches thinner than a goose-quill, pale-brown when dry, armed; the spines in pairs, recurved. *Leaves* varying much in size, coriaceous, oblong-elliptic, acute or shortly acuminate, the base cuneate, upper surface brown when dry, the lower pale olivaceous; main-nerves 6 to 11 pairs, rather straight, curving upwards and inter-arching rather far from the edge, very bold on the lower surface, somewhat depressed on the upper, as is the midrib; reticulations wide, obsolete on the upper surface, rather prominent on the lower; length 4·5 to 7 in.; breadth 1·5 to 2·25 in.; petioles ·3 to ·5 in.; stipules triangular, acuminate, shorter than the petioles, deciduous. *Cymes* from the axils of fallen leaves or terminal, shortly pedunculate, spreading, from 1 to 2 in. long, branching from the base; branches spreading and bearing many boat-shaped minute ovate-acute glabrous bracts; the large cymes 1·5 to 2 in. in diam. and many-flowered, the smaller little-branched and few-flowered. *Flowers* ·75 to 1 in. long, on pubescent pedicels ·1 to ·4 in. long. *Calyx* narrowly tubular-campanulate, adpressed-pubescent outside; the mouth with 5 triangular acute teeth. *Corolla* white, salver-shaped, glabrous outside, tube narrow; limb with 5 oblong-elliptic, blunt or acute spreading lobes; throat and tube inside pubescent. *Anthers* exserted, linear, about as long as the corolla-lobes. *Style* stout; stigma clavate, 2-lobed.

PENANG: *Curtis* 3590. PERAK: *Wray* 2611; *King's Collector* 3305, 4882, 6507, 6814, 8480.

7. RANDIA DENSIFLORA, Benth. Flora Hongkong 155. A glabrous tree, often as high as 60 feet; young branches thinner than a goose-quill, pale-brown, 4-angled. *Leaves* coriaceous, elliptic-oblong to oblong-lanceolate, acute or subacute, rarely acuminate, the base cuneate; both surfaces brown when dry, tinged with olivaceous, the lower usually paler; main-nerves 8 or 9 pairs, rather straight, ascending, thin but prominent on the lower surface, slightly depressed on the upper; length

4 to 6 in.; breadth 1·75 to 2·75 in.; petioles ·25 to ·3 in.; stipules triangular, acuminate, shorter than the petioles, caducous. *Cymes* from the axils of fallen leaves, many-flowered, almost sessile, much branched from near the base, 2 to 4 in. in diam., the branches puberulous, spreading and bearing many acute persistent bracteoles. *Flowers* ·4 in. long, on pedicels equalling or exceeding the calyx. *Calyx* tubular-campanulate, about ·1 in. long, the mouth with 5 minute acute teeth. *Corolla* with a short tube hairy on the throat inside; the limb with 5 oblong blunt minutely cuspidate reflexed lobes equalling in length the 5 linear exserted *anthers;* filaments dorsifixed. *Style* much exserted, stigma fusiform. *Fruit* like a pepper-corn. Hook. fil. Fl. Br. Ind. III. 112. Koord. & Valet. Bijdr. VIII. 93. *Webera densiflora*, Wall. in Roxb. Fl. Ind. III. ed. Carey & Wall. II. 536. *W. oppositiflora*, Roxb. Fl. Ind. I. 698; Kurz For. Fl. Burm. II. 47. *Stylocoryna densiflora*, Wall. Cat. 8404 *excl.* A. Miq. in Ann. Mus. Lugd. Bat. IV. 128, t. 5 A. *S. dimorphophylla*, Teysm. & Binn. Pl. Nov. Hort. Bog. 4. *Cupia densiflora* and *C. oppositiflora*, DC. Prod. IV. 394. *Gnopachis axilliflora* and *G. oblongata*, Miq. Fl. Ind. Bot. II. 221. *Urophyllum coriaceum*, Miq. l.c. Suppl. 542. *Ixora Thozetia*, F. Mull. Fragm. II. 132. *Psychotria*, sp. Wall. Cat. 8332. *Rubiacea*, Wall. Cat. 8455, 8456, 8465.

Common in all the provinces.—Distrib. Malayan Archipelago; Hongkong; North Australia.

Var. *parvifolia*, King & Gamble. *Leaves* narrowly oblong-elliptic, 3 to 5 in. long and 1·25 to 2·75 in. broad; petioles ·15 to ·2 in.

Penang: *Curtis* 796; *Ridley* 10243. Perak: *Scortechini* 811, *King's Collector* 1585.

8. Randia anisophylla, Jack in Roxb. Fl. Ind. ed. Carey and Wall. II. 561. A small unarmed tree; young branches at first rusty-tomentose but soon sub-glabrous, pale, and striate, as thick as a goose-quill. *Leaves* of each pair unequal, coriaceous, obovate-elliptic, shortly cuspidate, much narrowed from the middle to the base; upper surface dark-brown when dry, glabrous except the shortly tomentose depressed midrib and nerves; lower surface paler, tomentose on the midrib, pubescent especially on the transverse veins and on the 10 to 14 pairs of bold spreading main-nerves; length of the longer of each pair 8 to 10 in., of the smaller 3 to 6 in.; breadth of the longer 3 to 5 in., of the smaller 1·5 to 3 in.; petioles ·3 to 1 in., tomentose, stipules lanceolate, acuminate, tomentose, as long as petioles. *Cymes* pedunculate, rusty-tomentose everywhere, crowded, spreading, 1·5 to 2 in. in diam. with numerous lanceolate acuminate bracteoles ·2 to ·25 in. long; the peduncles about as long as the leaf-petioles. *Flowers* coriaceous, ·75 in. long, on short pedicels or sub-sessile. *Calyx* tubular-campanulate, with 5 acute lobes or

teeth. *Corolla* longer than the calyx, tubular, its lobes oblong. *Anthers* linear, sub-sessile near the base of the tube. *Style* fusiform. *Fruit* 1 to 1·5 in. long, bluntly ellipsoid, somewhat compressed, minutely tomentose, crowned by the rather large tubular calyx. Hook. fil. Fl. Br. Ind. III. 114; DC. Prod. IV. 381. *Gardenia anisophylla*, Jack, Miq. Fl. Ind. Bat. II. 230. *G.? anisophylla*, Wall. Cat. 8399 A.

PENANG: *Jack & Porter*; *Wallich* 8284 D.; *Curtis* 164; *Hullett* 162. MALACCA: *Derry* 27. SINGAPORE: *King's Collector* 1234.—DISTRIB. Sumatra, *Forbes* 2954, 3088.

A Bornean species, represented in Herb. Kew. by Beccari's 760 and Haviland's 3420, is allied to this, but its calyx has long teeth and much woolly hair. It is evidently undescribed and might be named *R. Beccarii.*

9. RANDIA SCORTECHINII, King & Gamble n. sp. An armed tree 20 to 60 feet high; young branches usually thicker than a goose-quill, glabrous, the bark pale when dry. *Leaves* of the pairs not very unequal, membranous, obovate-elliptic to oblanceolate-elliptic, obtuse or abruptly acute or minutely cuspidate, much narrowed from above the middle into the glabrous petiole; both surfaces brown when dry, rarely tinged with green and both glabrous except for a few scattered hairs on the nerves on the lower; main-nerves 14 to 18 pairs, little-curved, spreading, prominent on the lower surface, rather faint as the upper, veins on the lower prominent, transverse, wavy; length of the larger leaf of the pair 8 to 16 in.; breadth 4 to 6 in.; length of the smaller leaf 5 to 8 in.; breadth 3 or 4 in.; petioles ·75 to 1·5 in.; stipules ovate, connate by their bases. *Cymes* pedunculate, leaf-opposed (from the fall of the subtending leaf), many-flowered, much-branched, spreading, 2 to 2·5 in. in diam., everywhere puberulous; bracteoles numerous, broadly triangular, persistent; peduncles ·75 to 1 in. long. *Flowers* about 1 in. long, puberulous everywhere. *Calyx* tubular, the mouth truncate but usually with 5 small teeth. *Corolla* cylindric, ·75 in. long, with 5 short lobes. *Anthers* linear, nearly half as long as the corolla, dorsifixed and inserted near its base. *Ovary* two-celled, each cell multi-ovulate. *Style* short, stigma clavate, sulcate. *Fruit* sub-globular, somewhat compressed, densely puberulous, about 1 in. in diam., crowned by the short calyx-tube.

PERAK: *Scortechini* 574, 170; *Wray* 3031, 187, 3212, 1381; *King's Collector* 3455, 3696, 7205, 4485, 6786, 10131. SINGAPORE and PENANG: *Curtis* 164.—DISTRIB. Borneo, *Beccari* 2599; *Haviland* 84, 697, 2161.

10. RANDIA PERAKENSIS, King & Gamble n. sp. A small armed glabrous tree 12 to 18 feet high; young branches thinner than a quill, pale cinereous, glabrous, often armed with stout flower-bearing spines 1 to 1·25 in. long. *Leaves* thinly coriaceous, narrowly elliptic, tapering to each end, the apex bluntly acuminate; both surfaces

brown, the lower paler; upper surface dark-brown when dry, the nerves invisible; the lower pale-brown, the main-nerves 6 or 7 pairs, very distinct, curved, interarching at some distance from the edge, the reticulations rather distinct; length 3 to 5 in.; breadth 1·4 to 2 in.; petioles ·1 to ·2 in.; stipules triangular, acuminate. *Flowers* 1 in. long, on very short pedicels, solitary or in pairs from short branches which ultimately become spines. *Calyx* tubular, ·35 in. long, contracted at the base, the mouth with 5 narrowly triangular short teeth. *Corolla* salver-shaped; the tube ·45 in. long and nearly ·2 in. wide, the limb ·75 in. across with 5 or 6 oblong blunt lobes. *Anthers* linear, subsessile at the base of the tube, about ·3 in. long. *Style* short, stout, shorter than the cylindric stigma. *Fruit* globular, smooth, surmounted by the short scar of the calyx, 1·75 in. in diam.; pericarp very thick; *seeds* ellipsoid, compressed, ·25 in. long.

PERAK: *King's Collector* 7450, 8356.

11. RANDIA FASCICULATA, DC. Prod. IV. 386. A much-branched armed shrub; young branches thicker than a crow-quill, rough from small tubercles and softly and minutely pubescent. *Leaves* membranous, lanceolate, ovate or oblong-lanceolate, shortly acuminate (often bluntly so), rounded or cuneate at the base; both surfaces olivaceous, the upper usually glabrous or nearly so, the lower paler, minutely pubescent usually on the midrib and nerves only but sometimes on the spaces between; main-nerves 4 to 6 pairs, slightly curved, ascending, distinct on the lower surface, almost obsolete on the upper; length ·75 to 3 in.; breadth ·5 to 1·5 in.; petioles ·05 to ·2 in., pubescent; stipules broadly triangular, much acuminate, about as long as the petioles; spines axillary, slender, straight, ascending, slightly longer than the petioles, (sometimes absent). *Flowers* 1·5 to 2 in. long, axillary (under 1 in. in var. *parviflora*) solitary or in fascicles of 2 or 3, bracteoles lanceolate, acuminate, hairy. *Calyx* ·35 in. long; the tube narrowly funnel-shaped, villous, the mouth with 5 narrow subulate teeth as long as the tube. *Corolla* salver-shaped, the tube nearly 1 in. long, about ·05 in. in diam., glabrous outside, pubescent inside; limb nearly 1 in. across with 5 deep elliptic to oblong-elliptic, obtuse or sub-acute lobes. *Anthers* half-exserted from the throat, linear, not apiculate, ·3 in. long. *Style* slender; stigma exserted, with 2 short broad ovate blunt lobes. *Fruit* pisiform, 2-celled, 4-seeded, sparsely pubescent. crowned by the long-toothed calyx-tube. Brandis For. Flora 273; Hook. fil. Fl. Br. Ind. III. 109. *R. rigida*, DC. l.c. *R. malabarica*, Wall. Cat. 8255 A. B. C. D. *Gardenia fasciculata*, Roxb. Hort. Beng. 15. *G. rigida* and *G. parviflora*, Wall. Cat. 8257 A. B. *Posoqueria fasiculata*, Roxb. Fl. Ind. 1717. *P. rigida*, Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II. 570. *Webera fasciculata*, Kurz For. Flora Burm. II. 49.

KEDAH: *Curtis* 2549. PENANG: *Curtis* 718, 1498. PROV. WELLESLEY: *Curtis* 7106. PERAK: *Scortechini* 1802; *Wray* 3467.

VAR. *parviflora*; tube of corolla only about ·75 in. long, very narrow; the limb ·75 in. in diam.

LANGKAWI: *Curtis* 3383.

Roxburgh's unpublished figures of *Posoqueria fasciculata* and *Gardenia rigida* are practically alike. The only differences are that the leaves of the former are depicted as ovate-lanceolote and 2·25 to 3 in. long; the limb of the corolla as yellow, its tube as ·75 in. long and white; the calyx under ·2 in. long with teeth one quarter of its length; while *Randia rigida* is shown as having ovate leaves only 1·5 in. long; corolla-limb white and the tube 1 in. long, also white; the calyx ·3 in. long with filiform teeth half as long as the tube. The former he attributes to Nepal, the latter to Singapore. The two are evidently forms of the same widely distributed species.

12. RANDIA LONGIFLORA, Lam. Dict. II. 227; Ill. t. 156, f. 3. A glabrous shrub, sometimes scandent, usually armed; young branches twice as thick as a crow-quill, or thicker, pale-brown, shining, usually bearing stout curved axillary spines ·3 in. or more in length. *Leaves* coriaceous, oblong, oblong-lanceolate or obovate-elliptic, acute or shortly cuspidate, the base cuneate; both surfaces pale-olivaceous green when dry, dull; main-nerves 5 or 6 pairs, rather straight, ascending, faint on both surfaces but especially on the upper; length 1·5 to 3·75 in.; breadth ·75 to 1·75 in. (larger in var.); petioles ·1 to ·15 in.; stipules about as long as the petioles, broadly triangular, with abrupt acuminate apices. *Cymes* terminal or axillary, umbellate, as long as or longer than the leaves (shorter in var.), few-flowered, on peduncles ·25 to ·4 in. long; bracteoles few, ovate, acute. *Flowers* 1·5 (rarely 2 in.) long, white; their pedicels from ·25 to ·4 in., bracteolate about the middle. *Calyx* narrowly infundibuliform, ·25 in. long (·5 in. in var.) the mouth with 5 lanceolate acuminate teeth. *Corolla* salver-shaped, tube ·75 to 1·5 long and less than 1 in. wide; the throat pubescent; the limb 1 in. or more across with 5 oblong blunt spreading or reflexed lobes. *Anthers* linear, reflexed, exserted, much shorter than the corolla-lobes. *Style* filiform; stigma broadly clavate, exserted, separating into 2 spathulate lobes. *Fruit* globose-ovoid, glabrous, ·35 to ·5 in. long, its stalk somewhat longer; calyx-scar truncate, conspicuous; seeds rugose, embedded in pulp. DC. Prod. IV. 386; Hook. fil. Fl. Br. Ind. III. 111 (in part). *R. scandens*, DC. l.c. 387. *Posoqueria longiflora*, Roxb. Fl. Ind. I. 718. *Webera scandens*, Roxb. l.c. I. 698. *W. longiflora*, Kurz, For, Flora Burm. II. 48. *Canthium recurvum*, Wall. Cat. 8284 (all the sheets except D.) in Herb. Linn. Soc.

MALACCA: *Griffith* (K.D.) 2802, 2803, 2805, 2807. *Maingay* (K.D.)

900. SINGAPORE: *Lobb*; *Schomburg* 59; *Ridley* 2415, 9487. PERAK: *Wray* 2507; *King's Collector* 308, 5231; *Hullett* 93.—DISTRIB. Borneo.

Except that it has spines the plant here described agrees in all respects with Roxburgh's *Webera scandens* of which he has left a colonred drawing in the Calcutta Herbarium. Roxburgh's figure and description of his *Posoqeria longiflora* also agree with this, except in being arboreous. Lamark's figure of *R. longiflora* agrees with Roxbnrgh's except in having smaller leaves.

VAR. *major*, King & Gamble; young branches sometimes nearly as thick as a goose-quill, leaves 4 to 6 in. long and 1·75 to 3 in. broad; cymes shorter than the leaves; calyx ·5 in long.

PUNGAH: *Curtis.*—DISTRIB. Burma, *Helfer* (K.D.) 2906; *McClelland*; Andaman Islands, *King's Collector.*

13. RANDIA CLARKEI, King & Gamble n. sp. Quite glabrous: young branches thinner than a goose-quill, pale-brown when dry. *Leaves* thickly coriaceous, oblong-elliptic, subacute, the base rounded or slightly cuneate, both surfaces dark-brown when dry, the lower slightly olivaceous, the midrib on both thick and the 4 or 5 pairs of slightly curved ascending main-nerves faint; length 4 to 6·5 in., breadth 1·75 to 2·5 in.; petioles ·5 to ·6 in., thick. *Cymes* in the axils of fallen leaves or terminal, 3- or 4-flowered, the bracts broadly ovate, acute, persistent. *Flowers* 2·5 to 3 in. long, coriaceous. *Calyx* narrowly funnel-shaped, tapering much towards the base, about ·9 in long; the mouth with 5 small acute triangular teeth. *Corolla* salver-shaped, the tube 1 in. long and ·15 in. in diam.; its throat glabrous; the limb 1·5 in. across, deeply divided into 5 ovate-lanceolate, spreading lobes. *Anthers* sessile, included in the tube, linear, ·3 in. long. *Style* as long as the corolla-tube; stigma exserted, short, thick, separating into 2 broad lobes. *Canthium recurvum*, Wall. Cat. 8284 D. in Herb. Kew. (not D. in Herb. Linn. Soc.)

MALACCA: *Maingay* (K.D.) 840.

The type sheet of this species was included by Wallich in his *Canthium recurvum*, of which it stands in the Kew set as sheet D. It differs from the other sheets which belong to *Randia longiflora* in its greatly longer calyx and also larger more coriaceous corolla, which has a wider tube, glabrous in the throat as elsewhere, included anthers, and a much shorter stigma which opens out into 2 short broad lobes. The leaves of this are also larger and thicker than those of *R. longiflora.*

14. RANDIA PENANGIANA, King & Gamble n. sp. A large glabrous armed climber; young branches twice as thick as a crow-quill, dark coloured when dry, armed with stout axillary recurved spines ·3 in. long. *Leaves* thickly membranous, elliptic, sometimes slightly obovate, shortly and bluntly acuminate, the base cuneate, both surfaces brown when dry, the lower somewhat the paler and tinged olivaceous; main-nerves 5 to 7 pairs, rather straight, oblique, faint on both surfaces;

length 3 to 4·5 in.; breadth 1·5 to 2·5 in. petiole ·2 to ·3 in. slender; stipules shorter than the petioles, broadly triangular at the base, much acuminate upwards. *Cymes* terminal or from the axils of fallen leaves, on pedicels about ·2 in. long; the branches short and bearing persistent ovate-acute bracteoles. *Flowers* few, about 2 in. long, on pedicels about 2 in. long. *Calyx* ·4 in. long, tubular, tapering to the base, the mouth with 5 triangular acute short teeth. *Corolla* salver-shaped; the tube 1 in. long and about ·1 in. in diam.; the limb about 1 to 1·25 in. across, deeply divided into 5 broadly elliptic subacute lobes. *Anthers* linear, with a black apical process from the connective, included in the slightly pubescent throat, sessile, dorsifixed, about ·2 in. long. *Style* filiform; stigma somewhat exserted, thick, clavate, opening out into 2 thick spathulate reflexed fleshy lobes. *Fruit* depressed-globular, glabrous, ·5 to ·65 in. in diam. when dry.

PENANG: *Curtis* 927. SINGAPORE: *Hullett*, 114.

The following, of which we have seen no specimens in flower, also probably belong to this species; *viz:* Malacca: *Derry* 1056. Perak: *Scortechini* 1538; *King's Collector* 10171. One of Mr. Curtis's specimens is described as a tree, another as a climber. The leaves are thinner and broader than those of *R. floribunda*, Lam., and the flowers are (especially as regards the limb of the corolla) larger. The calyx although of the same shape is also larger. This species still more nearly resembles *R. Clarkei*, King & Gamble (of which the type is Wall. Cat. 8284 D.) but it has smaller, much less coriaceous leaves, which are broader in proportion to their width. This has also smaller flowers with a very much smaller calyx. From both it differs by its conspicuously apiculate anthers.

15. RANDIA EXALTATA, Griff. Notul. IV. 262. A tree 30 to 50 feet high, unarmed; young branches deciduously pubescent, ultimately glabrous, dark-coloured and striate when dry, thinner than a goose-quill. *Leaves* coriaceous, glabrous, oblong-lanceolate, acuminate at base and apex; upper surface dark-brown when dry, not reticulate, the nerves and midrib depressed; lower surface paler, reticulate; main-nerves 8 to 10 pairs, curved, ascending, thin, dark in colour and distinct beneath when dry; length 3·5 to 4·5 in.; breadth 1 to 1·35 in.; petioles ·2 in.; stipules triangular, acuminate, about as long as the petioles and like them rusty-pubescent. *Cymes* in the axils of leaves or of fallen leaves, when in flower half as long as the leaves, adpressed rusty-pubescent; branches few, bearing small persistent acute bracts and 4 to 6 large shortly pedicellate flowers. *Calyx* ·15 in. long, funnel-shaped; densely adpressed-pubescent outside, the mouth truncate but minutely 5-toothed. *Corolla* white, somewhat purplish, 2 in. or more long, rather sparsely adpressed-pubescent outside; the tube narrowly cylindric, only about ·3 in. long, villous at the throat; the limb widely funnel-shaped, scurfily hairy inside; the mouth with 5 broad subacute lobes ·3 or ·35

in. long. *Anthers* linear, ·4 in. long, sessile, dorsifixed above the throat. *Style* filiform 1 in. long, surmounted by the fusiform 2-lobed stigma. *Berry* globular-ovoid, smooth, woody, 2-5 in. in diam., on a thick peduncle ·5 in. long. *Seeds* embedded in pulp, compressed, angled, nearly ·5 in. broad. Hook. fil. Fl. Br. Ind. III.; Kurz For. Fl. Burma. II. 46 (in part), Koord. & Valet. Bijdr. VIII. 90. *Gardenia pulcherrima*, Kurz in Journ. As Soc. 1877 II. 155; For. Flora Burm. II. 43 (in part). *Gardenia Schoemanni*, Teys. & Binn. in Ned. Kruidk. Arch. III. 403; in Nat. Tijds. II. 201; Miq. Fl. Ind. Bat. II. 232.

PENANG: *Curtis* 793.—DISTRIB. Andaman Islands; Burma (*Griffith* K.D. 2826).

The Andaman plant included under *R. exaltata* by Kurz differs from Griffith's in having obovate leaves and a smaller corolla with a long tube.

16. RANDIA MACROPHYLLA, Benth. & Hook. fil. Gen. Plant. ex Hook. fil. Fl. Br. Ind. III. 114. An erect unarmed shrub 3 or 4 feet high; young branches thinner than a goose-quill, dark-coloured when dry, scaberulous-puberulous. *Leaves* large, coriaceous, almost sessile, narrowly elliptic-oblong, sometimes shortly acuminate, gradually narrowed to the acute base; upper surface olivaceous-brown when dry, glabrous except sometimes for a few hairs on the midrib; lower darker, usually glabrous, but sometimes sparsely pubescent on midrib and nerves; main-nerves 10 to 14 pairs, slightly curved, ascending, depressed on the upper, prominent on the lower surface; length 8 to 12 in.; breadth 1·75 to 2·75 in.; petioles ·1 to ·15 in. pubescent, stipules ·4 to ·5 in. long, triangular, with a broad base and long subulate-acuminate apex. *Flowers* 1 or 2 in a leaf-axil, subsessile, 4·5 to 6 in. long, with many subulate hairy bracts at the base. *Calyx-tube* funnel-shaped, about ·35 to ·5 in long; the mouth with 5 linear spreading teeth much longer than the tube. *Corolla* 4 to 5 in. long, infundibuliform, 3 or 4 inches wide at the mouth, white or with purple spots, puberulous or subglabrous outside; the limb with 5 ovate sub-acute lobes about 1 in. long. *Anthers* linear, about ·8 in. long, included in the glabrous throat. *Style* slender; stigma clavate, nearly as long as and parallel to the anthers. *Fruit* ellipsoid, sparsely and deciduously rusty-strigose, 2·5 in. long, crowned by the long, persistent calyx-lobes. *Rothmannia macrophylla*, R. Br. in Wall. Cat. 8304.

PENANG: *Wallich*, *Curtis* 966. MALACCA: *Griffith* (K.D.) 2822; *Maingay* (K.D.) 944; *Cuming* 2365; *Hervey*, *Derry* 43, 79. SINGAPORE: *Lobb* 65; *Dr. T. Anderson* 107; *H. J. Murton* 1; *Hullett* 117. PERAK: *Wray* 1380, 1632, 3232, 4214; *Scortechini* 1479; *King's Collector* 769, 10356. PENANG: *Curtis* 966; DINDINGS: *Curtis*. SELANGOR: *Gooderoy* 10484.—DISTRIB. Sumatra.

17. Randia Kunstleri, King & Gamble n. sp. A stout glabrous armed climber; young branches thinner than a goose-quill, pale-brown, 4-angled, shining; spines in pairs, slightly curved, slender, much deflexed, about ·5 in. long. *Leaves* coriaceous, broadly ovate to elliptic-rotund, obtuse or bluntly and shortly cuspidate; both surfaces pale hepatic-brown when dry; main-nerves 4 or 5 pairs, curved, ascending, rather prominent on both surfaces when dry; length 4 to 5·5 in.; breadth 2·5 to 3·5 in.; petioles ·3 to ·5 in.; stipules longer than the petioles, oblong, sub-acute. *Flowers* solitary or in scanty cymes, on short pedicels. *Calyx* tubular, the limb truncate but obscurely toothed. *Fruit* deflexed, on a short pedicel, depressed-globular, slightly contracted towards the base, crowned by the short tubular truncate calyx-limb, about 1·25 in. in diam. when dry and somewhat less in length; pulpy; pericarp leathery, smooth, shining. *Seeds* numerous, horizontal, compressed; albumen horny, scanty; radicle longer than the orbicular cotyledons. Wall. Cat. 8284 C. (in Herb. Kew, not in Linn. Soc.)

Perak: *King's Collector* 2683, 4335; *Scortechini* 485. Sumatra: *Curtis* 3543.

Scortectini's specimens of this in our hands are not in flower. From the field note on one of them we quote the description of the flower as follows. "*Calyx-tube* ·5 in. long, two-thirds being produced beyond the ovary, cylindric, slightly constricted in the middle; the limb with 5 shallow teeth, glabrous outside and inside except for an interrupted ring of yellowish thick hairs at the mouth inside. *Corolla-tube* ·5 in. long; the lobes as long, greenish yellow, glabrous except at the throat where are attached the slightly exserted linear *anthers*. *Ovary* 2-celled; each cell with many ovules in several series; stigma oblong, shortly 2-fid. *Berry* 1 in. in diam., not ribbed, crowned by the persistent calyx-tube."

26. Gardenia, Linn.

Shrubs or trees, often armed. *Leaves* opposite, rarely ternate; stipules often connate. *Flowers* often large, terminal or axillary, solitary, fascicled, rarely cymose, sometimes dimorphic and polygamous. *Calyx-tube* campanulate or tubular; the limb variable, tubular or dilated, sometimes spathaceous, often persistent on the fruit. *Corolla* various, longer than the calyx-limb; 5- to 12-lobed; the lobes twisted in bud. *Stamens* as many as the corolla-lobes. *Anthers* linear, included, sessile or sub-sessile on the tube, as many as the corolla-lobes, and alternate with them. *Ovary* 1-celled; style stout; stigma clavate, fusiform or bifid; ovules numerous, 2-seriate on the 2 to 6 placentas. *Fruit* often large, ovoid, ellipsoid or globose, baccate, with a coriaceous epicarp and woody endocarp which sometimes splits vertically at the sutures. *Seeds* numerous, imbedded in the placental pulp, compressed; testa thin; albumen horny; embryo minute.—Distrib. About 60 species, tropical and sub-tropical.

Calyx narrowly campanulate, its lobes long, linear, spreading:—
 Corolla-lobes under ·5 in. in length, oblong; fruit sub-globular, ·5 to ·75 in. in diam. ... ... 1. *G. tentaculata.*
 Corolla-lobes 2·25 to 4 in. long; fruit ovate-oblong, 2·5 in. long ... ... 2. *G. stenopetala.*
Calyx campanulate, boldly 5-keeled; the mouth expanded, sub-truncate or with 5 large deep keeled lobes; corolla-tube ·5 to 1 in. long; fruit ribbed ... ... 3. *G. carinata.*
Calyx tubular, smooth; fruit smooth:—
 Calyx much shorter than the corolla:—
  Calyx ·5 in. long, the mouth with 5 triangular acuminate keeled teeth; corolla 1·5 in. long, widely campanulate suddenly contracted into a cylindrical tube ·25 in. long, the lobes of the limb deep, oblong, obtuse ... ... 4. *G. Godefroyana.*
  Calyx ·4 to ·65 in. long; the mouth truncate, sometimes split on one side; corolla-tube 1·75 to 2·5 in. long ... ... 5. *G. tubifera.*
  Calyx ·75 to 1·5 in. long, inflated-tubular, the mouth oblique with a few irregular lobes; corolla-tube 2·5 to 3 in. long ... ... 6. *G. speciosa.*
 Calyx 3 to 4 in. in length; nearly as long as the tube of the corolla ... ... 7. *G. Griffithii.*

1. Gardenia tentaculata, Hook. fil. in Fl. Br. Ind. III. 119. An unarmed shrub or small tree; young branches thinner than a goose-quill; sparsely puberulous, dark when dry. *Leaves* membranous, narrowly oblanceolate or lanceolate-oblong, acuminate or caudate-acuminate, much narrowed to the short petiole; both surfaces dark-brown when dry, glabrous, the midrib and 14 to 18 pairs of thin spreading nerves sometimes puberulous on the lower; length 4 to 8 or even 10 in.; breadth 1·5 to 3 in.; petiole ·25 to ·4 in.; stipules tubular below the 2-lobed mouth, slightly longer than the petioles. *Flowers* in fascicles of 4 to 6 (sometimes fewer), from the axils of fallen leaves, about ·75 in. long, on stalks from ·3 to ·5 in. long. *Calyx* ·5 in. long, narrowly campanulate, with dilated limb deeply divided into 5 narrow flexuose linear-lanceolate spreading lobes. *Corolla* slighty exceeding the calyx, tubular, glabrous except a pubescent band at the base of the interior of the tube; the mouth with 5 oblong obtuse lobes. *Anthers* 5, linear, sessile, at the base of the corolla-tube, ·6 in. long. *Fruit* sub-globular, faintly ridged, glabrous, ·5 to ·75 in. in diam., crowned by the tentacle-like calyx-lobes. *Seeds* compressed, reticulate.

JOHOR: *Ridley* 11140; *Kelsall* 4082*a*. MALACCA: *Hervey; Maingay* (K.D.) 839; *Griffith* (K.D.) 2810; *Lobb*. PERAK: *Scortechini* 63; *King's Collector* 2691, 7851, 8377; *Wray* 2036. PENANG: *King's Collector* 1639, 2691. PAHANG: *Ridley* 2195.—DISTRIB. Borneo, *Motley* 934; *Beccari; Haviland* 2967.

2. GARDENIA STENOPETALA, King & Gamble n. sp. A shrub 4 to 8 feet high; young branches as thick as a goose-quill or nearly so, very dark-coloured when dry, covered with deciduous dark pubescence and minute white scales. *Leaves* large, thinly coriaceous, oblong-oblanceolate or elliptic, shortly acuminate, much narrowed to the short petiole; both surfaces olivaceous-brown when dry and both (but especially the lower) bearing sparse adpressed partly deciduous hairs, the midrib and nerves more densely pubescent; transverse veins on the lower rather distinct, distant; main-nerves 12 to 14 pairs, curved, ascending or spreading, rather bold on the lower surface when dry; length 7 to 14 in.; breadth 2 to 4 in.; petioles ·3 to ·5 in.; stipules shorter than the petioles, broadly triangular at the base, the apices long-acuminate. *Cymes* from the axils of fallen leaves, 2-branched and 4- to 6-flowered; their peduncles under ·3 in. long, with narrowly linear, lanceolate bracts. *Flowers* 2·5 to 5 in. long; their pedicels ·3 in., narrowly bracteate and rusty-pilose like the cyme-peduncles and calyx. *Calyx* narrowly campanulate, ·4 to ·6 in. long, the limb with 5 linear spreading lobes somewhat longer than the tube. *Corolla* with a puberulous cylindric tube about ·5 to ·75 in. long containing the 5 linear anthers at its base; lobes of the limb 5, narrow, 2·5 to 4·5 in. long and from ·15 to ·2 in. wide, with valvate inflexed edges, bearing some scattered hairs; *anthers* sessile, ·3 in. long. *Style* filiform; stigma fusiform, shortly bifid. *Fruit* ovate-oblong, 2·5 in. long and 1·5 in. in diam., crowned by the persistent hairy calyx; pericarp thin, brittle, smooth; *seeds* ellipsoid, compressed, ·3 in. long.

PERAK: *Scortechini* 1446; *King's Collector* 4156, 4265; *Curtis* 1306, 3144.

3. GARDENIA CARINATA, Wall. in Roxb. Fl. Ind. ed. Carey and Wall. II. 560. A shrub; young branches as thick as a goose-quill, whitish, glabrous, the cicatrices of fallen leaves prominent. *Leaves* membranous, obovate to oblanceolate, very shortly acuminate or cuspidate, much narrowed to the base; both surfaces brown when dry, the upper shining, glabrous except the midrib; the lower tinged olivaceous, puberulous especially on the stout midrib and 16 to 18 pairs of rather straight spreading stout nerves; length 4 to 7 in.; breadth 2 to 3 in. (sometimes much longer). *Flowers* 1·5 to 2 in. long, axillary, solitary or in pairs on short bracteolate puberulous pedicels. *Calyx*

1 to 1·25 in. long, campanulate, boldly 5-keeled, tapering to the pedicel, the mouth expanded sub-truncate or with 5 large deep-keeled lobes. *Corolla* salver-shaped; the tube ·5 to 1 in. long, adpressed-puberulous, ridged; limb 1·25 to 2 in. across, with 6 to 9 broad lobes. *Stigma* broadly clavate. *Fruit* ellipsoid, 5- to 8-ribbed, 1·5 to 1·75 in. long including the large persistent calyx. Wall. Cat. 8271; Hook. fil. Fl. Br. Ind. III. 117. DC. Prod. IV. 380; Miq. Fl. Ind. Bat. II. 229.

PERAK: *Scortechini* 2301. PENANG: *Wallich*, *C. Curtis* 525. MALACCA: *Maingay* 1486, (K.D.) 837; *Ridley* 953, 906. *Hervey.* PROVINCE WELLESLEY: *Ridley* 6974. SINGAPORE: *H. J. Murton.*

4. GARDENIA GODEFROYANA, O. Kuntze in Revis. Gen. Pl. I. 283. Young branches half as thick as a goose-quill, rusty-puberulous, bearing at the nodes the persistent bases of the stipules. *Leaves* thinly coriaceous, dark-coloured when dry, both surfaces glabrous except for a few hairs near the edge and on the midrib, narrowly elliptic, the apex abruptly sub-acute, gradually narrowed to the base; main-nerves 8 to 10 pairs, indistinct on both surfaces; length 1·75 to 2·25 in.; breadth ·65 to 1 in.; petiole ·15 in.; stipules conjoined into a wide tube longer than the petioles, obliquely cut on one side, the apex acute rusty-pubescent externally. *Flowers* solitary or in pairs, 2 in. long. *Calyx* ·5 in. long, infundibuliform; the mouth wide and with 5 short triangular keeled acuminate teeth with ciliate edges. *Corolla* about 1·5 in. long, widely campanulate, abruptly contracted into a cylindric tube ·25 in. long, the limb 1·75 in. wide, divided into 5 deep oblong blunt spreading lobes. *Fruit* ellipsoid, crowned by the thick calyx-scar about an inch long and more than half an inch in diameter. *Seeds* numerous, compressed, surrounded by pulp.

PENANG: *Ridley* 1316.—DISTRIB. Saigon, *Pierre;* Cambodia, *Kuntze;* Cochin-China, *Godefroy-Leboeuf.*

5. GARDENIA TUBIFERA, Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II. 562. An unarmed shrub or tree, young branches nearly as thick as a goose-quill, the bark very pale, glabrous, shining. *Leaves* thinly coriaceous, oblanceolate, the apex broad and shortly cuspidate, the base much narrowed; both surfaces pale olivaceous-brown, shining, usually glabrous, but sometimes the nerves and midrib beneath puberulous or scurfy; main-nerves 10 to 12 pairs, sub-horizontal, thin but distinct especially below; length 3 to 6 in.; breadth 1·5 to 2 in.; petiole ·2 to ·4 in., narrowly winged in its upper part; stipules tubular, sub-scarious, truncate, obscurely toothed, sometimes persistent, 2 in. long. *Flowers* solitary, axillary or terminal, glabrous, sub-sessile, 3 to 4 in. long. *Calyx* tubular, tapering slightly to the base, truncate, sometimes split at one side, smooth or ribbed, from ·4 to ·65 in. long.

Corolla thick, many times longer than the calyx; the tube 1·75 to 2·5 in. long, narrowly cylindric, slightly over ·1 in. in diam., pubescent at the throat, otherwise glabrous; the limb 2 to 2·5 in. across, spreading, deeply divided into 6 to 9 obovate or obovate-oblong lobes. *Anthers* inserted in the throat, half-exserted, linear, ·3 in. long. *Style* thick; stigma exserted, with 2 thick short lobes. *Fruit* globose or ovoid-globose, obscurely ridged or smooth, 1 to 1·5 in. in diam., crowned by the tubular calyx; endocarp thick, hard; seeds rather large. Wall. Cat. 8266; DC. Prodr. IV. 381; Hook. f. in Flor. Br. Ind. III. 117; Miq. Fl. Ind. Bat. II. 230; Schumann in Bot. Tidsskrift Kobn. XXIV. 333; Koord. & Valet. Bijdr. VIII. 99. *G. resinifera*, Korth. in Ned. Kruidk. Arch. II. 191; Kurz in Journ. As. Soc. Beng. 1876, II. 134 (*non* Roth). *G. glutinosa*, Teysm. & Binnend. in Herb. Lugd. Bat.

Three forms of this, founded on variations in the calyx, may be recognised as under:—

Form 1. Calyx obconical, smooth, ·4 to ·5 in long, truncate.

PERAK: *Scortechini* 1775; *King's Collector* 5260, 5581. JOHOR: *Kelsall* 4088. SINGAPORE: *Wallich.* PENANG: *Maingay* (K.D.) 838. MALACCA: *Maingay* (K.D.) 838; *Griffith* (K.D.) 2816; DISTRIB. Sumatra, *Forbes* 3222; Borneo, *Motley* 341; *Beccari* 3250; Koh Chang in Siam; Java, *Teysmann.*

Form 2. Calyx-tube ribbed, ·4 to ·5 in. long.

PERAK: *Wray* 2522; *King's Collector* 6285. PENANG: *King's Collector* 1474; *C. Curtis* 686. SINGAPORE: *Cantley* 215; *Ridley* 2588, also *Lobb* 125.

Form 3. Calyx tubular, smooth, ·5 to ·65 in. long, split on one side.

JOHOR: *King's Collector* 11139. PAHANG: *Ridley* 375, 1388 (?) The Johor specimen is well-marked, the other more doubtful.—DISTRIB. Borneo, *Curtis* 111.

6. GARDENIA SPECIOSA, Hook. fil. Fl. Br. Ind. III. 117. A glabrous tree 40 to 60 feet high; young branches much thicker than a goose-quill, pale, marked by the annular scars of the stipules. *Leaves* coriaceous, obovate- or oblanceolate-elliptic, shortly and abruptly acuminate, or cuspidate, the base much narrowed; both surfaces pale olivaceous-brown, glabrous except for some slight pubescence on the midrib and nerves; main-nerves 12 to 14 pairs, slightly curved, depressed on the upper but prominent on the lower surface as is the midrib; length 4 to 6 in.; breadth 1·5 to 3 in.; petiole ·5 to 1 in.; stipules tubular-sheathing, the mouth irregularly toothed. *Flowers* 4 to 6 in. long, coriaceous, solitary or in pairs, axillary, sessile. *Calyx*

·75 to 1·5 in. long, inflated-tubular, the mouth oblique, irregularly few-lobed. *Corolla-tube* cylindric, 3 to 3·5 in. long and about ·15 in. in diam. when dry; limb 2·5 to 3 in. across with 6 to 9 deep obovate-elliptic, blunt lobes. *Anthers* inserted in the villous throat, linear, ·4 in. long, half-exserted. *Fruit* globular, not ridged, 1·5 in. in diam., surmounted by the persistent tubular calyx-tube ·75 to 1 in. long. *Randia speciosa*, Hook. Ic. Pl. t. 824.

SINGAPORE: *Lobb.* PERAK: *Wray* 4265; *King's Collector* 4516, 5830, 8736, 10180.

7. GARDENIA GRIFFITHII, Hook. fil. Fl. Br. Ind. III. 118. A large shrub or small tree; young branches as thick as a goose-quill with pale bark marked by the annular cicatrices of the stipules, glabrous. *Leaves* thickly coriaceous, obovate-elliptic, cuspidate, much narrowed to the short petiole; upper surface olivaceous-brown, glabrous, shining, with the reticulations transverse and depressed; lower surface brown, puberulous especially on the stout midrib and 12 to 15 pairs of oblique slightly curved distinct main-nerves; length 5 to 9 in.; breadth 2·5 to 4 in.; petioles ·3 to ·4 in., stout, winged; stipules ·35 to ·4 in. long, with expanded irregularly toothed mouths. *Flowers* solitary, terminal or axillary, sessile, 4 to 4·5 in. long. *Calyx* nearly as long as the corolla-tube, coriaceous, tubular, expanding upwards, the mouth irregularly toothed, undulate, oblique, ·75 in. in diam., glabrous. *Corolla* salver-shaped, the tube cylindric, much narrower than the calyx; limb 3 in. across, with many lobes, imbricate in æstivation. *Fruit* woody, globular, when dry with slender vertical striæ, glabrous, 2 in. in diam., crowned by the very long, persistent calyx.

MALACCA: *Griffith* (K.D.) 2821; *Ridley* 223; *Derry* 1045. SINGAPORE: *Ridley* 6673; *Hullett* 611, 896.

VAR. *Maingayi*, Hook. fil. l.c. Mouth of the calyx irregularly cut into triangular coriaceous teeth.

MALACCA: *Maingay* (K.D.) 841.

27. PETUNGA, DC.

Glabrous shrubs or small trees with slender often 4-angled branches. *Leaves* petioled, narrowed to base and apex; stipules triangular or ovate-oblong. *Flowers* small, white, bi-bracteolate, in axillary spikes. *Calyx-tube* campanulate, with a persistent 4-lobed limb. *Corolla* funnel-shaped, its throat villous, the limb with 4 spreading lobes; lobes twisted in bud. *Anthers* 4, sub-sessile, linear, the connective thickened at the apex. *Ovary* 2-celled, but often incompletely so; style cylindric, with stoutly linear hairy stigmatic branches; ovules 2 to 8, pendulous from the apex of each cell. *Fruit* small, 2-celled. *Seeds* imbricate; testa thick, grooved, rugulose; cotyledons linear.—DISTRIB. 4 or 5 species in Malaya and Northern India.

Rachis and bracteoles of the raceme, the calyx corolla and fruit externally and the midrib and main-nerves of the leaves beneath pubescent ... 1. *P. longifolia.*
Rachis and inflorescence glabrous, except the bracteoles and edges of the calyx-lobes:—
  Fruit ellipsoid to ovoid, ·2 to ·25 in. long, its pedicel short; leaves narrowly oblong-lanceolate to lanceolate ... ... 2. *P. Roxburghii.*
  Fruit clavate ·5 to ·75 long, mammillate at the apex, not ridged; leaves broadly elliptic-oblong ... 3. *P. venulosa.*

1. PETUNGA LONGIFOLIA, DC. Prod. IV. 399. A small tree; young branches almost as thin as a crow-quill, 4-angled, cinereous-puberulous at first, afterwards glabrous. *Leaves* membraneous, oblong-elliptic, much tapered to both ends, glabrous except the midrib and main-nerves on the lower surface; both surfaces olivaceous-brown when dry; the lower conspicuously and transversely reticulate; main-nerves 6 to 8 pairs, slightly curved, ascending, thin but prominent on the lower surface, obsolete on the upper; length 4 to 5·6 in.; breadth 1·25 to 1·5 in.; petioles about ·35 in., deciduously puberulous; stipules broadly triangular, acuminate, the midrib hairy, ·2 in. long. *Racemes* at first not much longer than the petioles but afterwards lengthening much. *Flowers* ·2 in. long, the pedicels at first very short but lengthening in fruit from ·2 to ·35 in., pubescent like the triangular bracteoles. *Calyx* funnel-shaped, less than ·1 in. long, its mouth with 4 broad acute teeth. *Corolla* more than twice as long as the calyx, funnel-shaped, 4-lobed. *Fruit* clavate, crowned by the small calyx-limb, about ·3 in. long when ripe, puberulous, the pedicel usually longer. Koord. & Valet. Bijdr. 8. 114. *Higginsia longifolia*, Blume MSS.

PENANG: *Phillips*, Wall. Cat. 8301*a.*; *Curtis* 2476, 2839; *Ridley* 10238; *King's Collector* 1447. PERAK: *Wray* 863, 1350; *Scortechini; King's Collector* 470, 4567, 7700; *Curtis* 3143 (in part). PAHANG: *Ridley* 2194.—DISTRIB. Sumatra.

This differs from *P. Roxburghii* in having all parts of the inflorescence hairy, and in having differently shaped fruits on long pedicels. It has also broader leaves, the under surfaces of which are pubescent on the midrib, main-nerves and conspicuously transverse reticulations.

2. PETUNGA ROXBURGHII, DC. Prod. IV. 399. An evergreen much-branched shrub 3 to 8 feet high; young branches 4-angled, cinereous when dry, thicker than a crow-quill. *Leaves* thinly coriaceous, oblong-lanceolate to lanceolate, tapering equally to each end; upper surface

olivaceous-brown, not reticulate; the lower rather darker faintly reticulate; main-nerves 8 to 10 pairs, spreading, faint on both surfaces; length 2·5 to 5 in.; breadth ·75 to 1·5 in.; petiole ·1 to ·2 in., stipules about one-third of the length of the leaves. *Racemes* more than 1 in. long, but shorter than the leaves, slender, glabrous. *Flowers* ·25 in. long, with several bracteoles at their bases. *Calyx* funnel-shaped, the limb with 4 broad triangular lobes. *Corolla* salver-shaped, glabrous except the villous throat; the mouth with 4 broadly oblong obtuse reflexed lobes. *Anthers* partly exserted from the throat. *Style* with two thick hairy arms. *Fruit* elliptic to ovoid, ·2 to ·25 in. long, glabrous, surmounted by the small calyx-limb; the pedicels very short. Hook. fil. Fl. Br. Ind. III. 120. *P. microcarpa*, DC. Prod. IV. 399. *P. variabilis*, Hassk. in Flora 1845, 232. *Higginsia microcarpa*, Blume Bijdr. 988. *Spicillaria Leschenaultii*, A. Rich. in Mem. Mus. Hist. Nat. Paris V. 252. *Randia racemosa* and *R. polysperma*, Roxb. Hort. Beng. 15; Fl. Br. Ind. I. 525, 527. *R. polysperma*, DC. l.c. 389. *Hypobathrum racemosum*, Kurz. For. Fl. Burm. II. 51. *Rubiacea*, Wall. Cat. 8302, 8312.

PERAK: *Curtis* 3143 (in part); *King's Collector* 1385, 2900; *Scortechini* 335, 1093. PENANG: *Curtis* 3387. PANGKOR: *Curtis* 1387. SINGAPORE: *Ridley* 1990. MALACCA: *Griffith*, *Ridley* 230. SELANGOR: *Ridley* 3187.—DISTRIB. Northern India; Burma; Java; Sumatra; Borneo.

VAR. *floribunda*. Racemes longer than the leaves, flowers very numerous; a tree.

PERAK: *King's Collector* 10023. JOHOR: *Ridley* 11157. SELANGOR: *Ridley* 3187.

It is probable that this should rank as a species.

3. PETUNGA VENULOSA, Hook. fil. Fl. Br. Ind. III. 121. All parts glabrous; young branches thicker than a crow-quill, somewhat compressed, shining, dark-coloured when dry. *Leaves* coriaceous, elliptic-oblong, shortly and rather abruptly acuminate, cuneate or rounded and sometimes slightly oblique at the base; both surfaces warm-brown when dry; main-nerves 6 or 7 pairs, slightly curved, ascending, thin but prominent on the lower surface like the midrib, and depressed on the upper; length 3 to 6 in.; breadth 1·5 to 3 in.; petioles ·2 to ·3 in.; stipules triangular, acuminate, keeled, as long as the petioles. *Racemes* at first only about 1 in. long, afterwards much longer. *Flowers* ·35 in. long, on short pedicels with one or two ovate-acute bracteoles at their bases. *Calyx* less than ·1 in. long, campanulate, the mouth with 4 broad blunt lobes hairy at the edge. *Corolla* ·3 in. long, funnel-shaped, the throat densely pubescent, otherwise glabrous, the limb

with 4 ovate-acute reflexed lobes. *Anthers* oblong, apiculate, partially exserted. *Style* with 2 thick hairy arms. *Fruit* clavate, slightly mammillate at the apex and much narrowed at the base when ripe, ·5 to ·75 in. long and ·2 to ·25 in. in diam. at the middle; pericarp leathery, endocarp woody.

PENANG: 8301 (in part); *Curtis* 762, 3386; *King's Collector* 1332. MALACCA: *Griffith* (K.D.) 2829; *Maingay* (K.D.) 911; *Holmberg* 774; *Derry* 1116. SINGAPORE: *Ridley* 8427. PERAK: *Wray* 500, 2315, 2487, 3386; *Ridley* 7183; *King's Collector* 1332, 2594, 3156; *Scortechini* 141, 1411.

The fruits of this species are often attacked by an insect and become ·5 to 1·75 in length and ·4 in. in diam. These galled-fruits are fusiform in shape and have 6 or 7 sharp vertical ridges and their apices are crowned by the slender much elongated calyx-tubes. They are moreover borne on peduncles nearly as long as themselves.

28. DIPLOSPORA, DC.

Shrubs or trees with shortly petiolate coriaceous leaves and triangular acuminate stipules. *Flowers* small, in axillary fascicles or small cymes, polygamo-dioecious, greenish or white; bracts free or connate in a cup. *Calyx* with short tube and truncate 4- or 5-toothed or -lobed limb. *Corolla* cylindric-campanulate or salver-shaped; the limb with 4 or 5 spreading lobes twisted in bud. *Stamens* 4 or 5, inserted by long or short filaments on the throat of the corolla; anthers oblong or linear, exserted, sub-basifixed, often recurved. *Ovary* 2-, rarely 3-celled. *Style* long or short, its branches linear or oblong; ovules 2 or 3 in each cell; placentas on the septum. *Berry* ovoid or globose; seeds few in each cell, imbricate; embryo small.—DISTRIB. Species about 16; tropical Asiatic and Malayan.

All parts quite glabrous:—
  Leaves broadly elliptic, 6 or 7 in. long; fruit ovoid, ·85 in. long ... ... 1. *D. Beccariana.*
  Leaves narrowly elliptic, 2·25 to 4·5 in. long; fruit fusiform ... ... 2. *D. malaccense.*
Nerves and midrib of leaves pubescent or puberulous on the lower surface:—
  Leaves 6 to 11 in. long:—
    Leaves shortly caudate-acuminate, main-nerves 7 or 8 pairs; young branches deciduously pubescent 3. *D. Wrayi.*
    Leaves with long narrow apical tail; main-nerves 10 to 12 pairs; young branches cinereous-tomentose ... ... 4. *D. velutina.*
  Leaves usually under 6 in. in length:—
    Leaves oblanceolate, their main-nerves 8 to 10 pairs; petioles ·35 to ·4 in. long ... ... 5. *D. Kunstleri.*

Leaves narrowly elliptic or elliptic-oblong, not oblanceolate, their main-nerves 6 or 7 pairs; petioles ·15 to ·2 in. long ... ... 6. *D. pubescens.*
Imperfectly known species ... ... 7. *D. n. sp.?*

1. DIPLOSPORA BECCARIANA, King & Gamble n. sp. A glabrous tree 30 to 40 feet high; young branches compressed, thinner than a goose-quill. *Leaves* coriaceous, broadly elliptic, shortly and bluntly cuspidate, the base broad, rounded and slightly unequal; both surfaces pale olivaceous-brown when dry, shining (the lower the paler), with wide faint reticulations; main-nerves about 7 pairs, much curved, ascending, thin but distinct on both surfaces; length 6·5 to 7·5 in.; breadth 3·25 to 3·75 in.; petioles ·5 in.; stipules triangular, sub-acute, only ·15 in. long. *Flowers* not seen. *Fruit* ovoid, mammillate at the apex and tapered to the base, smooth, several-seeded; length ·85 in., breadth about ·2 in. when dry.

PERAK: *King's Collector* 6408.

A species badly represented in the Calcutta collections. It appears to be the same as Beccari's Bornean (Sarawak) plant Nos. 300 and 2062 and we have associated it with the name of that distinguished botanist and explorer.

2. DIPLOSPORA MALACCENSIS, Hook. fil. in Fl. Br. Ind. III. 124. A small tree; all parts quite glabrous; young branches rather thicker than a crow-quill, cinereous, glabrous. *Leaves* narrowly elliptic, shortly abruptly and obtusely acuminate, more or less narrowed at the base; upper surface brown when dry, the lower very pale-olivaceous; main-nerves 4 or 5 pairs, faintly prominent on the lower surface and slightly depressed on the upper; length 2·5 to 4·5 in.; breadth 1 to 2 in.; petioles ·15 to ·2 in.; stipules shorter than the petioles. *Flowers* ·2 in. long, in small clusters in the axils of fallen leaves; their pedicels short, bracteolate at the base, usually (*fide* Hook. fil.) unisexual. *Calyx* shorter than the corolla, tubular-campanulate, the mouth with 4 broad, coriaceous, acute teeth. *Corolla* thin, tubular, cut half-way down into 4 blunt oblong lobes. *Anthers* 4, narrowly ovate, sessile, half-exserted from the throat. *Fruit* fusiform, surmounted by the calyx, glabrous. *Lachnostoma triflorum*, Korth. in Ned. Kruidk. Arch. II. 202; Miq. Fl. Ind. Bat. II. 257.

In all the provinces; common.

3 DIPLOSPORA WRAYI, King & Gamble n. sp. A shrub or small tree; young branches half as thick as a goose-quill, cinereous, covered like the stipules and petioles with minute deciduous cinereous pubescence; all other parts save the interior of the corolla-tube glabrous. *Leaves* elliptic or elliptic-oblong, often somewhat obovate, shortly caudate-acuminate, the base cuneate; both surfaces pale

olivaceous-green when dry, the lower the paler; main-nerves 7 or 8 pairs, curved, ascending, thin but prominent on the lower surface, faint on the upper; length 6 to 11 in.; breadth 2·5 to 4·75 in.; petioles ·25 to ·4 in.; stipules shorter than the petioles, broadly ovate, acuminate, keeled. *Flowers* ·25 in. long, in dense shortly peduncled or sessile axillary minutely bracteolate fascicles a little longer than the petioles. *Calyx* very short, cupular, with 4 broad shallow teeth. *Corolla* tubular, slightly inflated above the middle; the tube villous inside; the lobes of the limb shorter than the tube, glabrous, imbricate, oblong, sub-acute. *Anthers* sessile in the tube ·1 in. long oblong. *Style* cylindric, as long as the corolla, divided into 2 linear hairy arms; ovary with 2 bi-ovulate cells. *Fruit* globular-ovoid, crowned by the faint scar of the calyx, glabrous, ·4 in. long, and about ·3 in. in diam.

PERAK: *Wray* 60, 2879, 3469; *Ridley* 5544; *King's Collector* 2366, 2697, 2782, 5277, 6253.

This closely resembles specimens in Herb. Kew. named *Vangueria palembanica* Teysm. & Binn. which is a *Diplospora*.

4. DIPLOSPORA VELUTINA, King & Gamble n. sp. A small tree; young branches half as thick as a goose-quill, densely covered with short dark-cinereous tomentum like the stipules and petioles. *Leaves* coriaceous, oblong-elliptic, sometimes slightly obovate, the apex abruptly contracted into a narrow acute point about 1 in. long, the base rounded or slightly narrowed; upper surface glabrous, shining, the midrib and main-nerves depressed; the lower with bulbous-based hairs in the interspaces between the nerves; main-nerves 10 to 12 pairs, slightly curved, ascending, stout, the latter as well as the bold midrib and transverse curved veins very pubescent; length 8 to 10 in.; breadth 3 to 4·5 in.; petioles about ·2 in.; stipules about as long as the petioles, keeled, triangular, very acuminate. *Flowers* ·25 in. long, sessile, in dense sessile axillary heads not much longer than the petioles. *Calyx* very short, cupular, obscurely lobed. *Corolla* funnel-shaped, glabrous except the densely villous throat; the limb with 4 oblong, broad, slightly emarginate lobes. *Anthers* sagittate. *Style* slender, with 2 short, linear, compressed stigmatic lobes. *Fruit* unknown.

PERAK: *King's Collector* 3142.

5. DIPLOSPORA KUNSTLERI, King & Gamble n. sp. A small tree; young branches thinner than a goose-quill, deciduously puberulous like the stipules, petioles, and lower surfaces of the midrib and main-nerves, otherwise glabrous. *Leaves* sub-coriaceous, oblanceolate to elliptic or oblong, shortly, abruptly, and bluntly acuminate, the base rounded or slightly cuneate; both surfaces of rather a dark-brown

when dry; the midrib impressed on the upper, prominent on the lower; main-nerves 8 to 10 pairs, oblique, little curved, prominent beneath; veins transverse, thin but distinct on the lower surface length 6 or 7 in.; breadth 1·75 to 2·5 in.; petioles ·35 to ·4 in. long; stipules about as long as the petioles, triangular-lanceolate, keeled, produced into a long narrow point. *Cymes* small, shortly peduncled, axillary. *Flowers* not seen. *Fruit* mamillate when young, ovoid and crowned by the small calyx-scar when ripe, smooth, ·4 in. long; 2-celled, 2-seeded.

PERAK: *Scortechini* 298; *King's Collector* 3211.

6. DIPLOSPORA PUBESCENS, Hook. fil. Fl. Br. Ind. III. 124. A shrub; young branches thicker than a crow-quill, compressed, minutely pubescent like the stipules and petioles. *Leaves* coriaceous, narrowly elliptic or elliptic-oblong, shortly and obtusely caudate-acuminate, the base cuneate; both surfaces when dry pale-brown, the upper everywhere glabrous and the midrib and main-nerves channelled; the lower glabrous between the minutely pubescent stout midrib and 6 or 7 pairs of slightly curved slender but prominent main-nerves; length 3 to 6 in.; breadth 1·25 to 2·25 in.; petioles ·15 to ·2 in.; stipules about as long as the petioles, narrowly lanceolate, tapering into long subulate points. *Flowers* about ·2 in. long, in dense short axillary sub-sessile heads slightly longer than the petioles. *Calyx* short, with 4 very small blunt lobes, pubescent. *Corolla* longer than the calyx, tubular, lobes of limb 4, short, the throat villous. *Fruit* ovoid-globular, smooth, the calyx scar small; length ·4 in.; seeds 4. Wall. Cat. 8297.

PERAK: *Scortechini* 6, 94; *Ridley* 5537.—DISTRIB. Mergui, *Griffith* 1108; *Helfer* (Kew. Dist. 2799).

Imperfectly known species.

7. DIPLOSPORA, n. sp.? Young branches thicker than a crow-quill, densely and minutely cinereous-pubescent. *Leaves* coriaceous, narrowly elliptic, shortly and somewhat bluntly caudate-acuminate, the base slightly narrowed; both surfaces dark-brown when dry; the upper shining, glabrous, lower dull, puberulous on the bold midrib and 6 or 7 pairs of prominent oblique little curved main-nerves; length 4·5 to 5·5 in.; breadth 1·5 to 2·35 in.; petioles ·15 to ·2 in.; stipules about as long as the petioles, triangular, sub-acute or acute but not acuminate. *Flowers* not seen. *Fruit* ovoid-globular, crowned by the small calyx-scar, smooth, ·45 in. long, and ·35 in. in diam.

PERAK: at an elevation of 5,000 feet; *Wray* 4086.

29. SCYPHIPHORA, Gaertn.

A small tree with stout terete nodose branches, gum-yielding when young; all parts except the inside of the corolla-tube glabrous.

Leaves coriaceous, obovate, obtuse; stipules short, broad. *Flowers* small, in dense, shortly-pedunculate cymes. *Calyx-tube* elongate-obconic; the limb cupular, truncate, minutely 4- or 5-toothed, persistent. *Corolla-tube* cylindric; the throat dilated and villous; the limb with 4 or 5 oblong lobes twisted in bud. *Stamens* 4 or 5, inserted by short filaments between the lobes of the corolla, anthers linear, sagittate. *Disk* annular, lobed. *Ovary* with 2 narrow cells; style filiform, with 2 linear obtuse stigmatic branches. *Ovules* 2 in each cell, attached to the middle of the cell, one pendulous, the other ascending; the contiguous funicles dividing each cell into 2 chambers. *Drupe* sub-cylindric, 8- to 10-grooved and winged, separating into 2 crustaceous 4- to 5-ribbed pyrenes. *Seeds* sub-cylindric; testa membranous; albumen scanty; cotyledons oblong.—Distrib. A single species in Malaya and Ceylon.

Scyphiphora hydrophyllacea, Gaertn. Fruct. III. 91. t. 196. A miniature evergreen tree, with a spherical crown and simple stem hardly exceeding 4 feet in height. *Leaves* acute at the base on a petiole ·5 to 1 in. long; nervation obsolete; length about 2 in.; breadth 1·5 in. *Flowers* whitish often tinged with red; collected in small dichotomously branched axillary cymes. *Calyx* about ·15 in. long. *Corolla-tube* about as long as the calyx and its lobes half as long. *Drupes* elliptically oblong, about ·35 in. long. DC. Prod. IV. 577; Kurz. Fl. Burm. II. 4; Hook. fil. Fl. Br. Ind. III. 125; Miq. Fl. Ind. Bat. II. 239; Koord. & Valet. Bijdr. 8. 125; Trimen Fl. Zeyl. III. *Epethenia malayana*, Jack in Mal. Misc. I. 12; Wall. Cat. 8444; DC. l.c. 478; W. & A. Prod. 424. *Epithenia* sp., Griff. Notul. IV. 269; Ic. Pl. Asiat. 478 and 644 A. (*Lumintzera*). *Rubiacea*, Wall. Cat. 9055 A. *in part.*

In Mangrove swamps.—Distrib. Coasts of S. India and Ceylon; Andaman Islands; Malay Archipelago to N. Australia; Philippines and New Caledonia.

30. Jackia, Wall.

A tall tree; young branches stout, obtusely 4-angled, covered by the persistent bases of the fallen leaves and by the large coriaceous, sheathing long-bristled stipules. *Leaves* coriaceous, large. *Flowers* densely pubescent, in prominently bracteolate scorpioid cymes arranged corymbosely in long-peduncled pendulous axillary panicles. *Calyx-tube* small, obconic, the limb with 5 unequal lobes, two of them small the other 3 coriaceous, large, veined, accrescent and forming wings to the ripe fruit. *Corolla* funnel-shaped, the tube narrow, sub-glabrous inside, lobes of the limb 5, valvate in bud, triangular. *Anthers* 5, linear, sub-sessile in the throat, the connective apiculate. *Disk* hairy. *Ovary*

2-celled, ovules 2 in each cell, attached to the apex of an erect basilar placenta. *Style* compressed, slender, long-exserted, thickened and hairy about the middle, stigmatic-lobes 2, short. *Fruit* dry, indehiscent, obconic, ·1 in. long, densely hairy, crowned by 3 accrescent, persistent, veined, oblong somewhat oblanceolate blunt calyx-lobes about ·6 in. long; *seeds* (by abortion) solitary, ellipsoid, embryo straight in the axis of much fleshy albumen; cotyledons broad, flat.—Distrib. A single Malayan species.

Jackia ornata, Wall. in Roxb. Fl. Ind., ed. Carey & Wall. II. 321. Young branches as thick as the little finger. *Leaves* oblanceolate, the apex sub-acute, narrowed from above the middle to the short stout petiole; upper surface glabrous and shining, the lower adpressed-puberulous; main-nerves about 12 pairs, prominent beneath; length 6 to 12 in.; breadth 2·5 to 5 in.; petiole ·4 to ·9 in.; stipules widely and deeply cupular, often 1 inch or more in length (to the end of the hairy bristles). *Flowers* ·4 in. long; corolla many times longer than the calyx-tube, twice as long as the calyx-lobes when young, densely sericeous externally; bracteoles broadly oblong-ovate, shorter than the flowers, imbricate, sericeous, the lower ones sometimes connate. Wall. Pl. As. Rar. t. 293; Wall. Cat. 6284; DC. Prod. IV. 621; Hook. fil Fl. Br. Ind. III. 126; Miq. Fl. Ind. Bat. II. 237.

In all the provinces.—Distrib. Malay Archipelago.

A first note on the Life-History of Chermes abietis-piceæ *Steb. MS.—By* E. P. Stebbing.

[Received 21st June, 1903—Read 1st July, 1903.]

In a paper read before the Members of this Society in April last I gave an account of the mode of development of the alar appendages of the Spruce form of *Chermes abietis piceæ*, Steb. MS.* I propose to describe here in detail the further observations I have been able to make up to the present on the life-history of this exceedingly interesting insect. In order to make the somewhat complicated stages of life passed through understood, and the subsequent parts of this paper intelligible, it will be first necessary to give some short description of the various forms this insect assumes in its different generations.

* Vide No. 2, p. 57 of this Volume.

C. abietis-piceæ closely resembles its European confrère *C. abietis-laricis* in the fact that the individuals of one generation may assume different habits at different stages of their existence, and so set up the phenomenon known as parallel series. Further different stages in the life-history may be passed on plants of a different species, the host plants in India being the Spruce and Silver fir instead of the Spruce and Larch as in Europe. Blochmann, Dréfus, and Cholokovsky have made a series of the most important and interesting observations into these habits in the case of the European species within the last two decades or so, but the fact that a closely allied species lives in a somewhat similar manner on conifers in the N.-W. Himalayas seems to have remained unknown until discovered by the writer in 1901.

Before proceeding to describe in detail the stages as yet observed in this complex life-history, I may briefly run over the points which give rise to the phenomenon known as 'parallel series.'

In the early spring wingless ♀ of the *Chermes* are to be found upon the Spruce trees, they probably having hibernated upon them through the winter. These ♀ lay eggs from which shortly hatch out young larvæ which feed at the base of the young developing needles, causing them to swell up and coalesce into a pseudo-gall within which the aphids become enclosed. When fully grown about July the galls open, the larvæ crawl out, moult, and become fully developed winged insects. Some of them remain on the Spruce and lay eggs on it. A portion however of this winged gall generation leaves the Spruce and flies to the silver fir and lays eggs on it on the bark of the twigs or stem. The parthenogenetic ♀ which arise from these eggs either hibernate upon the trees and lay their eggs in the early spring of the ensuing year, or lay the eggs in the autumn. These eggs are covered with a white cottony substance which can be seen in the form of white specks all over the branches, and often all over the whole of the stems of young saplings. Each little white cottony mass contains a large number of eggs. From these eggs hatch out in the spring small larvæ which crawl up on to the newly-developed young silver fir needles and feed by sucking out the sap from them. It would appear that whilst some of this generation go on to the winged form, others remain on the needles and mature and lay eggs on them without ever acquiring wings or leaving the tree. A part of this generation, however, always acquires wings about the beginning of July, and these winged insects then fly to the Spruce tree and lay their eggs on the bark of the stem (in young trees) or branches.

My observations in the case of the Indian species seem to prove that either form in the two series can remain for a prolonged period on the one host tree before producing the winged generation which enables it to return to the alternative host plant. This is evidently the case with the silver fir series, since eggs have been found on needles which only opened from the bud in May, and therefore could not have been those of the autumn or winter stem mothers of the previous season. These eggs hatched out, and quite young larvæ were found on the fully-developed silver fir needles six weeks after the spring larvæ had first appeared. There also appear to be other forms of the Chermes, and their feeding causes the silver fir needles of the year to become distorted and to curl and twist up, the individual needles being stuck together by the copious sticky excretions of the Aphidæ. This is especially noticeable on young plants, at times 70 °/₀ to 80 °/₀ of the terminal portions of the branches being treated in this way.

I will now proceed to consider these life-cycles separately, first dealing with the stages on the Spruce, and subsequently with those upon the silver fir.

The Chermes on the Spruce.

At the beginning of May, 1901, an examination of the Spruce at elevations of between 8,000 and 9,500 ft. in Jaunsar Barwar, in the N.-W. Himalayas showed small pinkish-white cone-shaped masses appearing here and there on the side branches. At the base of these in the axil between the branch and the cone (which was an unopened bud) masses of elliptical reddish eggs were to be observed, the mass being partially covered by the dried skin of the stem mother who died as soon as she had laid them. I have not as yet definitely ascertained whether these eggs were laid in the previous autumn or in the April of the year in which they were found. If at the latter period the stem mother evidently lays very early in the season, as snow was still lying in shady spots that year at the beginning of May at elevations of 9,000 ft. In the first week of the month a careful inspection showed young larvæ emerging from these eggs, and on cutting a section vertically through the small cone, young larvæ were visible in numbers between the bases of the young needles. Under the microscope these larvæ were seen to be minute red aphids furnished with a pair of antennæ consisting of two large basal joints followed by a narrower longer one which is surmounted by a hair. The beak was long and coiled, and three pairs of short legs were present. These minute larvæ were engaged in feeding upon the juices of the young undeveloped needles of which the pink gall consisted. Other patches of eggs examined were seen to be in a less advanced state, the bud above them having only just commenced to increase in size. The irritation set up by the young larvæ feeding at the bases of the needles soon causes the bud to swell, but instead of opening out into a short stiff brush of needles it develops into a gall or pseudo-cone shaped green mass. When quite young there is no partitioning off into distinct cells to be observed within the cone, but as the swelling under this constant irritation continues, the interior gradually becomes divided off into distinct compartments, in each of which numbers of the young larvæ are to be found engaged in sucking up the juices of the walls of the compartment. In the third week of May this partitioning is already distinct, and a section of the small gall, which is by then bright green externally, and pyramidal in shape, will show a number of chambers situated on either side of a central axis. The young aphids are still bright crimson in colour, with legs and antennæ light yellow. No indications of wings are apparent at this period. As the gall becomes partitioned off inside the outside presents distinct diamond-shaped surfaces, each of which is the cover to a chamber below. A centre spot in each of these surfaces is lighter-coloured than the rest, and may form a minute projection. This would appear to represent the tip of the swollen up needle. It is never more than a minute projection, and in this differs from the European Spruce Chermes gall in which the spine or leaf top projects to some distance beyond the cone surface and can be seen to be the true upper portion of the needle. The false cone continues to steadily increase in size throughout June, and the young larvæ turns to a dark purple colour. They moult several times whilst in the chamber, and the white papery cast skins can be found in the cavities. From 6 to 8, or at times an even greater number of larvæ inhabit each chamber.

Several cones may often be found upon the same branch, and the writer has seen young trees absolutely loaded with these pseudo-galls. I have already described to the members of this Society* the manner in which the larvæ leave the false cone and develop their wings. A certain number of them on acquiring these fly off to the Silver Fir where they may be found in the first half of July clinging to the new year's needles.

The subsequent history of these winged forms from the Spruce has not as yet been traced.

The Chermes on the Silver Fir.

The presence of the spring eggs on the silver fir is easily discernible, since they are invariably covered or partially covered with a white cottony material. At times this substance is so abundant as to clothe the bark of young trees more or less thickly from top to bottom, either entirely encircling the stem or occupying one or two sides only. At other times it is to be found only upon the upper portion of the stem of

* Vide No. 2, p. 57 of this Volume.

old trees and saplings or on portions of some of the side branches. Tops, leading shoots and branches, covered in this way with what look to be white fungous filaments, are often seen to be dying or dead and dried up. Round Deoban (elev. 9,300 ft.) in the Jaunsar Barwar Forests a number of both young and old trees have these dead tops. I have, however, up to date been quite unable to discover any cause for this dying off of the tops. It does not take place in patches but here and there in the forest. It will, of course, require very careful investigations carried out over a series of years before we are in a position to say whether the Chermes is in any way accountable for this state of affairs.

On examining the cottony patches with a lens, one sees that this white wool-like material forms a covering to a blackish skin. This skin is that of the dried-up stem mother Chermes. At her anal end a portion of a bunch of yellowish brown elliptical glossy eggs is visible, the rest of them being hidden beneath the dried-up skin. The eggs are superficially very similar to those to be found upon the Spruce at this period (the beginning of May). These eggs were present in millions on infested silver firs at the beginning of May 1901. Little larvæ were observed hatching out from the eggs about the first week in the month, and these at once crawl up on to the young newly-developed or developing silver fir needles, at that period just bursting through the bud scales, where they appear as minute black specks covering the young bright green tassels of needles. Seen beneath the microscope the young larvæ are apparently identical with those to be found at the same time on the Spruce.

Young Larva.—Red to crimson in colour, with two large basal antennal joints followed by a longer narrower one, this latter being surmounted by a bristle. Three pairs of short legs with two jointed tarsi, nine abdominal segments and a long curved proboscis.

Within a few days the young larvæ develop a white cottony covering. To the naked eye the young grubs appear to be surrounded by a white fungus. The microscope shows this however to be a white wooly substance which grows or is excreted all over the dorsal surface of the body. Towards the end of the third week in May these small aphids appear to become fullgrown, and they then lay the grape-bunch like masses of eggs of a new generation. They then die, the dead body skin remaining as a cover or partial cover to the eggs as in the case of the winter stem mother.

Since the whole of this first series of larvæ spend their lives upon the newly developed needles of the year, it becomes evident that this first generation of the year, or a portion of it, is a short-lived one; only stem females arising from the eggs, a winged generation being entirely absent. The eggs so laid hatch within a week of being laid, and the young larvæ spread out over the undersurfaces of the still young green needles and remain feeding on them. At times these undersurfaces are quite black with the numbers of dark crimson-coloured larvæ attached to them. The production of these apterous forms continues until the first week in July, *i.e.*, up to the period when the monsoon rains burst over the Himalayas.

Towards the end of May, however, or beginning of June, the apterous crimson larvæ collect at the base of the needles and on the needle-bearing shoots. The irritation set up by their sucking operations causes the needles to draw together into a kind of corkscrew-shaped bud, the needles being twisted round one another and stuck together by the sugary excretion from the aphids. This excretion is also added to by an exudation of turpentine from the plant and round nodules of resin are to be found in the axils of the needles. A new and larger form of larvæ now begins to appear, yellowish in colour. These yellow aphids are to be found in the axil at the base of each needle, each having its proboscis firmly fixed in the tissue of the stem or leaf base. In addition to these yellow apterous forms a winged generation began to appear on the trees at the beginning of June. The winged insects found at this stage were on the twisted-up silver fir needles.

Apterous yellow larva.—Bright canary yellow with two curled, white, cottony, whisp-like tails at the posterior extremity of its body. Patches of the white cottony material are also present elsewhere on body. The proboscis is short; antennæ six-jointed.

Winged form.—Dark orange-yellow in colour. Four wings large and black.

The crimson-coloured larvæ in the cotton developed stage of their existence are also numerous within the corkscrew-twisted needles.

The action of the insects at this stage is to contort and dwarf all the new shoots attacked. Some young trees were found with 90 °/₀ of the new leaves treated in this way, whilst the branches below and the stem shewed numerous patches of eggs covered by the white cottony substance.

A few days later I was able to note that the yellow larvæ are also to be found in the open on needles which are not twisted-up in the corkscrew manner. Later on I found a winged form of the apterous yellow larva.

Winged form of apterous yellow larva—Yellow green, with light silvery wings, one and three-quarters to twice the length of body; proboscis yellow as are the legs.

Observations were continued up to the first week in July upon these various forms of the Chermes upon the silver fir, and the following summary of conclusions arrived at is given here :—

As already seen, eggs placed in branches at the base of the leaf buds hatch out in May, as the young needles unfold, and the minute larvæ crawl up on to the leaves. After a time these young larvæ apparently develop the white cottony substance and then die and lay fresh eggs on the needles. Later on a generation from these eggs (or a portion of the first generation) collect down towards the base of the needles, and feeding here set up an irritation which results in an exudation of turpentine, and also causes the needles to curl up in a corkscrew manner, the stickey excretions binding them together into a large twisted bud. Within or near the corkscrew bud the following are to be found :—

(*a*) Ordinary crimson-coloured larval form.

(*b*) Yellow apterous form.

(*c*) The yellow-green, silvery winged forms.

(*d*) A few dark orange-coloured black-winged forms.

By the end of the first week in July the twisted-up leaves are found to contain numerous eggs covered by the usual dead mother skin and white cottony substance. These are also to be found on the twig and stem of the tree and are very visible. The apterous yellow larvæ will now have mostly left the corkscrew buds, and the numerous white papery skins on the twigs and the untwisted needles in the neighbourhood showed that they moulted after quitting the deformed shoots. This moult, I am of opinion, is the last one gone through, the Chermes after shedding this last skin appearing as the light green and yellow silvery-winged insect described above. Although the writer has not absolutely watched the change in colour, he is of opinion that the orange-yellow dark-winged forms are but a later stage of the bright coloured silvery forms, the bright tints assumed after the last change of skin darkening in a similar manner to that of the Spruce gall form described in the previous paper read before this Society. This winged form will probably fly off to the Spruce and lay eggs on it in a similar manner to that of the Spruce gall form which flies to the silver fir on leaving the pseudo-cone and acquiring its wings. I am not prepared as yet, however, to say exactly what happens to these winged forms. I found many dead upon the trees, and this would point to their lives being short in this stage. It is probable that during the heaviest of the monsoon rains the Chermes would not be active, and it is possible that this season is passed in the egg stage. I have not yet had an opportunity of observing whether the aphid resumes its activity during the brilliant warm autumn months which succeed the monsoon season in the Himalayan Region.

The occurrence of Melanterite in Baluchistan.—*By* David Hooper, F.C.S.

[Received 27th May, 1903. Read 3rd June, 1903.]

During the last cold weather, Mr. R. Hughes-Buller, C.S., Superintendent, Imperial Gazetteer, Baluchistan, forwarded several samples of economic products to the Indian Museum for identification. Among these were two specimens of minerals called *Khaghal* and *Pulmâk* which were employed in the Brahui method of dyeing in conjunction with pomegranate husk in producing black or deep green colours.

A special interest attaches to the production of *Khaghal*, otherwise known as *Zagh*, on account of a note drawn up by Mirza Sher Mahomed, describing one of the mines in the Jalawan district. It appears that the collection of *Khaghal* is a regular industry in two or three localities in Baluchistan. One of the mines is about forty miles from Nargana, and at Tangọ, about a mile distant, is another mine, situated at the foot of the hill and on the bank of a river. The entrance to the mine is an opening about a yard wide leading into a gallery of unknown length. The *Zagh* has been collected from these mines for several years, and although large quantities of mineral have been taken away, only a small area of about two yards has been worked. It is always mixed with a slate-like stone. The narrow gallery forming the mine is called "Ragh," a vein of the hill. The inhabitants say that after a rainfall pure white *Zagh* "bursts out" in the mine which in the dry weather is dug out together with the decomposed slate. The mine has a disagreeable corrosive smell "like iron rust," and this causes the workmen to vomit in the course of half an hour. Further samples were sent by Mr. Hughes-Buller, one from Ladon Pass, said to be of superior quality, and another from Bhapar which was very inferior. It has also been discovered at Chotok on the Kil river, Mula Pass, and at two places at Khuzdar.

The mine at Chotok is in a gorge, at a distance of six miles west of Janh. Here a cave is formed in the hill with a pool of warm water, noted for its mineral properties, and overhead is a rock from which water drops from innumerable stalactites of fantastic shape. The length of the pool is 150 yards, through which guides conduct visitors after they have undressed. At about ten yards from the entrance of the gorge is a large cave on the bed of which the mineral incrustation known as *Khaghal* forms. This is of a yellow colour and is said to be in an excellent condition for dyeing purposes.

Upon examining the samples of *Khaghal* it was soon discovered that they were impure forms of ferrous sulphate or green copperas. The sample from Ladon Pass contained 30·1 per cent., of anhydrous ferrous sulphate, and that from Kil Chotok 27·36 per cent. Analyses of the water-soluble portions of the minerals revealed the fact that in addition to the iron salt sulphates were present of other available metals peculiar to the rock. The following tables indicate the composition :—

	Ladon Pass.	Kil Chotok.
$FeSO_4$	30·10	27·36
$Al_2\,3\,SO_4$	4·50	4·02
$CaSO_4$	3·12	3·78
$MgSO_4$	1·20	1·50
K_2SO_4	·74	·27
Na_2SO_4	2·06	2·86
	41·72	39·79

The minerals contained about 40 per cent. of matter insoluble in water consisting of silica, iron, alumina and lime. These estimations leave a balance of about 20 per cent. which might be referred to water of crystallisation.

The specimen of *Khaghal* from Bhapar yielded to hot water only a small quantity of sulphate of alumina with traces of calcium sulphate, and was therefore almost valueless as a dye or mordant.

Melanterite or native ferrous sulphate is usually the product of the decomposition of pyrites and occurs as an efflorescence on the out-crop of rocks containing a considerable quantity of this mineral. But in volcanic regions it appears to be formed by the chemical action of sulphurous vapours upon siliceous and oxidised ores of iron. There are volcanic regions in Baluchistan where sulphur is obtainable and where sulphurous fumes are constantly acting upon the surrounding rocks converting the metals into sulphates. The Khaghal mines of Nargana and Chotok provide the conditions of warmth, air, and moisture necessary to promote the combination of sulphurous acid and iron and the ultimate conversion into crystallised sulphate.

Iron sulphate has already been found in India in the following places: Shekawati, Rajputana;[1] hills of the Kakur district, Afghanis-

[1] J. C. Brooke, *J. As. Soc. Beng.*, Vol. xxxiii., 529.

tan;[1] in the Ramganga and Garja Valleys, in Kumaon;[2] on shales of the Kaimur tableland, Central Provinces;[3] in the Langyin Valley, Central Assam; and at the headwaters of the Attaran River, Tenasserim.[4] That the green copperas as used as a dye is often very impure, is shown by an analysis of a sample made by J. Stevenson in Bihar[5] who found 39 per cent. of anhydrous ferrous sulphate; the pure crystallised sulphate should yield, according to the formula $FeSO_4$, 7 H_2O, about 54 per cent. of the anhydrous salt.

A note might be added regarding the mineral *Phulmâk*, sent by Mr. Hughes-Buller as a mordant in dyeing employed by the Brahuis, or inhabitants of the highlands of Baluchistan. *Phulmâk* is found in the Koh-i-Sultan, a hill in the Western Sanjrani district. At Kundi, south of the Koh-i-Sultan, some of this "mak" was found in the course of sinking a well. The water was consequently very saline and unfit for drinking purposes. The average price paid by the Nashki Banias for *Phulmâk* varies from Rs. 5 to Rs. 6 per maund. It is said to be used as a mordant while *Zagh* is used as a dye.

This mineral has recently been described by Mr. E. Vredenburg in his "Geological Sketch of the Baluchistan Desert" (*Memoirs of the Geological Survey of India.* Vol. xxxi., Pt. 2 (1901), pp. 278-279.) Describing the region of the solfataric volcano, Koh-i-Sultan, Mr. Vredenburg states—"The clays are impregnated with sulphate of alumina, which is extracted and used as a mordant under the name of "Koh-mak." The efflorescent salt is known as "Phul-mak."

Mak is a term given to the soft ferruginous lithomarge, occurring in the hills south of Saindak and in the Koh-i-Sultan, and is collected and carried to Kandahar for dyeing purposes by Kakars and Babars. (T. H. Holland, *Records of Geological Survey of India*, Vol. xxx., 129) *Mak* or *Lak* was also collected by Major G. W. Brazier Creagh, I.M.S., from the Cheltan Range and was reported to give a black dye called *Lak-i-Siah* with leaves of the Kangak shrub. Specimens examined in the Laboratory of the Geological Survey were pronounced to be yellow marl containing large quantities of sulphate of iron. (*Ib.*, Vol. xxx., 253).

Although the substance termed *Mak* appears to differ in appearance and properties, the identity of the *Phulmâk* has been set at rest by an examination of two samples sent by Mr. Hughes-Buller. One speci-

1 T. Hutton, *Calcutta Journ. Nat. Hist.*, Vol. vi., 597.

2 J. D. Herbert, *Asiatic Researches*, Vol. xviii., Pt. 1, 229.

3 F. R. Mallet, *Memoirs G.S.I.* Vol. vii., 121.

4 E. Riley, *Journ. Ind. Archipelago*, Vol. iii., 395.

5 *Geology of India*, Vol. iii., 419.

men was in white granular cakes, and the second contained in addition masses of white silky crystals. On analysing the soluble portion of each it was proved that the mineral was *Alunogen* or "Hair Salt," with a composition of: Alumina 15·3, sulphuric acid 36 and water 48·7 per cent. This composition agrees with the formula of Alunogen, *viz.*, Al_2O_3 3 SO_3, 18 H_2O.

Himalayan summer storms and their influence on monsoon rainfall in Northern India.—*By* C. LITTLE, M.A.

In a paper which I read at the April meeting of this Society I pointed out that the monsoon season of 1902 could be divided into four periods, in each of which the character of the season as regards the distribution of rainfall and the movement of cyclonic storms which entered India from the Bay of Bengal were noticeably different. I gave a number of tabular statements showing that important changes appeared in the Himalayan region about the 30th of June and the 11th of August, that these changes did not begin over India, and that there was abundant reason for the belief that they approached India from Central Asia, that is, from an easterly or north-easterly direction. I gave the paper the title of "Two remarkable rainbursts in Bengal," because the unexpected occurrence of heavy rainfall in north-eastern India attracted my attention and led to the subsequent investigation.

Although the present monsoon season is not yet half over, there have, in my opinion, been already no fewer than three occasions on which the weather in Northern India has been influenced by similar disturbances, that is, by disturbances which have made their first appearance in the region of the Himalayas. I have called them Himalayan storms because they come within our range of observation when they reach the hills; but the probability is that they are due to depressions moving across Central Asia. Their appearance begins with an irregular fall of the barometer at stations in Northern India, and an indraught of winds in that direction: after a longer or shorter period pressure begins to rise, and this rise of pressure is accompanied by the commencement of rainfall, not I believe rainfall of the monsoon type, but the irregularly distributed, and often heavy rainfall caused by numerous thunderstorms.

The two storms of 1902 regarding which I gave details in the paper read on April 1st were rapid in their advance and widespread, so that within a few days their influence was felt along almost the whole length of the Himalayas.

The storms of the present season have been slower in their movement and of limited extent, so that their influence has been confined to sections of Northern India, the latest occurring only a few days ago when the unexpected rainburst in the United Provinces produced so important a change on the agricultural outlook in that region.

It is not my intention to give details of all these three disturbances, but the middle one of the three is so important, in my opinion, inasmuch as it confirms a conclusion I came to last year after the disturbance of August 11th. That conclusion was that these Himalayan disturbances not only have an influence on the motion of cyclonic storms which cross Northern India from the Bay of Bengal, but they directly contribute to their commencement. The Himalayan storm which entered north-east India on July 8th or 9th, 1903, is in its main features so similar to the storm of June 30th, 1902, and it resembled the storm of August 11th, 1902, in that it was followed by a remarkable series of cyclonic storms over the north of the Bay. Because of these similarities I think it desirable to give tabular statements for it, similar for purposes of comparison with the tables I gave in my previous paper. It will be seen from these tables that pressure began to fall on the 7th in the extreme north-east of Assam, that this fall was general along the Himalayan range on the 8th and 9th and was followed by a rise on the 10th. As these changes extended south-westward over Bengal, rainfall with a rapid fall of temperature became more general—between the 9th and 10th in North and East Bengal and between the 10th and 11th in the western districts. The small charts which are given in the Indian Daily Weather Report, one for the "variation of 8 A.M. pressure of day from normal," and the other "variation of mean temperature of day from normal," show more clearly than the tables the succession of changes which passed over Northern India with that Himalayan storm. The dates for which reference to these charts is suggested are from July 7th to 14th. An examination of the pressure charts will show that pressure was normal along the Himalayas on the 7th and practically over the whole of India. Two days later it was low over Northern India, but still practically normal over the continent. This low pressure area was displaced southward, and by the 13th we have pressure again normal over Northern India and low over the continent; while one depression has formed over the north of the Bay and another in the north-east of the Arabian Sea.

TABLE I.

Giving the pressure change daily from July 7th to July 13th, 1903, *arranged to show the southward movement of the disturbance.*

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+·010″	−·026″	−·055″	+·068″	+·001″	−·071″	−·014″
North Bengal ...	+·014	−·027	−·082	+·062	+·015	−·043	−·046
East Bengal ...	+·020	−·004	−·066	+·041	−·050	−·045	−·025
S.-W. Bengal ...	+·006	−·006	−·058	+·012	+·006	−·060	−·054
Orissa ...	+·007	+·015	−·044	−·029	−·018	−·075	−·129
Circars ...	−·005	+·020	−·027	−·021	−·020	−·054	−·078
Akyab ...	+·020	+·018	−·034	−·022	−·072	−·071	+·019
Diamond Island...	+·034	+·002	−·021	−·050	−·028	−·062	+·024

TABLE II.

Giving the pressure variation from the normal from July 7th to July 13th, 1903, *arranged to show the southward movement of the disturbance.*

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+·014″	−·011″	−·080″	−·014″	−·014″	−·076″	−·100″
North Bengal ...	+·025	+·008	−·078	−·019	+·001	−·042	−·084
East Bengal ...	+·037	+·034	−·031	+·011	−·038	−·082	−·107
S.-W. Bengal ...	+·029	+·026	−·032	−·019	−·012	−·070	−·123
Orissa ...	+·043	+·059	+·016	−·011	−·029	−·102	−·230
Circars ...	+·007	+·027	0	−·019	−·039	−·093	−·171
Akyab ...	+·024	+·043	+·009	−·012	−·083	−·153	−·133
Diamond Island...	+·055	+·007	−·014	−·064	−·091	−·153	−·129

The above tables show the southward movement of these changes in Eastern India, the commencement of the fall of pressure in Assam and North Bengal on the 8th, the general fall on the 9th followed by a rise in Assam and Bengal Proper on the 10th, also the developing depression over the north of the Bay on the 12th and 13th.

TABLE III.

Giving the temperature change daily from July 7th to July 13th, 1903, arranged to show the southward movement of the disturbance.

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+0·6°	+1·4°	−1·0°	−3·5°	−0·2°	+3·1°	+3·2°
North Bengal ...	+0·4	−1·0	−1·8	−0·5	−3·9	−0·6	+2·8
East Bengal ...	+1·3	+0·7	−0·4	−1·9	−0·4	+2·8	−0·7
S.-W. Bengal ...	+0·2	+0·5	+0·8	+0·1	−2·9	−1·2	−0·2
Orissa ...	+2·0	+0·1	+0·4	+0·5	−2·0	−2·2	+0·4
Circars ...	+2·7	+2·5	−2·1	+3·4	+0·9	−4·4	−5·1
Akyab ...	+2·0	−2·2	+1·7	−0·5	+1·8	+0·7	−0·7
Diamond Island...	−1·3	+2·3	−1·0	+1·0	−2·8	+0·3	−0·8

TABLE IV.

Giving the temperature variation from the normal from July 7th to July 13th, 1903, arranged to show the southward movement of the disturbance.

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+1·8°	+0·9°	+1·0°	−0·6°	−3·2°	−0·9°	+1·8°
North Bengal ...	+2·6	+1·2	−0·6	−1·1	−5·2	−1·2	+1·7
East Bengal ...	+1·7	+2·1	+2·1	−0·3	−0·8	+7·3	+7·0
S.-W. Bengal ...	+2·5	+3·0	+3·7	+3·8	+1·0	+2·2	+2·1
Orissa ...	+3·2	+3·4	+4·2	+4·8	+3·2	+2·1	+3·0
Circars ...	+2·5	+0·1	−1·8	+1·8	+2·7	−1·5	−6·5
Akyab ...	+1·2	−0·9	+0·8	+0·3	+2·1	+2·8	+2·1
Diamond Island...	+0·7	+3·1	+2·2	+3·2	+0·4	+0·7	0

The temperature fall began in North Bengal on the 8th, it was general though not rapid on the 9th and 10th in Assam and North and East Bengal, and extended to the south-western districts between the 10th and 11th. Defect was greatest in North Bengal on the 11th. In South-West Bengal and Orissa there was excess throughout, smallest in the former on the 11th and in the latter on the 12th. The large defect in the Circars on the 13th was probably due to the disturbed weather which accompanied the formation of the depression off Orissa and the Circars.

TABLE V.

Giving the pressure change daily from July 7th to July 13th, 1903, arranged to show the westward movement of the disturbance.

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+·010″	−·026″	−·055″	+·068″	+·001″	−·071′	−·014″
North Bengal ...	+·014	−·027	−·082	+·062	+·015	−·043	−·046
Bihar ...	+·004	−·014	−·092	+·064	+·048	−·066	−·016
United Provinces	+·024	−·039	−·113	+·034	+·023	+·022	+·001
Punjab ...	−·004	−·050	−·145	+·030	+·014	−·010	+·126
Srinagar ...	+·035	?	−·101	−·019	+·008	0	+·004

TABLE VI.

Giving the pressure variation from the normal from July 7th to July 13th, 1903, arranged to show the westward movement of the disturbance.

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+·014″	−·011″	−·080″	−·014″	−·014″	−·076″	−·100″
North Bengal ...	+·025	+·008	−·078	−·019	+·001	−·042	−·084
Bihar ...	+·005	−·007	−·096	−·033	+·013	−·052	−·065
United Provinces	+·013	−·022	−·130	−·096	−·078	−·062	−·062
Punjab ...	+·029	−·017	−·118	−·123	−·112	−·126	−·027
Srinagar ...	+·111	?	−·039	−·016	−·013	+·080	+·104
Leh ...	+·078	?	?	?	+·031	−·018	−·023

The above tables show that the fall of pressure was general along the Himalayan range on the 8th and that it continued more rapidly on the 9th, that the rise was equally general on the 10th but that it proceeded more slowly in the north-west than in the north-east. It appears to have been owing to the slow recovery of pressure in North-West India and the consequent retarding of the northerly wind in the upper atmosphere, that the depression in the Arabian Sea appeared two days later than the one at the head of the Bay. The recovery in the Punjab is shown on the 13th and the delay appears to have been due to the formation of a slight depression over that area in much the same way as occurs with cold season storms.

TABLE VII.

Giving the temperature change daily from July 7th to July 13th, 1903, *arranged to show the westward movement of the disturbance.*

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+0·6°	+1·4°	−1·0°	−3·5°	−0·2°	+3·1°	+3·2°
North Bengal ...	+0·4	−1·0	−1·8	−0·5	−3·9	−0·6	+2·8
Bihar ...	+0·6	+0·4	+1·1	+0·9	−5·2	−2·5	+0·1
United Provinces	−3·1	+1·6	+2·3	+1·3	−3·7	−3·6	−7·3
Punjab ...	−1·1	−6·1	+2·8	+3·8	0	−6·1	−8·8
Srinagar ...	−1·6	?	+2·6	+1·3	+1·2	−2·5	−5·4

TABLE VIII.

Giving the temperature variation from the normal from July 7th to July 13th, 1903, *arranged to show the westward movement of the disturbance.*

	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	+ 1·8°	+0·9°	+ 1·0°	− 0·6°	− 3·2°	− 0·7°	+ 1·8°
North Bengal ...	+ 2·6	+1·2	− 0·6	− 1·1	− 5·2	− 1·2	+ 1·7
Bihar ...	+ 4·8	+6·4	+ 7·2	+ 8·0	+ 2·7	+ 0·1	− 0·3
United Provinces	+ 8·3	+9·9	+12·1	+13·6	+10·0	+ 6·2	− 1·1
Punjab ...	+ 5·3	+8·2	+12·1	+15·1	+15·2	+12·4	+ 2·8
Srinagar ...	− 5·7	?	− 0·6	+ 0·9	+ 3·4	− 0·9	−10·2
Leh ...	−12·2	?	?	?	− 5·4	− 4·0	− 3·9

These tables show very clearly the westward movement of the second stage of the disturbance, that is, of the stage where with the rising pressure the northerly or north-easterly winds commence in the upper atmosphere accompanied by general thunderstorms, rainfall, and low temperature. The greatest change in Assam is on the 10th, in North Bengal and Bihar on the 11th, and in the United Provinces between the 11th and 13th. In the United Provinces the mean difference from normal temperature changed from excess of 14° on the 10th to defect of 1° on the 13th, and in the Punjab from excess of 15° on the 11th to excess of 3° on the 13th. At Srinagar the fall was from excess of 3° on the 11th to defect of 10° on the 13th.

TABLE IX.

Rainfall (*July* 7*th to* 13*th*, 1903).

	No. of Stations.	July 7th	July 8th	July 9th	July 10th	July 11th	July 12th	July 13th
Assam ...	5	1·31	1·67	2·81	7·59	3·19	2·86	1·17
North Bengal ...	7	3·28	2·86	7·57	13·72	12·52	5·68	0·41
East Bengal ...	7	4·54	1·81	2·78	7·94	1·87	1·53	3·01
S.W. Bengal ...	9	0·10	2·78	0·74	0·96	10·48	*Nil.*	1·76
Bihar ...	13	0·14	0·79	0·42	1·18	6·92	3·00	5·45
United Provinces	12	0·23	0·15	*Nil.*	0·10	1·36	3·02	4·36
Punjab ...	6	0·05	*Nil.*	*Nil.*	*Nil.*	*Nil.*	0·09	0·55
Simla Hills ...	5	*Nil.*	*Nil.*	*Nil.*	*Nil.*	*Nil.*	0·36	5·23
Kashmir ...	6	0·09	?	?	*Nil.*	0·03	2·09	1·49
Darjeeling ...	...	1·29	0·66	0·32	0·42	0·80	0·02	*Nil.*
Cherrapoonjee ...	...	3·03	11·36	24·20	21·33	0·06	*Nil.*	*Nil.*
Orissa ...	4	0·02	*Nil.*	*Nil.*	*Nil.*	1·68	1·85	2·21
Circars ..	4	*Nil.*	3·25	1·74	*Nil.*	0·38	5·21	5·61

The rainfall in the above table has been prepared as in the previous paper referred to above. The figures give the total fall in each division or Province, and the number of stations is given in the first column. The average fall may be obtained by division. It may be seen that rainfall was increasing in Assam and North Bengal from about the 7th, that it was most heavy in those parts on the 9th and 10th, and that the increase in the west and south-west of Bengal is shown on the 11th. No rain fell on the Simla Hills until the 12th and the increase in Kashmir began on the same date.

As in the storms in 1902, strong southerly or south-westerly winds developed at Saugor Island, and generally over Northern India, showing a strong indraught towards a low pressure area in the north. The contention that no disturbance had formed over India or the adjacent seas previous to these changes in the Himalayan region is supported by the following quotation from the Indian Daily Weather Report of date July 9th, 1903. "An important change has taken place in the distribution of pressure and very steep gradients favouring strong south-westerly or westerly winds prevail over the greater part of Northern India. These winds are, however, up to the present, dry winds and are not an extension of monsoon winds from the Arabian Sea: hence no rain of any importance may be expected during the next 24 hours in North-West India, though local dust storms may occur in that area."

In the following table I have given the wind direction and strength at Saugor Island for the two periods of disturbed weather in 1902 and for the one under discussion, placed side by side for purpose of comparison. During the advance of these disturbances from the north there was almost the same wind direction and strength at Saugor Island on the three occasions. The direction was south-south-west almost continuously and there was a steady increase of velocity.

1902		Daily velocity in miles.	Wind direction at 8 A.M.	1902.		Daily velocity in miles.	Wind direction at 8 A.M.	1903.		Daily velocity in miles.	Wind direction at 8 A.M.
June	27	312	S.S.W.	August	8	360	S.W.	July	7	432	S.
	28	408	S.S.W.		9	504	S.S.W.		8	552	S.S.W.
	29	576	S.S.W.		10	768	S.		9	696	S.S.W.
	30	840	S.S.W.		11	394	W.S.W.		10	624	S.S.W.
July	1	360	W.S.W.		12	288	S.W.		11	408	S.S.E.
	2	456	S.W.		13	384	W.S.W.		12	168	E.
	3	384	S.W.		14	120	W.N.W.		13	216	E.N.E.

A point of interest which may be noticed in the table is in the wind changes during the days 12th to 14th August, 1902, and 11th to 13th

July, 1903. In the former case the wind turned to northerly through west and in the latter through east. The reason appears to be that the cyclonic storm which developed subsequently over the north of the Bay last year was a little more eastward than this year.

In the previous paper I gave some facts showing the passage of the disturbance on June 30th, 1902, over Bengal, and more detailed information for Calcutta partly from personal observation. On that occasion the disturbance began to affect weather at Calcutta about 5 A.M., and its progress was shown by the continued fall of temperature. The disturbance this year began about 5 P.M. and came on as last year with a rush of wind from the north accompanied by light rainfall, some thunder and a rapid fall of temperature. The fall of temperature was more rapid than last year, and was in the course of an hour from 92° at 5 P.M. to 78° at 6 P.M. This greater rapidity was partly due to the disturbance occurring at the end instead of the beginning of the day.

The barometer at Calcutta was only slightly affected and in much the same way as last year. The small irregularities began about 1 P.M. and a slightly more rapid rise than usual began about 5 P.M., followed by a fall which was completed about 7 P.M.

I have mentioned that since the commencement of the monsoon season there have been several of these disturbances. There were, I believe, between June 13th and July 23rd, no fewer than four, although, with the exception of the one for which tables have been given above, they were not of so well marked a character as to make them useful for establishing the occurrence of such disturbances. They possessed, however, more or less distinctly the characters of the storms which have been more fully described. These characters are—

(1) A fall of pressure along the Himalayan range, followed by a rise, both the fall and the subsequent rise being apparently unconnected with the pressure changes in progress on the plains of India, and having a southward progressive motion.

(2) An indraught from the plains towards the hills shown by strongish south-westerly winds in Northern India.

(3) Unsettled weather in the Himalayas and adjacent plains, with numerous thunderstorms and a rapid fall of temperature.

The last of these appears to be due to a strong northerly or north-easterly wind from Thibet, across the Himalayas into the upper atmosphere of the Indian plains.

It is not my intention to prove the existence of the smaller disturbances. It will be sufficient for my purpose if I mention approximately the dates of their occurrence, and these dates can be readily found from the rainfall at Cherrapoonjee. Owing, probably, to the indraught which these Central Asian storms cause up the Brahmaputra valley, there has been in all cases which I have examined, an increase, at times a very great increase of rainfall at Cherrapoonjee. I do not wish it to be understood that in the occurrence of such heavy rainfall there is proof of a disturbance in Central Asia, but when the rainfall cannot be accounted for by any changes proceeding over India, and the other characters of Himalayan storms can be traced, the rainfall affords a valuable item of evidence. I give in a table below the rainfall for June and July, from which it can be easily seen that there were, during that period, six occasions of increased rainfall, the most noticeable being the falls of 24 and 21 inches on the 9th and 10th July, with the storm I have described above. The other dates approximately were June 10th, June 16th, June 22nd, June 29th, and July 20th.

Rainfall at Cherrapoonjee.

June.	Inches.	June.	Inches.	July.	Inches.	July.	Inches.
1	2	17	10	1	2	17	0
2	0	18	6	2	1	18	0
3	0	19	2	3	4	19	2
4	1	20	2	4	3	20	4
5	0	21	3	5	2	21	2
6	0	22	8	6	1	22	2
7	0	23	1	7	3	23	0
8	0	24	0	8	11	24	3
9	7	25	0	9	24	25	2
10	4	26	1	10	21	26	0
11	5	27	8	11	0	27	1
12	0	28	8	12	0	28	0
13	3	29	19	13	0	29	1
14	5	30	0	14	1	30	3
15	8			15	0	31	0
16	7			16	0		

The occasions on which pressure fell along the Himalayan range were June 9th, June 17th, July 8th, July 18th.

The disturbances which passed along the Himalayas about the 9th and 17th June appear to have commenced in the north-west and advanced eastward, and they were probably followed by a north-westerly wind in the upper atmosphere. My reason for thinking that the upper wind was north-westerly during the latter part of June is based on the direction in which thunderstorms moved over Bengal during that period. In a paper read by me at the last meeting of the Society I stated that thunderstorms during the past hot season had been abnormal in several respects, the most noticeable being that instead of approaching from the usual north-westerly direction they had without exception come from the west. After the middle of June, thunderstorms continued but they no longer moved from the west. Instead they had become, so far as direction went, typical nor'westers.

A storm of a very exceptional kind began over Orissa in the early morning of the 11th June. It was of the thunderstorm type and moved southward along the coast, causing squally weather in the north of the Circars on the forenoon of that date and in the south in the afternoon. I mention it in this connection as showing the existence of a northerly wind in the upper atmosphere in that region.

After a period of continuous low pressure over Northern India from the 17th to the 22nd June, a general rise began along the hills and extended southward. This rise was probably accompanied by an increase of velocity in the upper northerly wind, as a depression which was beginning to form over the Bay, developed over the north-west angle, moved into Chota Nagpur, and then recurved into Bihar and north Bengal. The heavy rainfall at Cherrapoonjee between the 27th and 29th June was caused by this storm, and the recurving was probably due to the north-westerly wind aloft.

The next occasion of disturbed weather in the Himalayan region was between the 7th and 13th July, and that has been already discussed. The last disturbance began about the 17th July and was very little felt at the eastern end of the Himalayan range. The only indication is the falling pressure in Assam on the 17th and the indraught up the Brahmaputra valley. But in the centre and west of the range there were important developments. Thunderstorms with heavy rainfall and large changes of pressure occurred. This rainfall is very similar to the rainbursts which occurred in Bengal last year, and it is difficult to account for its occurrence by any series of changes then in progress in India. A cyclonic storm was shown in the Indian Daily Weather Report of the 18th, but, as stated under the heading of pressure in that report the depression moved westward. The slight to moderate deficiency of pressure in the United Provinces was not, as was quite natural under the circumstances, recognised as the commencement of the disturbance which was to cause the first heavy rain of the season in the United Provinces, or, as the disturbance developed, the floods in Kashmir. I note these matters to show how unsuspected the rainfall was, and that forms the strongest argument, in my opinion, in favour of the disturbance not being connected directly with the weather changes in progress at that time over India.

There only remains to point out a few of the more important features of the weather of the past few months as regards storms in the Bay of Bengal and monsoon conditions in Northern India. Throughout the hot season the northerly element in the upper wind was conspicuously absent in Lower Bengal, and whether or not by reason of that abnormal wind direction, not a single depression formed over the Bay up to the middle of June. Then a disturbance appeared over the Himalayas, weather became disturbed over Bengal, and when the final rise of pressure followed, a depression formed over the north-west of the Bay. That storm recurved to the north-east over the western districts of Bengal. Throughout June, rainfall was abundant in Bengal Proper and Assam, but not in the western districts.

The second stage began with the Himalayan storm of the 10th July. It may be remembered that in 1902 the Himalayan storm of August 11th was followed by a "remarkable series" of cyclonic storms which formed at intervals of a week. The first three of these moved westward and saved part of Western India from impending famine. The fourth moved northwards into Chota Nagpur and filled up there. Now this year, since the storm of July 10th, there has been an even more remarkable series of cyclonic storms. At regular intervals of five days four depressions of greater or less intensity have formed in the north-west angle. The dates of commencement of these depressions are July 12th, 17th, 22nd, and 27th. The first was the most severe, and although conditions appeared to be exceptionally favourable for its advance towards Western India it broke up and disappeared about the 15th. The second depression disappeared over Chota Nagpur and the adjacent part of Central India. The third which began in the north-west angle of the Bay on the 22nd moved rapidly westward, was a well-defined depression over the Central Provinces on the 24th, in the Central Indian Plateau on the 25th, and in the north-west dry area on the 26th.

The behaviour, therefore, of the third depression, was quite different from that of the second which filled up in the Chota Nagpur region. The cause of this change was probably the Himalayan storm of the 19th which was probably followed by a stronger north-easterly wind overhead. This upper north-easterly wind probably extended southwards over North-Western India and was, I believe, an important factor in maintaining the vitality of the disturbance during its passage westward. The fourth depression has been doubtful. Part of it appears to have moved westward, and part northward into Bengal.

The rainfall distribution in Northern India has been well-defined, and as in 1902 there has been an evident connection with the Himalayan storms. During June and the first week of July, that is up to the occurrence of the more decided Himalayan storm of July 10th, rainfall was almost entirely confined to Bengal and Assam. After that disturbance passed over Bengal and cyclonic storms began at the head of the Bay the character of the rainfall changed in Bengal. Only light scattered showers fell. On the other hand, rainfall became more general in Central India, and, after the Himalayan storm which began in the western half of the range about the 19th, rainfall became general in the extreme west.

The behaviour of the last depression of the series shows that the change produced by these Himalayan storms in Bengal is coming to an end, and while I write cloud is increasing and ordinary monsoon weather is becoming general over this Province.

It should be noticed how the west of Bihar appears to have been very little affected by either of the more important of the Himalayan storms. The one of the 10th July was probably confined more, as regards after-effects, to Bengal, and that of the 19th July to the northwest. The result has been that the west of Bihar and the adjacent part of the United Provinces have, during the three months ending with July, received less rain than they usually receive during June alone.

On the life-history of Arbela tetraonis, *Moore, a destructive Insect pest in Casuarina Plantations in Madras.—By* E. P. Stebbing.

[Received July 25th. Read August 5th, 1903.]

How little is really known about our Insect foes in India is becoming increasingly evident day by day. An insect suddenly swarms over an area in numbers owing to some particularly favourable conditions in its surroundings, it commits serious depredations in the fields, orchards, or forests of the tract it is invading, and owing to its being so very much *en évidence* or owing to the great damage it is committing specimens are collected and sent for identification to specialists. The odds are greatly in favour of its being new to science. Instances of this state of affairs are numerous, and it may be said that leaving out of account the butterflies and one or two other groups which have received attention it is easier to pick up a new species in many parts of the country than to collect one that is known. The insect about whose life-history, as far as it is at present known, I wish here to put on record a few notes furnishes an illustration of the aptness of the above remarks, since although rare in Collections and new to those of the Indian Museum its larva has been known for some years as a destructive bark eater in Casuarina plantations on the eastern seaboard of Madras. There may, however, be said to be some excuse for its having remained so long undiscovered since it belongs to a family of moths, closely allied to the *Cossidæ*, which have been little studied and the life histories of whose members are little known, the larvæ living mostly in the wood of trees. The moths are rarely seen and owing to the habits of the larva are difficult to find. The pupal stage and pupa of the English Goat-moth is known, and has been described; but very little is known as to other pupæ of the family. The description of the pupal stage of this insect given below is therefore of some interest.

In the Indian Museum we have but 4 genera and 11 species of the family *Cossidæ* from the Indian Region, the insects being *Cossus cadambe*, *Duomitus ceramicus*, *D. strix*, *D. lenconotus*, *D. mineus*, *Azygophleps asylas* (said to be S. African by Hampson in the Fauna), *A. pusilla*, *Zeuzera indica*, *Z. pyrina*, *Z. multistrigata, and Z. Coffeæ.* There are also two unnamed specimens one of which is an *Arbela* and closely allied to the insect under description. This latter specimen was obtained by the late

Mr. De Nicéville and is labelled Calcutta 1891. It is the only representative of the *Arbelidæ* in the Museum Collections. The genus *Arbela* has a fairly wide range, inhabiting, according to Hampson, Peninsular India, Ceylon, and Burma.

The species here described appears to infest most of the Casuarina plantations on the Madras Eastern Seaboard. Hampson records it only from Poona, Bombay, and Raipur.

Hampson gives the description of the genus as follows : Palpi minute, antenna bipectinated to tips in male, the branches short, simple in female. Mid and hind tibiæ slightly hairy with terminal pairs of spurs. Forewing with veins 7, 8, 9 stalked together. Hindwing with cell of normal length ; vein 6 given off below the angle ; vein connected with the subcostal nervure by an oblique bar near centre of cell.

Arbela tetraonis, Moore, P.Z.S., 1879, p. 411, pl. 34, fig. 3 ; C. & S., No. 1605 ; Hampson. F. Br. Ind. Moths I. 315, No. 675, (♀).

♂ Head and thorax covered with long silky brown hairs. Abdomen with long greyish hairs. Forewing greyish, thickly irrorated with dull-brown spots which tend to form transverse bands ; three large velvety-brown patches, one centrally, placed a little below the costa, a second near the base of the wing, and the third, the largest, a little beyond it.

Hindwing grey irrorated with a few ashy-coloured spots and a dark marginal band. Exp. 43 millim.

♀ Already described by Hampson.

Larva. Head black with a few longish yellowish-white hairs on it. Following three segments, which each bear a pair of long legs, yellowish, this colour merging into pink on the third. These three segments are swollen and larger than the head. The following segments are flesh-coloured except the last which is yellowish. Five pairs of short sucker legs are present, one pair each on the 6th to 9th and a pair on the last segment. A few long scattered whitish hairs on each of the segments. These nine segments are narower than the first three and taper off slightly behind so that the 12th segment has only about the diameter of the 4th. Length ½″. Width of thoracic segments 3-16ths inch.

Pupa. Very shining, yellowish-brown merging into black at anterior end. Circular in section and of uniform thickness throughout except for a slight swelling at thoracic end, which is furnished at the top with two small spiny spikes ; the last segment tapers bluntly. Wing covers short, shining yellowish-brown posteriorly merging into black above. Abdominal segments visible, 7 to 8 dorsally, 5 ventrally. The last 5 bear transverse circular rows of fine saw-like closely set black teeth upon them, the first three segments having a double row placed slightly apart near the centre whilst the last two have but one encircling band situated near the centre. The last segment is blunt at its posterior extremity where it is furnished with a circle of irregularly sized black spines. The two segments visible dorsally immediately anterior to the first of those bearing the double encircling girdle of teeth have each a single row of closely set curved teeth placed near their anterior margins which end on either side at the wing covers Long. 21 to 28 millim.

As we shall see later the presence of these spines is absolutely essential to the pupa since by their means it is able to make its way from the heart of the tree where the larva pupates to the outside in order to provide for the escape of the moth.

The appearance of the moth on the wing is evidently very variable. In the Godaveri district a report states that the insect issued as early as March. A specimen taken in 1901 and preserved for transmission to me got damaged and so was not sent, but I have little doubt from the descriptions given that the insect was the *Arbela*. In Ganjam on the other hand a specimen was bred from a pupa by Mr. C. E. C. Fischer, of the Imperial Forest Service, as late as the 3rd July of the present year. The specimen so bred is the only one that has been yet recorded from the Casuarina Plantations of Madras, and should the one in the Indian Museum taken by Mr. De Nicéville in 1891 prove a different species, it forms the only record of the species that I am aware of in India. When I state that I have seen probably several dozen empty pupal cases upon the trunks of the trees in one small plantation alone, it will be obvious that although in its particular locality so plentiful it is not often taken.

From Cuddalore nearly mature pupæ were sent to me on June 1st. It would thus appear that the moth is to be found on the wing between March and beginning of July. I could find none in a plantation at Chatrapur (Ganjam) between the 9th and 13th July, 1903, although I noted numbers of the empty pupal cases on the Casuarina trees.

Since the moths of this family are unprovided with a proboscis and consequently take no food at this stage of their lives they probably lay eggs soon after emerging. The eggs are deposited upon the bark of the trees. We do not yet know what period elapses before they hatch out. Ganjam being situated in the N.-E. corner of the Presidency gets the S.-W. Monsoon which bursts about the middle of July and consequently the eggs would probably not hatch out until September or October, after the worst of the rains are over. Further south, however, where this monsoon is not felt and the rain is not received until October and November they may hatch out earlier. The at present recorded months in which larvæ have been obtained are January and March in Chatrapur (with pupa in June and a moth on 3rd July); December in North Arcot (with pupa in June); the same month in Godaveri (with pupa and moth in March); full-grown caterpillars and almost mature pupæ in Cuddalore on June 1st and what appear to be nearly mature larvæ in Nellore also in June.

We have yet to ascertain the period spent by the larvae in this stage of its existence. In some instances in the case of allied families two to three years are passed in this stage. So little is known about the larvæ of this and the *Cossidae* that only the caterpillars of *Duomitus niger* (the 'black borer' of coffee planters) and *Zeuzera coffeæ* (the white borer of coffee planters), are described in the Fauna and no larvæ of the *Arbelidæ*. They are considered to spend nearly, if not over, a year in the larval stage. In the case under consideration I am of opinion that the larva spends less than a year in the grub stage, and the difference may be due to the fact that whilst the former two feed on wood the latter confines itself until full-grown to a bark diet. Whatever the period may be however which the larvæ passes in its grub stage the greater portion of it is spent upon the bark of the tree and not inside the wood.

I have said that the eggs are laid upon the bark, and they may be so deposited in patches, and if so the young larvæ may be gregarious for a time after hatching out. This is to some extent borne out by the fact that the thinner bark of the trees is seen to be eaten off in patches. If they are however gregarious at first this condition would not appear to last long since the greater part of the larval life is spent in a solitary state, and at this period the grub constructs for itself a covered-way gallery resembling a glorified termite gallery running up the outside of the bark. This covered way is formed of particles of its excreta bound together with a fine silk. Externally the appearance is simply that of a mass of excrementous particles. These covered ways curl round or run up or down the stem of the tree and are very conspicuous, being from one-third to one-half inch in breadth externally and from nine inches to as much as eighteen inches in length. They are reddish-brown to, in parts, black in colour and form raised galleries on the surface. Sometimes the gallery completely encircles the stem, the tree being then ringed; at others it is taken in a spiral manner up or down the tree. The covered ways have a more or less uniform width throughout their length and from their appearance the larva would seem to add to them at the sides so that the internal chamber remains uniform in width throughout its length. Generally only two to three of these galleries are to be found upon any one tree and then generally far apart, and it would therefore appear probable that if a considerable number of eggs are laid together in a patch there must be a high mortality amongst the young larvæ. The foliage of the Casuarina is very thin and open and a caterpillar feeding in the open on the bark would be very visible to bird and other depredators. It is, therefore, within the bounds of probability that the caterpillars suffer heavily in this manner in early life and that the grub has developed the habit of living in a protective tunnel to safeguard itself from these attacks. During the whole period it spends upon the trunk of the tree the larva feeds upon the bark eating this latter away either in thin irregular-shaped patches in places adjacent to its covered gallery or gnawing it right through down to the wood below under the shelter given it by the covered way itself. In this way the tree is at times very nearly girdled, and if a number of larvæ are working close together the result is probably the death of the tree. Some trees seemed to be more preferred than others, several moths resorting to them to oviposit. In such cases it often happens that one or more of the covered ways made by the larvæ developing from the eggs meet at a kind of junction and a large mass of excrement and silk forms a great bulge on the tree from which, if the moths have flown, several empty pupal cases may be seen protruding quite close to one another. When full fed the larvæ returns down its covered way until it has reached to about the centre and then bores horizontally into the tree, going deep to the centre of the heart wood. This tunnel is kept quite clean all the wood particles being ejected from it. When it has arrived there after making a tunnel which may be as long as six or more inches though in smaller trees it is considerably less, it slightly enlarges the chamber, turns round in it and pupates. This tunnel in the wood is only bored by the larva for pupating purposes. It does not ramify about in the wood as would be the case if the grub were feeding in the wood.

From the periods at which both larvæ pupæ and moths have been found it is probable that the time passed as a pupa is short, probably a month at most. When the moth is nearly ready to emerge the pupa projects itself along the tunnel by wriggling forward with the help of the rows of spines with which its outer covering is garnished. On reaching the end of the tunnel it forces its way through the covered way from the outer surface of which it projects for about one-fourth of its length. The case then splits down anteriorly and the moth crawls out. These empty pupal cases found projecting in this manner from the covered ways enable a period to be roughly fixed for the term of pupation. Under the action of the monsoon rain they soon get soaked and sodden and fall off the tree, and it is thus certain that but a few weeks are passed by the insect in this quiescent stage of its existence.

The points which still remain uncertain are the exact length of time spent as a feeding larvæ, the number of eggs laid, and the time spent before they hatch out.

In addition to the scientific instinct which attaches to the taking of this insect and to the study of its life-history both, owing to the little known about the habits of the family, of some importance there is another aspect, the economic one, which is equally deserving of attention. The Casuarina has been planted, and is being planted, in Madras with two objects in view; the one, to protect the cultivated lands or towns and villages, roads, &c., from the encroachments of moving sand dunes, and secondly, to provide timber and fuel for the inhabitants in areas where the only other tree growth is palm trees. The action of the larvæ of this moth by which trees are often killed off and plantations or portion of them ruined is therefore of some importance.

INDEX.

Names of New Genera and Species have an asterisk (*) prefixed.

NOTE ON THE PUBLICATIONS

OF THE

ASIATIC SOCIETY.

The *Proceedings* of the Asiatic Society are issued ten times a year as soon as possible after the General Meetings which are held on the first Wednesday in every month in the year, except September and October; they contain an account of the meeting with some of the papers read at it, while only titles or short resumés of the other papers, which are to be subsequently published in the *Journal*, are given.

The *Journal* consists of three entirely distinct and separate volumes: Part I, containing papers relating to Philology, Antiquities, etc.; Part II containing papers relating to Physical Science; and Part III devoted to Anthropology, Ethnology, etc.

Each Part is issued in four or five numbers, and the whole form three complete volumes corresponding to the year of publication.

The *Journal* of the Asiatic Society was commenced in the year 1832 previous to which the papers read before the Society were published in a quarto periodical, entitled Asiatic Researches, of which twenty volumes were issued between the years 1788 and 1839.

The *Journal* was published regularly, one volume corresponding to each year from 1832 to 1864; in that year the division into two parts above mentioned was made, and since that date two volumes have been issued regularly every year. From 1894 an additional volume, Part III has been issued.

The *Proceedings* up to the year 1864 were bound up with the *Journal*, but since that date have been separately issued every year.

The following is a list of the Asiatic Society's publications relating to Physical Science, still in print, which can be obtained at the Society's House, No. 57, Park Street, Calcutta, or from the Society's Agents in London, Messrs. Luzac & Co., 46, Great Russell Street, W. C.; and from Mr. Otto Harrassowitz, Leipzig, Germany:—

ASIATIC RESEARCHES. Vols. VII, Vols. XI and XVII, and Vols. XIX and XX @ 10/ each ... ... Rs. 50 0

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JOURNAL of the Asiatic Society for 1843 (12), 1844 (12), 1845 (12), 1846 (5), 1847 (12), 1848 (12), 1850 (7), 1851 (7), 1857 (6)

1858 (5), 1861 (4), 1862 (5), 1864 (5), 1866 (7), 1867 (6), 1868 (6), 1869 (8), 1870 (8), 1871 (7), 1872 (8), 1873 (8), 1874 (8), 1875 (7), 1876 (7), 1877 (8), 1878 (8), 1879 (7), 1880 (8), 1881 (7), 1882 (6), 1883 (5), 1884 (6), 1885 (6), 1886 (8), 1887 (7), 1888 (7), 1889 (10), 1890 (9 and 2 Supplts.), 1891 (7), 1892 (7 and Supplt.), 1893 (11), 1894 (8), 1895 (7), 1896 (8), 1897 (8), 1898 (8), 1899 (7), 1900 (7), 1901 (7), 1902 (9) @ 1/8 per No. to Members and @ 2/ per No. to Non-Members.

N.B.—The figures enclosed in brackets give the number of Nos. in each Volume.

Centenary Review of the Researches of the Society from 1784 to 1883	3	0
Theobald's Catalogue of Reptiles in the Museum of the Asiatic Society (Extra No. J.A.S.B., 1868)	2	0
Catalogue of the Mammals and Birds of Burmah, by E. Blyth (Extra No., J.A.S.B., 1875)	4	0
Catalogue of Fossil Vertebrata	4	0
Catalogue of the Library of the Asiatic Society, Bengal ...	3	8
Moore and Hewitson's Descriptions of New Indian Lepidoptera, Parts I–III, with 8 coloured Plates, 4to. @ 6/ each ...	18	0