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H. F. MACMILLAN

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TROPICAL GARDENING AND PLANTING



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See Chapter XI.

TROPICAL GARDENING AND PLANTING

WITH SPECIAL REFERENCE TO CEYLON



BY

H. F. MACMILLAN, F.L.S.

(Superintendent, Royal Botanic Gardens, Ceylon).

AUTHOR OF "ILLUSTRATED GUIDE TO THE ROYAL BOTANIC GARDENS, PERADENIYA," ETC.

THIRD EDITION

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ZOOLOGICAL GARDENS
CALCUTTA.

FOREWORD.

Within recent years, very considerable developments have been made in the agriculture and horticulture of the tropics and sub-tropics, and markedly progressive changes have taken place. In the tropics, one has seen a very material increase in the prosperity of its peoples and, with improved health conditions, the establishment of a large number of homes by colonists from temperate climes.

This development has consequently resulted in a demand for such a Handbook as that prepared by Mr. H. F. Macmillan at Peradeniya, Ceylon, which for many years has been recognised as a standard work that could be recommended with confidence. Ceylon has always been a pioneer in tropical agriculture and many of its methods are amongst the best. Its Botanic as well as its private gardens have always been its pride and several of those surrounding estate bungalows are noted for their attractive charm.

Macmillan's Handbook has now been out of print for some years, and there is certain to be a considerable demand for the present completely revised edition. Many sections have been entirely rewritten and a large number of new illustrations, specially prepared by the author, are included. I am confident that the new edition will be appreciated by those who take an interest in the agriculture and horticulture of the Tropics.

F. A. Stockdale.
Director of Agriculture, Ceylon.

ABBREVIATIONS.

$. =illustrated.
S. (*italic*) =Sinhalese, used after names.
T. (*italic*) =Tamil, " " "
Mal. =Malay, " " "
Nat. =naturalised.
Prop. =propagation.
(Lay.) =layers or layering.
(C.) =cuttings.
(S.) =seeds.
(Off.) =offsets.
(Tu.) =tubers or bulbs.
(Su.) =suckers.

(Rhiz.) =rhizome.
Var. or var's. =variety or varieties.
Hort. =of horticultural or garden origin, as a variety or sport.
Fl's. =flowers.
Fol. =foliage.
Sh. =shrub.
T. =tree.
Cl. =climber.
Ep. =epiphyte.
Hp. =herbaceous perennial.
A. =annual.

PREFACE TO FIRST EDITION

The need for a practical work of this nature, especially adapted for the Tropics, has apparently been long felt, judging by the demand for information on the subjects treated in this handbook. Of books on horticulture in temperate countries, there is no end, but they are generally of little guidance in tropical regions, where the conditions of climate, labour and methods of working are so different. A writer in the *Ceylon Observer* recently remarked : " How much more attractive and interesting our bungalow gardens and compounds might be made if the right sort of information regarding their care were available. Too often they are left entirely to the garden cooly, who has no pretensions to any knowledge of gardening, and things which grow do so more by luck than by good management." The aim of the author has been, therefore, to supply as concisely as possible and in a manner to suit the practical man in the field or garden, the kind of information which is most generally sought for, not only on horticultural matters, but also on general planting or agricultural subjects.

In practice there is no sharp line of distinction between Planting or tropical farming and Horticulture, the main principles underlying both being the same. " Agriculture in the tropics," said SIR WILLIAM THISELTON DYER, late Director of Kew Gardens, "is essentially extended gardening ; it has little relation to the agriculture of temperate countries, and its methods are those of horticulture. " According to LIEBIG, " perfect agriculture is the foundation of all trade and industry, the foundation of the riches of state." " Scientific horticulture," said DR. BAILEY, " joins hands with the plant biologists on the one hand, and with commerce on the other."

Gardening or horticulture is obviously advancing in Ceylon, as in other tropical countries, and it is being recognised that it plays an important part in home attraction as well as in urban and rural improvement. Nowadays many planters, mercantile and professional men manifest a keen interest in their gardens, and in some cases become expert in the cultivation of certain classes of plants which claim their special attention. Superintendents of estates or plantations in lonely districts claim that the presence of choice flowering plants or trees about their bungalows has an exhilarating influence, and when these are absent it is usually due not so much to indifference on the part of the planter as to circumstances over which he has no control. In Rubber districts especially, the depressing effect of long monotonous

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stretches of sombre-looking rubber trees is well-known, and recently several companies have shown a desire to have attractive flowering trees (as urged by the writer in a recent paper) planted around the bungalows of their superintendents.

For ladies, gardening has special attractions; the cultivation and arrangement of flowers is not only especially appropriate to them, but they are also frequently successful competitors with men in the art.

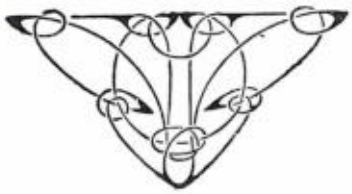
I leave it in the hands of readers to judge of the merits of this work, if it has any. The general arrangement of the plants or crops, useful or ornamental, into sections according to the elevation and purpose for which they are especially suited will, I trust, be appreciated. The planting products in Chapters XXII and XXIII are considered in accordance with their importance in Ceylon. Though a botanical arrangement has been avoided in preference to an economic or practical one, the botanical name and Natural Order or family of each plant or product mentioned throughout the book are invariably given. Most people nowadays know the meaning of plant affinity, and to these a knowledge of a plant's scientific name and family often conveys some idea as to its general character or utility. The common or vernacular names, when sufficiently popular or well-known, are given in English, Sinhalese and Tamil, also in some cases in Hindustani and Malay.

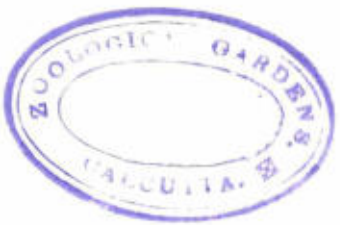
My thanks are due to several gentlemen as well as ladies who have kindly supplied me with valuable suggestions and information. HER EXCELLENCY LADY BLAKE has favoured me with useful notes on various ornamental plants in China, and MRS. WESTLAND and other ladies have contributed useful recipes for jams, jellies, preserves, etc. I am especially indebted to MR. E. E. GREEN, F.E.S., F.Z.S., Government Entomologist, and to MR. T. PETCH, B.A., B.SC., Government Mycologist, who obligingly furnished me with much of the information in the chapters on *Insect Pests* and *Fungus Diseases* respectively; to DR R. H. LOCK, M.A., SC.D., Assistant Director, Royal Botanic Gardens, for useful guidance; to MR. M. KELWAY BAMBER, M.R.A.C., F.I.C., Government Chemist, who has read, and contributed to, the chapters on *Soils* and *Manures*; to MR. J. K. NOCK, Curator of Hakgala Gardens, for useful information on Up-country fruits, vegetables, etc.; to MR. C. DRIEBERG, B.A., F.H.A.S., Secretary of the "Ceylon Agricultural Society" and Superintendent of School Gardens, who has written the Calendar for the Low-country and given many useful suggestions; and to the Hon. the Principal Collector of Customs, Colombo, who has courteously obliged me with statistics of exports. Finally I desire to acknowledge the constant courtesy of MESSRS. H. W. CAVE. & Co., the printers, whose work I think speaks for itself.

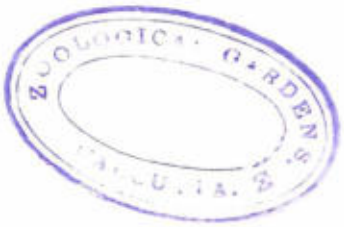
For the loan of several excellent half-tone and electro blocks, I have to thank *The Agricultural Economist & Horticultural Review*, *The Gardener's Chronicle*, *The Ceylon Agricultural Society*; also MESSRS. WALKER, SONS & Co., and MESSRS. BROWN & Co. My thanks are likewise due to MR. H. W. CAVE, M.A., and MR. T. PETCH for permission to use certain photographs. With the exception of these, the photographs for all the illustrations have been taken by myself.

Among useful works of reference which I have consulted, I would especially mention the following :—WATTS' *Dictionary of Economic Products of India*, CAMERON'S revised edition of *Firminger's Manual of Gardening for India*, WOODROW'S *Gardening in India*, NICHOLL'S *Tropical Agriculture*, MUKERJI'S *Indian Agriculture*, HALDANE'S *Sub-tropical Cultivations and Climates*, NICHOLSON'S *Encyclopædia of Gardening*, *The Soil* by A. D. HALL, *Fertilisers and Manures* by A. D. HALL, BAILEY'S *Pruning Book*, MAXWELL-LEFROY'S *Indian Insect Pests*, SORAUR'S *Physiology of Plants*, WILLIS' *Flowering Plants and Ferns*, TRIMEN'S *Flora of Ceylon*, WRIGHT'S *Hevea brasiliensis*, and Lock's *Rubber and Rubber Planting*.

H.F.M.







PREFACE TO SECOND EDITION

The rapid exhaustion of the first edition has given the author an opportunity of enlarging and fully revising this work, which is now considerably increased in size. Some of the chapters have been entirely re-written and extended, and several new features have been added, including the following : Use of explosives in agriculture; Intercrops and catch-crops; Sericulture; Lac-culture; Selections of trees, plants, etc., for cemeteries or memorial purposes; Selections of Ceylon indigenous plants; Poisonous plants; Sacred trees; Remarkable or curious seeds and fruits ; Insectivorous, fly-catching, and myrmecophilous plants. The illustrations also have been almost doubled in number.

I have to express my indebtedness especially to MESSRS. JOHN PARKIN, M.A., N. C. ROLT, and C. DRIEBERG, B.A., for valuable assistance and suggestions ; also to MESSRS. R. N. LYNE, Director of Agriculture, Ceylon, for kind encouragement ; C. H. KNOWLES, B.SC., Superintendent of Agriculture, Fiji ; GEO BRYCE, B.SC. ; and J. W. IRWIN, of Coorg, for a photograph of coffee cultivation. For the loan of some excellent blocks, I have to thank MESSRS. SUTTON & SONS, Reading ; RYDER & SONS, St Albans ; BROWN & Co., and WALKER SONS & Co. LTD., Colombo.

H.F.M.

Royal Botanic Gardens,
Peradeniya,
May 12th, 1914

PREFACE TO THIRD EDITION

The second edition, published just after the outbreak of the Great War, was, like its predecessor, sold out much more rapidly than the author anticipated, and the delay in bringing out a third edition has been due partly to conditions caused by the war, such as the dearness of printing, &c. It has also been largely due to a disaster which befell my collection of negatives, owing to termites, the curse of the tropics, whilst I was out of the country. The numerous correspondents who have booked copies long in advance and patiently waited will, I trust, accept this as my apology for the untoward delay.

The present edition has been re-arranged and mostly re-written and brought as far as practicable up to date. This has necessitated the addition of five new chapters, there being now 37 chapters in all, which, for the convenience of readers, are divided into five main *Sections*. In order further to facilitate reference, free use has been made both in the text and index of a system of cross-references, whilst each plant illustrated is indicated in the text by the mark $, and in the index by heavy type. The index, which has been considerably enlarged, includes common or popular names as well as Sinhalese and Tamil names, &c., and contains over 20,000 references. An effort has been made to make the illustrations a special feature of the work, it being recognised that the instructive value of pictures, especially in a work of this nature, is incalculable. Therefore the illustrations, now some 400 in all, have been largely increased in number, and those which appeared in the last edition have been improved or replaced with others.

The three coloured blocks, illustrating three of the most beautiful trees of the tropics, the plan of a modern garden with bungalow, and the addition of a glossary of terms are also new features which I trust will be appreciated, whilst the chapters on "Recipes for Jams, preserves, &c.," "Scents and perfumes," "Verandah gardening," &c., will, I hope, appeal especially to ladies. In the economic or "planting" section, an effort has been made to give approximately the present market value of the different products, as "essential" and "fixed" oils, "vegetable drugs," "dyes," "tans," &c.

The arrangement of the matter, it will be noted, is primarily according to the purposes which the different trees or plants serve, and secondarily, with reference to the elevation, &c., to which certain species are especially suited. The botanical names and Natural Orders are given

throughout, the latter, apart from botanical considerations, being sometimes an indication of the economic or ornamental character of plants. The same plant or tree may therefore be found under several different headings. Thus a *Flowering tree* may also deserve to be included under the headings of *Foliage*, *Timber*, and *Shade trees*, and if its seeds yield a useful oil or its bark a fibre, it may also be found under *Oils* and *Fibres*. The Poppy, for example, will be found under *Flowering Annuals* (for high elevations or sub-tropical conditions), and also under the heads of *Drugs* and *Oil-seeds*. The advantage of this arrangement is that the reader, whether a specialist or an amateur, may at once look under the different headings for the information desired, without referring to the different pages given in the index.

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Royal Botanic Gardens, Peradeniya.
February 6th, 1925.

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Coloured Plate p. 91 for Flamboyant *read* Flamboyante.
Page 141, for Jussiaea *read* Jussieua.
Page 163, for Actinorrhytis, *read* Actinorhytis.
Page 190, line 11, for Swainsona, *read* Swainsonia.

ZOOLOGICAL GARDENS
CALCUTTA.

Tropical Gardening & Planting

CHAPTER I.

CLIMATE AND SOILS

Climate. Climate is the principal factor which controls the growth of plants, and constitutes the conditions which render a country suitable for the abode of man and animals. One of the first questions the planter or gardener in the tropics has to consider is whether the climate is suitable for the cultivation he intends to take up. Climate mainly depends upon latitude and altitude; it is usually hottest at the equator at sea-level, and coldest the further away from it and the higher above sea-level. It is also, however, materially affected by the distance from the sea, form and slope of the land surface, nature of the soil and its vegetation, and by other circumstances. The influence of altitude is specially noticeable in the tropics, the temperature becoming appreciably cooler as one ascends the hills. Thus, whilst at Colombo it is hot and tropical, at Nuwara Eliya, 6,000 feet above the level of the sea, it is cool and fairly temperate. For about every 300 feet of elevation there is a reduction of about one degree in the temperature, and it is estimated that for about every 270 feet elevation the effect on the temperature is equivalent to receding a degree from the equator. Thus, Kandy being about 1,500 feet above sea-level, its average shade temperature is about 5 degrees cooler than that of Colombo. At Nuwara Eliya the difference is even more marked, so that if Pidurutalagala, the highest mountain (8,296 ft.) in Ceylon, were some 8,000 ft. higher still, it would probably be covered with perpetual snow. The cooler climate of the hills not only renders possible the cultivation of certain plants or crops peculiar to temperate regions, but also affords residents and visitors a very grateful substitute for the more bracing climate of a temperate country. The flat northern and eastern portions of Ceylon are characterized by a dry arid climate, to which typical forms of thorny vegetation or scrub are indigenous. Here, however, certain plants and crops may thrive better than in the wet zone, being specially adapted (*xerophytic*) to the arid climate, as, for example, the Palmyra palm, which in the dry zone luxuriates and forms a valuable product.

In Ceylon there thus occur four distinct types of climatic zones, viz :— (1) *hot and moist zone*, from sea-level to about 1,000 feet elevation, with a well distributed rainfall of 70 to 120 or more inches, and a mean shade temperature of about 80° Fah.; this is confined to the south-western part of the island ; (2) *hot and dry zone*, formed by the flat country of the northern and eastern parts of the island, with a rainfall confined to only a few months of the year ; (3) *intermediate zone*, from 1,000 to 4,000 feet alt., with a rainfall of 80 to 130 or more inches ; (4) *montane* or *cool zone*, from about 4,000 feet to the highest altitude (8,296 feet), with an evenly distributed rainfall of 85 to 150 or more inches.

During the months of January and February, cool night temperatures are usually experienced in the low-country; thus at Colombo a night temperature of 65° F., and at Kandy of 50° F. has been recorded ; whilst at Nuwara Eliya a slight frost frequently occurs in the period named. Such a diversified climate allows of the cultivation of a large variety of plants or crops from different latitudes. Consequently there may be seen in Ceylon and similar countries a considerable number of acclimatized plants from other countries, many having become naturalised.

Seasons. The line is faint that divides the seasons in the tropics. No period of the year is entirely without flowers or fruit, some species producing both at all or various periods of the year. In Ceylon, for example, the uniform moist climate of the south-western districts is only varied by a period of comparatively short rainfall between January and March, *i.e.*, the "dry season." No "cold season" occurs here as in India, though during the dry season named, as well as in the hotter months (March to May), most people prefer to adjourn to the more bracing air of the hills, which is then dry and crisp. These changes are brought about by the two annually recurring monsoons, viz., the *south-west monsoon*, commencing at the end of May and lasting till October, and the *north-east monsoon*, occurring from October to May. The rainfall of the former is more or less confined to the south-west of the Island, while the eastern side of the country receives its most copious rain from the north-east monsoon, chiefly in November and December, its driest season being from June to September. In the northern and eastern parts of Ceylon, the rainy season is mostly confined to the three months of October to December, very little rain falling from April to September. The hottest period of the year, all over Ceylon, is from March to May.

LOCAL INFLUENCES ON CLIMATE.

Forests constitute one of the most important conditions affecting climate. Their presence prevents erosion of the soil, retards the evaporation of moisture, enables the soil to retain a large proportion of rain water, and tempers the atmosphere both by cool vapours from the soil and by preventing the sun's rays from reaching the earth. It is sometimes claimed that forests indirectly also cause precipitation of the clouds, resulting in more frequent showers but reducing the number of torrential rains. When forests are cleared away, radiation from the land is increased, the soil is less retentive of moisture, and the air, as well as the

soil, becomes drier and warmer. A similar result occurs when swampy and marshy land is drained and brought under cultivation. The climate of islands and maritime districts is usually more equable than that in the interior of continents, the atmosphere in the former being frequently loaded with clouds and vapours. Lakes, marshes and rivers have usually an unfavourable effect on climate, as they give rise to fogs, especially at night, which chill the ground and render the vicinity unhealthy.

Aspect has an important influence on climate, a northern or eastern being, as a rule, cooler and moister than a southern or western aspect. In a north verandah, for example, plants which require a cool temperature thrive better than in a verandah facing south; in the southern hemisphere the reverse is the case. In a mountainous country, aspect is, of course, often affected by the lie of the land, and ridges, alternating with valleys or ravines, often cause an appreciable difference in the climate of places relatively near to each other. Similarly in a narrow valley, while one side, being partially shaded, may be cool and damp, the other side may be warm and dry; so that plant-life would differ materially on either slope.

Wind-breaks. Climatic conditions may be improved locally by the planting of suitable shade and wind-break trees, for these not only break the force of the winds, but also tend to lessen the excessive evaporation of moisture, and temper the sun's rays. Exposed and windy situations have a different climate from sheltered places, although the soil, rainfall, and aspect may be approximately the same. Wind-breaks may therefore be said to be as essential to many plantations as a breakwater is to an open harbour.

Soil Formation. Climate is also affected by the nature of the soil, there being greater radiation of heat from sandy than from clay soils; thus districts with sandy soils invariably have the highest air temperatures. This largely accounts for the intense heat in parts of Egypt, Bengal, Arabia, etc., during certain seasons of the year.

Irrigation, it is admitted, has a marked beneficial effect on climate; thus the enormous lake-like dams or reservoirs, like that at Assouan in Egypt for accumulating the Nile waters, and others in India and Ceylon, must have an important influence in cooling the surrounding atmosphere. See p. 31.

Table Showing Elevation, Average Rainfall, and Mean Temperature

at the Principal Towns or Stations in Ceylon.

Station.	Elevation in feet.	Average Inches.	Rainfall Days.	Average Mean Temp. in Fahr. degrees.
Agrapatana, (Holmwood Estate).	5,240	104	200	60
Anuradhapura	.. 295	55	105	81
Avisawella	.. 105	153	174	—
Bandarawela	.. 4,036	71	135	67
Badulla	.. 2,225	72	133	73
Batticaloa	Sea-level	63	104	81
Bogawantalawa, (Campion Estate).	4,500	98	209	65
Chilaw	Sea-level	49	111	81
Colombo	.. „	79	180	80
Deltota, (Pattiyagama).	.. 3,500	106	165	70
Galle	Sea-level	90	196	80
Gampola, (Mariawatte Estate).	.. 1,600	106	183	—
Hakgala Gardens	.. 5,581	93	209	60
Hambantota	.. 50	38	95	80
Haputale	.. 4,800	82	151	—
Hatton	.. 4,143	144	222	69
Henaratgoda. (Gampaha).	.. 33	100	145	—
Jaffna	Sea-level	49	74	81
Kalutara	.. „	100	162	—
Kandy	.. 1,654	83	193	76
Kegalla, (Jail)	Sea-level	105	193	—
Kegalla, (Ambanpitiya 3 miles west of)	.. 729	107	160	79
Kurunegala	.. 381	80	162	80
Mannar	Sea-level	38	68	82
Matara, (Hospital).	.. „	70	174	80
Matale	.. 1,208	79	143	76
Nawalapitiya, (Kenilworth).	.. 2,500	205	220	70
Negombo	Sea-level	69	109	81
Nuwara Eliya	.. 6,188	92	203	59
Peradeniya Gardens	.. 1,540	88	161	75
Puttalam	Sea-level	44	83	80
Ratnapura	.. 84	150	223	80
Trincomalee	.. 110	63	106	82
Welimada	.. 3,300	54	123	67

SOILS

Soils are formed by the gradual decomposition or wearing away of rocks, under the influence of weather, glacial or volcanic action, assisted by the presence of plant-life. Variations of temperature also have an important effect on the formation of soils, for rocks expand with heat and contract with cold. Thus in hot tropical sunshine, the surfaces of the rocks expand and are again contracted by the cool air of the nights ; this causes them to crack, and particles crumble off, thereby giving rise to a small but constant addition to the soil. Plant-life assists in the formation of soils in two ways, *i.e.*, mechanically and chemically. The roots enter crevices of rocks, and, by their gradual increase in bulk, act like wedges in forcing the two sides apart; the force thus exerted, even by the roots of very small plants, is considerable, being sometimes sufficient to break through concrete or lift stone pavements. Roots have also, by means of their acid sap, a solvent action on rocks and thus assist in their decomposition. Vegetation further contributes to the formation of soil by depositing dead leaves and stems on the surface in the form of humus, to the presence of which is largely due the black colour of garden soils.

Other important factors in the formation of soils are rivers and streams, the sea, and, in some cases, wind. Rivers grind down rocks and stones, and carry particles of rock or gravel to the plains or valleys, depositing them in the form of mud ; this is known as *alluvial soil*, which is usually rich in plant-food. The wind occasionally adds fertile matter to soils by carrying sand, dust, straw, leaves, etc., and depositing them in hollows.

All soils may be classed as either (1) *transported*, when they are carried from a distance, as by any of the agencies named above ; or (2) *sedentary*, *local*, or *indigenous*, when they remain where formed. To the latter belong the greater portion of Ceylon soils. In some cases the surface soil is transported, while the sub-soil is sedentary, or *vice versa*. Transported deposits, as alluvial soils, are, as stated above, usually characterized by greater fertility than those of a sedentary nature.

CONSTITUENTS OF SOILS.

The five main substances of which all soils may be said to be composed are : sand, clay, lime, vegetable matter or humus, and stones.

Sand is principally composed of quartz, flint, or silica. It imparts a loose porous consistency to the soil, assists air and water in finding their way through the land, and aids the roots of plants in their efforts to penetrate in all directions. In agricultural and horticultural practices, sand is frequently added to the soil to render it porous and "sweet," as in potting composts. See *Manures*, pp. 20, 24.

Clay is composed of two chemical bodies, known as silica and alumina, in combination with water. When wet, it is sticky and plastic ; but when burnt, as was formerly done in the cultivation of stiff soils, it loses its plastic property and becomes brittle. *Liming* also has this effect on clay soil, depriving it of its adhesive, binding nature and rendering its constituents fit for plant food (see below). There are various kinds of clay, some being white, from which china-ware is made ; others yellow, from which are made bricks, pots, chatties and other earthenware articles. Clay is colder, and retains much more moisture

than sand. A certain proportion of clay is a desirable constituent in all soils, and no land can be efficiently and economically worked unless clay is present to an appreciable extent.

Lime usually occurs in soils combined with carbonic acid as a carbonate of lime in various forms, as chalk, lime-stone, and coral. It is present in large quantities in the shells of land-snails and some marine animals, besides coral. Ceylon soils generally are lacking in lime, which, when present, usually occurs in the form of dolomite. See pp. 8, 20.

Humus or vegetable mould is formed by decaying vegetable matter, such as leaves, roots, stems, etc., and exists to some extent in all cultivated soils as a dark brown substance. It often occurs abundantly on the surface of the ground in forests. Humus may be said to be the most important constituent of all soils for the planter or gardener. It has a great influence on the capacity of soils for retaining moisture, renders their cultivation easier, and encourages the activity of soil bacteria. Soils deficient in humus are liable to cake and become very hard in dry weather, and quickly lose their heat in cool weather. (See *Capacity of soils for holding moisture.*)

Leaf-mould may be distinguished from humus by being composed almost entirely of decayed leaves; it is a valuable ingredient in composts for pot-plants, tender seedlings, etc. See p. 19.

Stones are simply particles of the original rock from which the soil was formed. If they do not exist in too great a number (10% of small stones not being considered harmful) they serve a useful purpose in the soil, as they render it lighter in character, affording porosity and assisting in the retention of moisture. The stones are weathered by the atmosphere and other agencies, in the same way as the rocks from which the soil was made, so that their gradual wasting away adds material to the soil.

CLASSIFICATION OF SOILS.

Soils are classified in accordance with their physical or chemical composition, and are divided into classes, sub-classes, etc., according to the proportion of clay, sand, lime and humus they contain. The principal classes are :—

Clay or argillaceous soils. These contain over 50 per cent. of clay. They are heavy and dense, very retentive of water, are cold and difficult to work, and require to be well-drained in order to be properly cultivated. In periods of drought, plants on clay soils are apt to suffer, as the roots cannot penetrate into stiff clays, or obtain water from the subsoil. Though such soils may contain an abundance of mineral food for plants, it is often rendered unavailable by their stiff texture. This may, however, be corrected by the addition of sand, lime, or suitable manures, and by drainage. Clay soils of moderate texture have, nevertheless, very important advantages in the tropics, owing to their power of retaining soluble manures and moisture. (See under *Clay*).

Loamy soils are composed of 30 to 50 per cent. of clay, under 5 per cent. (if any) of lime, and the remainder of vegetable mould and sand.

Sandy loams contain from 20 to 30 per cent. of clay, and may be with or without lime.

Loamy sands comprise 10 to 20 per cent. of clay ; lime may be present or absent.

Sandy soils contain not less than 70 per cent. of quartz sand, have little cohesion, are very porous, and contain little nourishment for plants. Such soils can be improved by the addition of clay, marl or chalk. See p. 20.

Marly soils contain from 5 to 20 per cent. of lime, and may partake of the characters of the first four classes, or of gravelly soils.

Calcareous soils contain over 20 per cent. of lime, and may partake of the characters of a loamy soil with 30 to 50 per cent. of clay, or sandy soil with over 70 per cent. of sand. Marly or calcareous soils rarely occur in Ceylon.

Gravelly soil is a term applied when a considerable amount of gravel or stones is present ; such soil may also partake of the characters of the sandy, clayey, or calcareous classes.

Vegetable mould. This term is applied to soils which contain not less than 5 per cent. of humus or vegetable matter; they may in their turn partake of the character of clayey, loamy, or sandy soils; or they may be composed almost entirely of vegetable matter, as in the case of peat.

Peat is a black soil formed by the decay of marsh plants and bog mosses, as Sphagnum moss. A black, clayey, peat-like soil occurs on mountain plains in Ceylon at elevations above 5,000 feet, usually forming a flat barren area, but it in no way forms a substitute for peat. Peat bogs are not adapted for cultivation in their natural condition, although they are a favourite resort of certain plants. Rhododendrons and allied plants thrive best on well-drained peaty soils. To render peat-bogs fertile, the excess of water must be drained off, and lime and sand added. The effect of this treatment is to aerate the soil, destroy the injurious acids present and prevent the stagnation of water.

Surface-soil and sub-soil are convenient terms, the former indicating the top layer of soil, which is usually distinct by its darker colour (owing to the presence of humus) and looser texture than that underneath, *i.e.*, the subsoil. The latter, though usually more compact and of a lighter colour, varies considerably in character. It may consist mainly of sand, or of gravel or clay, or even resemble the surface-soil. The surface-soil varies in thickness according to locality and surrounding influences; in forests and highly cultivated lands it is usually deep, but on steep hill-sides and in dry localities it is inevitably shallow.

Heavy and light soils. Although sandy soils are heavier than clay ones, agriculturists and horticulturists call a clay soil "heavy," and a sandy soil "light." These terms, however, refer to the facility with which the soils are worked, and not to their relative weights.

Cold or warm soils. Clay soils retain much more moisture than sandy soils, and this causes a great difference in regard to their temperature. The former are therefore sometimes spoken of as *cold*, and sandy soils as *warm*. As a certain amount of warmth in the soil is necessary for plant-life, this indicates the importance of draining low-lying, cold, clayey land.

Volcanic soils are formed by the lava which has flowed over the surface of volcanoes, and subsequently become subject to the action of the atmosphere. Soils of volcanic origin, as those of certain islands, are usually very fertile. Such soils may be said not to exist in Ceylon.

Submarine or coral soils are found in certain islands which, by volcanic or other agencies, have been lifted up above the sea.

Chemical composition of soils. All soils are composed of (1) *organic* and (2) *inorganic* elements. The former comprise oxygen, hydrogen, nitrogen and carbon, which disappear as vapour or smoke when an organised body, vegetable or animal, is burnt in the air. The first three are gases, and the last is a substance, one form of which, charcoal, is familiar to every one. Besides these, there are two other substances, namely, *sulphur* and *phosphorus*, which are sometimes called *secondary organic* elements, because they are frequently, but not always, found in organised bodies. The inorganic elements, which are always to be found in combination with other elements in lands suitable for cultivation, are *potassium*, *sodium*, *magnesium*, *calcium*, and *iron*. With the exception of magnesium, calcium, and iron, all these are *essential constituents* of plant-food.

Examination of soils. To ascertain approximately the composition of a given soil: Weigh out ½ lb. of earth after it has been well dried, boil it for a short time in a pint of water, and then pour all into a glass vessel. Into this insert a piece of blue litmus paper; if the paper turns to a red colour, it shows that acid humus is present in the soil, and that lime is necessary to counteract the acidity. Then add more water, stir well, and pour off carefully the muddy water into a large vessel, care being taken that none of the sand which settles to the bottom is lost; stir up the sand with fresh water, which is again poured off into the larger vessel. This is to be done several times until the sand becomes clean and free from mud. The contents of the larger vessel are to be allowed to remain for several hours until the fine mud settles to the bottom, when the clear water is to be carefully poured off. The sand and the mud should then be dried and weighed separately, when, by comparing their bulk or weight, the proportion of sand and earthy matter in the soil can be ascertained.

To ascertain the presence or absence of lime in a soil. Besides the blue litmus paper test for lime, as already described, the presence of lime may be ascertained thus: Take some 10 or 20 small samples from different parts of the ground, mix them well together; then place a small sample in a tumbler and pour on it a wine-glassful of muriatic (hydrochloric) acid. If the liquid fizzes and bubbles freely, the soil may be considered to contain a sufficiency of chalk (carbonate of lime); but if it only effervesces feebly, it is safe to conclude that a dressing of lime is desirable.

To ascertain proportion of humus in the soil, heat for an hour to a red-heat a given weight of thoroughly dry earth in an iron or clay vessel; the soil rapidly blackens if much humus is present, and then turns red or yellow, the vegetable matter being burnt off; when cool, weigh the earth again, and the loss in weight will give the proportion of humus in the soil.

Capacity of soils for holding moisture. This is mainly dependent on the mechanical texture or porosity of the soil material. In a soil consisting of solid particles of fairly uniform size, the interspaces are about 40 per cent. of the volume, whether the particles are large or small; but if the particles are a mixture of large and small (as gravel and sand), the volume of the interspaces is much diminished. On the other hand, if the particles themselves are porous, as in the case of loam, and especially humus, the volume of the interspaces is much increased. It is this volume of interspaces that determines the amount of water which a soil will hold when perfectly saturated, or the amount of air which it will contain when dry. The influence of humus on the capacity of a soil for holding moisture is remarkable. Schubler found that after 72 hours exposure to moist air, humus had taken up nearly 2½ times as much water as clay, and 40 times more than sand, which, under the same circumstances, took up 16 times less than clay.

A simple way of ascertaining the power of any soil to hold water: Fill a flower-pot nearly to the top with dry soil, and then weigh it (the weight of the pot, both wet and dry, must, of course, be known). Then gradually pour water on the soil until it begins to drop from the bottom. As soon as the dropping has ceased, weigh the whole; the difference in weight will approximately show the proportion of water held by the soil.

Capillary action of soils. The power of soils for drawing up water from the lower strata towards the surface is of the greatest importance to the cultivator. It is possessed in a greater or less degree by all soils, being greater in proportion as their pores are finer. Sand possesses this power to the least extent, and fine clay to the greatest; thus a clay soil is always wetter than sandy soil placed under the same influences.

There is, however, a limit to the fineness of particles which favours capillarity, and when this limit is passed, fineness is disadvantageous, since the minute particles of earth are then apt to cohere together so closely that few, if any, spaces are left between them for the admission of water. For light soils, too open a tilth is not desirable; hence the benefit of surface-rolling such soils after ploughing and harrowing. From the sub-soil, moisture is gradually and steadily sucked up and transmitted to the upper cultivated surface. When the surface soil is left undisturbed and becomes hard, much of its moisture passes off by evaporation, while rain-water is also prevented from percolating through.

The process of soil capillarity may be illustrated by taking a lump of loaf-sugar to represent the hard-caked soil. Hold one end of the lump so that it touches the surface of a cup of water, when instantly the whole lump is moistened; then take about the same quantity of granulated sugar (equalling in height the thickness of the loaf-sugar), and hold on a screen so that the lower surface of the sugar just touches the water; in this it will be found that the water rises very slowly, and not until some of the sugar is dissolved will it reach the top. King calculated that 6.24 tons of water a day evaporated from 1 acre of unstirred soil, while only 4.52 tons evaporated when the surface was raked or harrowed.

Mulching. One of the chief objects of tillage or good cultivation is to cut off the upward flow of underground moisture at a point below the actual surface of the soil, so that a supply of moisture shall be brought to the roots of the plants and prevented from escaping freely into the air. This is sometimes referred to as *natural*

mulching. Any covering that can be placed between the atmosphere and the soil, as leaves, straw, twigs, &c., also has the effect of checking the evaporation of moisture, and is known as *artificial mulching*. When a soil is nearly dust-dry, nitrification ceases ; thus surface-stirring operations in dry weather not only preserve the soil moisture, but keep the nitrifying organisms employed. (See p. 27.)

Fertility of soils. The fertility of a soil largely depends, according to Liebig, " on the bulk and composition of the previous crop residues, and the extent to which these have been subsequently destroyed." Therefore the crop which leaves behind the largest amount of roots, foliage, etc., will best maintain or increase the organic capital of the soil. Fertility of soils has been summarised as being dependent on the following conditions, viz. :—

(1) Sufficiency of available plant-food ; (2) suitable texture or mechanical state of the soil ; (3) absence of injurious compounds ; (4) a healthy percolative sub-soil ; (5) suitable climate, season, and aspect. The absence of any of these conditions will render a soil proportionately infertile. Needless to say, one of the most essential factors that control soil fertility is the amount of moisture present, for on this depends the healthy action of the nitrifying bacteria. Agricultural chemists now distinguish between *fertility analyses* and *complete analyses*, the latter indicating only the amount of plant-food present in the soil, whereas the former aim at showing the proportions available to the crop—a very different thing.

Sterilisation of soils. Experiments have shown that sterilising the ground by intense heat restores or enhances soil fertility by destroying injurious protozoa which exist in the soil and prey on the useful soil bacteria engaged in the work of fixing nitrogen from the atmosphere into a form suitable for plant-life. This may partly account for the fact that in the tropics, after a period of great heat and drought, the soil shows signs of extraordinary fertility. Similarly, soils which have become exhausted by intensive culture in glass-houses may be largely restored to fertility, in addition to killing off eelworms and other injurious insects present, by heating artificially to a temperature of about 140° Fah.

Exhaustion of soils. The term is based on money values, and has no precise definition. Although no soil can be entirely exhausted, generally speaking it becomes so, as regards any particular crop, whenever the cost of cultivation comes to as much as the crop is worth.

Thus the word " exhaustion " refers to the available character of the plant-food present in the soil. Most cultivated soils contain a store of plant-food which it would take many crops to exhaust ; but a large proportion of this may be present in such a form that plants are unable to make use of it. Thus an acre of land may contain several thousand pounds of phosphoric acid, potash, or nitrogen, and yet be in " poor condition."

Theory of toxic substances in the soil. It is sometimes supposed that infertility in a soil may occasionally be due to the presence of compounds injurious to plant-growth, rather than to insufficiency of plant-food. Such compounds are attributed to decomposition products of plant-tissue, excretions from growing roots, germinating seeds, etc. It is thus supposed that certain crops may form toxic substances in the soil which are deleterious to the crop following. Excessive organic matter in the soil, as in a long-cultivated and much-manured vegetable garden, is also considered capable of producing similar toxic effects. The proper corrective for such a condition is suitable crop-rotation (which see), a liberal application of lime and of a suitable fertiliser.

Ceylon soils, as a rule, are poor and shallow, and their character in general may be summed up thus :

(1) *Sea Coast* : soils loose and gravelly or sandy, often with a large proportion of laterite (cabook), usually of a deep reddish colour, in some localities a deposit of white silvery sand occurring on the surface; in such soils, however, the Cinnamon, Coconut palm and certain other crops flourish, provided the rainfall is sufficient. (2) *Inland*, up to medium elevations in Southern and Central Provinces: soils of a reddish clay, often with a large proportion of laterite and a small percentage of humus. (3) *Up-country*, soils occasionally of a loamy character but usually lacking in fibre and deficient in lime; rich loamy soils, rare; black peaty clays occur in valleys or swamps at the higher elevations. (4) *North-Central Province*: soil variable, in some places hard and poor; in others deep and black, free from stones and easily worked. (5) *Jaffna Peninsula*: soil generally of a hard clayey nature.

Patana soils. These and similar soils in an inert condition should, when brought under cultivation, be thoroughly drained and deeply dug, the surface grass, leaves, &c., being burnt on the ground; well decayed manure, basic slag and air-slaked lime (say ½ lb. of each per sq. yd.) should be spread on the surface and well forked in.

Method of Taking Soil Samples for Analysis. After clearing the surface of the ground of leaves and twigs at any selected spot, dig a small square hole 18 in. to 2 ft. deep, removing all the soil.

Then cut a thin section from top to bottom of one side of the hole, and collect this in a clean basket or sack. Repeat this operation in five or six other spots where the soil is uniform in appearance, and thoroughly mix the samples so obtained. From the mixture take sufficient soil to fill a box 6 in. by 4 in. by 4 in., and label the box with name or number of plot or field. Particulars as to elevation, rainfall, crop growing or to be grown, and previous manuring (if any) should be sent with each sample.

CHAPTER II.

PLANT LIFE

Most plants consist of *shoot* and *root* systems, the former ascending, seeking the light, bearing branches, leaves, flowers, and fruits; the latter descending and avoiding the light. The point from which the two diverge is popularly known as the "collar." Some plants have one or more of these parts wanting, but it is unnecessary to consider these here.

The roots (descending axis) fix the plant in the soil or substratum; they absorb nutriment in a fluid state from the soil, and in many cases act as reservoirs of food stored for the growth of a succeeding season, *e.g.*, Yams, Sweet-potato, Carrot, Dahlia and other tuberous-rooted plants. To enable the roots to penetrate the soil without injury, their delicate tips are protected by *root-caps*. In most plants these are very minute, but in some they are large and plainly seen; in the thick, hanging, *aerial roots* of the Screwpines (Pandanus) the root-caps are very large, and can be pulled off by hand. Towards the ends of the roots *root-hairs* are produced; these apply themselves to the particles of the soil, and by means of the acid fluid permeating their thin cell walls they dissolve ingredients, which they then absorb and use in the nourishment of the plant.

The shoot or stem (ascending axis), generally arising above the surface of the ground, exposes the leaves and other appendages to the full influence of light and air, conducts the necessary mineral substances from the roots to the leaves, and also the food supply from the leaves to the roots. Stems are *erect* (as in trees), *climbing* by hooked spines (as in Calamus), or by tendrils (as in Bignonia and Vitis), *twining* (as in Ipomoea), *creeping* (as in Sweet-potato, Pepper, Vanilla, etc.), or *underground* (as in Ginger). Underground stems (*rhizomes*) superficially resemble roots, but can be distinguished by their possessing rudiments of shoots and leaves in the form of scales with buds in the axils. Ordinary stems are of two types, *dicotyledons* and *monocotyledons*, sometimes known as *exogens* and *endogens* respectively. The former represent the majority of trees, shrubs and annual plants, in the young stem or shoot of which there is a soft central cylinder of pith, surrounded completely by wood, and external to this by *cortex* and then *bark*, the latter being formed by the dried and dead cortex cells.

The cortex is separated from the wood by a fibrous layer or *bast*, on the inner side of which is a thin, watery or viscid layer called the *cambium* or formative tissue. In plants of this type which exist for

more than two years, new layers of wood and cortex are successively formed from the cambium. In the second type of stem (monocotyledon), as occurs in palms, bamboos and grasses, the wood and bast are scattered throughout in strands (*vascular bundles*), instead of being continuous and solid ; there is no separable bark, that being represented by a hard external layer called the *rind* ; in these the stem is hardest externally (whilst in the former type the hardest part of an old stem is interna , *i.e.* the heartwood) ; there is no cambium ring, therefore the stem does not normally increase in thickness when once formed.

The Leaves are usually composed of a thin layer of green tissue termed the *mesophyll*, which contains the *chlorophyll* bodies or green colouring matter. This is held together by a framework of ribs commonly known as *veins* or *vascular bundles*. Each surface is protected by a special layer of cells, the *epidermis*. In the lower surface of ordinary leaves are microscopic openings, called *stomata*, leading into the substance of the leaf ; through these the inhalation and expulsion of air and moisture take place. In a few exceptions the leaves are placed edgewise towards the source of light, as those of Eucalyptus, Loranthus, etc., the stomata in these being equally distributed over both surfaces of the leaf ; in floating leaves, as in Nymphoea, the stomata are on the upper surface.

The functions of leaves may be compared to those of the stomach and lungs of animals. The roots, stems and leaves, being concerned in the supply and elaboration of food, are called *Organs of Nutrition*, whilst the flowers are the *Organs of Reproduction*, normally producing fruits and seeds.

Flowers. A typical flower consists of four distinct series or circles of parts, the outer of which, composed of small, green, leaf-like organs called *sepals*, forms the *calyx* ; the next inwards, a circle of usually brightly coloured and sometimes scented leaves, called *petals*, forms the *corolla* ; when both sepals and petals are similar in appearance and colour, as in Lilies, they are known collectively as the *perianth* ; this term is also sometimes used when one of the circles is absent, as in *Euphorbiaceae*. The third series, consisting as a rule of a few or many thin stalks, bearing swollen bodies at their tips, are the *stamens* or male organs ; the stalks are known as the *filaments*, and the swollen bodies as the *anthers*, which contain the *pollen*. The fourth and innermost circle consists of the *pistil*, the lower inflated part of which is the *ovary*, containing the *ovules*, which when fertilised become the *seeds*. At or near the apex of the pistil is the *stigma*, through which the pollen tubes penetrate to fertilise the ovules. The intervening part, when present, between stigma and ovary is called the *style*.

Flowers are *pollinated* when the pollen from the anthers is transmitted, either naturally or artificially, to the stigma. The act of *fertilisation* is brought about by one (or more) of the pollen grains developing a tube which grows through the stigma, down the style to one of the ovules, when its contents fuse with a special cell of the latter and form the embryo.

The functions of the exterior circles, calyx and corolla, may be considered as protective and attractive, respectively (or collectively), while the stamens and ovary

are essential for reproduction. These latter may be present in the same flower (*hermaphrodite*), or they may exist in separate flowers (*unisexual*). Flowers which possess stamens and not a pistil are called *staminate* or *male* flowers; *female* or *pistillate* flowers are those in which the stamens are absent. Some plants bear both kinds of flower on the same individual, and are called *monoecious*; others bear them on separate individuals, as the date palm and nutmeg tree, and are known as *dioecious*.

Seeds. Every perfect seed contains an *embryo*, which is the future plant in a rudimentary state. In some cases, as in *Leguminosae*, it is large and fills the seed. If the shell be taken off a bean seed, for example, the following parts can be easily distinguished.

(1) Two fleshy bodies placed face to face called *cotyledons* or seed-leaves, known also as "nursing leaves;" (2) a minute projection at their base pointing upwards, called the *plumule* or future shoot; (3) a longer projection, also at their base, but pointing downwards, called the *radicle* or future root. In germination the radicle grows downwards, the *cotyledons* separate, and the plumule develops upwards, the whole seedling living and increasing on the reserve food stored in the nursing leaves, until the roots are functionally active and the young parts and leaves above ground assume their green colour. In other seeds, as cereals, palms, grasses, etc,, the whole embryo is very small and is surrounded by a mass of tissue (*endosperm*), which may be either of a mealy consistency (as in maize), oily (as in Hevea), or horny (as in palms). In these cases the endosperm, and not the cotyledons, provides the requisite nutrition for the young plant. In some cases, as often in Mango, Citrus, and Eugenia, the seed contains several embryos (*polyembryonic*). These usually arise as buds from the nucellar tissue and are therefore equivalent to buds or grafts.

NUTRITION OF PLANTS

In the youngest stages of its life, as has just been shown, the plant is supplied with nourishment from the food stored up in the seed for that purpose. By the time the roots and leaves have been formed, this supply becomes exhausted, and the plant must now obtain its food from the soil and the air. Through their delicate root-hairs the roots absorb from the soil various chemical salts in solution, which are transported upwards through the stem and distributed to the leaves. The acid sap of the root, together with the CO_2, (carbon dioxide) gas, probably assists the moisture in dissolving the mineral matter in the soil. The leaves imbibe from the atmosphere, through their stomata (*respiration* process) carbon dioxide, the carbon of which enters into combination with the substances absorbed by the roots to form sugar and then starch, and also albumen matter.

The process of forming starch by the agency of *chlorophyll* (the green colouring matter in the leaves and green parts of plants) is called *assimilation* or, to use the more modern term, *photosynthesis*. This can only take place under the influences of light and air, the latter supplying the CO_2 and the former the energy by which the carbon is split from it. During sunlight the stomata of the leaves are continually giving off oxygen which has been separated from the CO_2 taken in, the carbon itself being retained by the leaf. In darkness no fixation of carbon can take place, as light is necessary for the splitting of the CO_2, so no starch is formed and at the same time no oxygen is evolved. Consequently the process of respiration, which is always going on, becomes evident through the evolution of CO_2. In sunlight this is masked as the CO_2 formed in the leaf by respiration is immediately concerned in assimilation.

As the saline matter is carried up from the soil through the plant in extreme dilution, the excess of water thus absorbed has to be got rid of in the leaf. This passes out through the stomata in the form of water vapour, and the process is known as *transpiration*. It is important therefore to distinguish clearly between the three processes of *assimilation*, *respiration*, and *transpiration*.

Food of Plants. The main elements necessary in the food of plants may be said to be hydrogen, oxygen, carbon, nitrogen, sulphur, phosphorus, potassium, magnesium, calcium and iron. The supply of the first three elements comes from the air and water, the remainder are taken up in the form of salts from the soil. Nitrogen is of the greatest importance, being an essential constituent of every living body. It constitutes the chief bulk of our atmosphere, but plants (other than Leguminous species) are unable to assimilate it in a free state, that is, unless it is first chemically combined with another element. Plants most probably absorb their nitrogen from the soil in the form of nitrate or ammonia compound. Besides nitrogen, the other elements likely to be deficient in the soil are phosphorus and potassium. These are often supplied in the form of phosphates and potash salts.

Soil Bacteria and Nitrification. The appropriation of nitrogen by plants is due to the agency of bacteria, which exist in all fertile soils. These microscopic organisms, or ferments as they are called, perform the usual function of converting the nitrogenous organic matter in the soil into *nitrates*, or soluble plant-food. The process is accomplished by the action of two separate groups of bacteria, and is termed *nitrification*; one group of these organisms converts ammonia into *nitrites*, and the other changes nitrites into *nitrates*. A favourable degree of warmth and moisture is essential to the active operations of these bacteria; at low temperatures their work is retarded, and at a certain degree of coldness it practically ceases. Hence an open porous soil, assisted by good tillage and mulching, encourages their activity and thereby tends to promote oxidation of the organic matter in the soil.

Nitrogen-collecting bacteria. It is well known that on the roots of certain Leguminous plants there usually occur nodules or tubercles which vary in size from that of a pin's head to a pea. These nodules contain bacteria which abstract and fix the free nitrogen of the air. The nitrogen thus becomes stored up in a combined form in the roots and stems of such plants, and when the roots of these are left in the ground, or the whole crop dug in as green-manure, the soil is considerably enriched thereby with nitrogen. Only Leguminous plants (chiefly those of the sub-tribe Papilionaceae) obtain their nitrogen in this way, all other plants, so far as is known at present, depending for their supply on nitrates formed by the soil bacteria from organic substances in the soil. This property of Leguminous plants has long been recognised in agriculture, and crops of this family are therefore esteemed an important factor in the rotation of crops, and also in what is known as "green-manuring."

Nitro-bacterine, Nitragin, or Bacteria culture. The nitrogen-gathering bacteria of Leguminosae having been isolated, cultures of them have been placed on the market in commercial forms under such names as the above, it being claimed that these benefit certain crops growing in soils which are deficient in the right kind of bacteria. These cultures are applied by means of inoculating the seed, before sowing, or the soil, by watering through a rose, with a solution containing the desired germ. So far, however, the advantages claimed for these cultures and their artificial application do not appear to have materialised to any important extent.

Water in relation to plant-food. Water is an essential factor in the life of a plant; it enters very largely into its composition, enabling it to retain rigidity and carrying nutritive substances in solution through the plant's body. It constitutes by far the greater bulk of fresh vegetable substances (at least 80%), and also forms a large percentage of ordinary cultivated soils. The solution of mineral substances and gases,

for absorption by the roots of plants as food, is dependent on the presence of water. When the amount of water at the root is deficient, the plant wilts, and, unless a timely supply is restored to the roots, it withers and dies.

Water differs in several respects according as it is obtained from rain, ponds, streams, springs, or wells. Rain-water is free from mineral matter, but usually contains a small percentage of ammonia which it obtains from the atmosphere; it also contains carbon dioxide, so that it is able to dissolve carbonate of lime in the soil. Rain-water is thus said to be "soft," and is preferred for watering plants or crops. Spring or well-water usually contains varying quantities of carbonate of lime and other mineral matter, when it is said to be "hard;" in some cases it also contains large quantities of iron oxides, and these form encrustations on bodies placed in the water; this is often characteristic of well-water in the northern part of Ceylon, which consequently is injurious in that condition to plant or animal life. Such water should always be exposed for some time to the sun before use. Running water also contains, in the form of sediment, different mineral substances varying in quantity according to the source of the water and the course through which it runs. Irrigation waters in their passage through the soil remove large quantities of nitrogen (in the form of nitrates) and other valuable ingredients from the soil.

COLOURATION OF LEAVES, FLOWERS, ETC.

*Colours in leaves, flowers and fruits are due to the presence of certain pigments which arise mainly through the direct influence of sunlight. The greenness of leaves is due to the presence of the pigment *chlorophyll*. Accompanying it are two yellow colouring matters (*carotin* and *xanthophyll*), chemically akin. As a rule, before a leaf is shed the chlorophyll disappears, leaving behind the yellow pigments, which give rise to the autumnal golden tints of temperate climes.

The above pigments are closely associated with the protoplasm of the leaf-cell. Other pigments known as *anthocyanins* occur dissolved in the cell-sap, colouring this as a rule. This term literally means "blue flower." The more appropriate one, *erythrophyll*, signifying "red leaf," was formerly applied to these pigments. Pink and blue flowers, as well as those of intermediate shades, and red leaves, all owe their colouration to this class of pigment. According as the cell-sap is acid or neutral, so the pigment reveals itself in the red or blue respectively. As the sap is usually acid, reds of various shades predominate in the plant world. When *anthocyanin* develops in a leaf prior to its fall, the effect, in combination with the yellow pigments, is to create bright orange-red foliage, a pleasing addition to the commoner yellow autumn leaves.

Anthocyanin may appear temporarily in the young leaves, and, if abundant before the chlorophyll is largely developed, a bright red immature foliage results. This is very evident in many tropical trees, *e.g.*, Mesua ferrea (Ironwood-tree of Ceylon), species of Calophyllum ("Keena") Eugenia, Cinnamomum, &c. The colouration is at times so vivid that from a distance such trees appear to be in flower. Very occasionally the young foliage is of a bluish rather than of a reddish hue, hence even the blue of the flower, like the other floral colours, may be foreshadowed in the foliage leaf.

In the wild state, in temperate countries, the *anthocyanin* rarely persists in the leaf, but examples of such are abundant in tropical floras. For example, brightly coloured foliage is a feature of species of Coleus, Acalypha, Cordyline, Codiaeum and Caladium. Selected horticultural varieties of these are sometimes preferred for

* John Parkin, M.A., in the *Quarterly Journal of Forestry* Oct., 1919, and Jan., 1920.

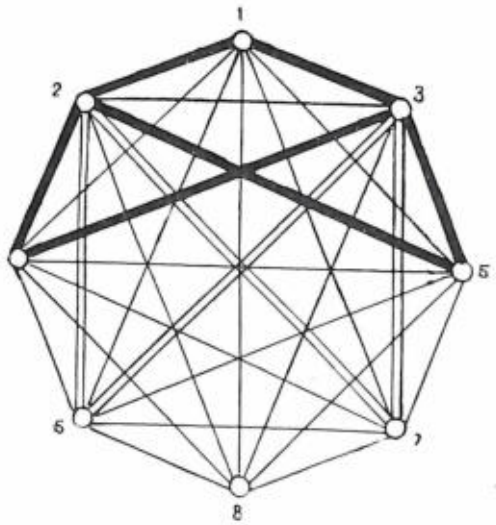
colour-effect in tropical gardens to flowering plants, whose sombre greenness is, as a rule, enlivened by floral colouring only for a brief period of the year.

Flowers which are pollinated by insects are usually brightly coloured, while wind-pollinated flowers are generally inconspicuous.

In those flowers which depend upon insect agency for cross-pollination the greenness has been eliminated from the floral leaves (petals), and other pigments substituted in order to render the flowers conspicuous to insects amid the green foliage. It may be assumed that if cross-pollination through insect agency had not arisen in the course of plant evolution we should have had no brightly coloured flowers.

In bright yellow flowers the protoplasmic pigments predominate. When only sap pigments (*anthocyanins*) are present, the flowers range from pink to blue—the latter being the most advanced floral colour, beloved of bees. Pale yellow flowers also owe their delicate colouration to a sap-pigment, a form of anthocyanin.

Our gorgeous orange and scarlet flowers result from the occurrence together of both yellow protoplasmic and pink sap pigments. A complete elimination of all pigments results in white flowers, which in nature are generally visited, and so pollinated, by night-flying insects. The lack of pigment makes such flowers visible in the semi-darkness. A similar range of colouring occurs in fruits as in flowers. As the green of the ripening fruit disappears, either yellow, red, purple or occasionally blue takes its place. Very rarely all pigments may disappear, leaving a white fruit, *e.g.*, *Eugenia malaccensis var.*, and *Solanum melongena var.* Here again, as in flowers, the vivid colouration of fruits is generally for a definite purpose, viz., to attract birds or animals for the sake of seed-distribution. Fruits distributed by the wind or those which scatter their seeds by explosive mechanism are not, as a rule, brightly coloured. Brightly coloured seeds are also commonly met with in the tropics. See *Remarkable Fruits and Seeds*, pp. 460, 461.



GEEHENS' CHART SHOWING WHICH FERTILISERS MAY BE MIXED AND WHICH MAY NOT. See p. 24.

1. Superphosphate; 2, Lime; 3, Basic slag; 4, Sulphate of ammonia; 5, Farm-yard manure and guano; 6, Potash salts; 7, Kainit; 8, Nitrate of soda.

Those fertilisers which are joined by thick lines should never be mixed before using; those joined by double lines, only immediately before spreading; those joined by a single line may be mixed together at any time.

CHAPTER III.

MANURES

The use of manures is, briefly, to supply nutritive matter for encouraging and sustaining plant-growth. They restore the fertility of an exhausted soil, and enrich a naturally poor soil. Any substance, therefore, added to the soil, which has the power, either directly or indirectly, of increasing its fertility may be considered as a manure. It may contribute directly by supplying what is required, or indirectly by its chemical action on dormant substances already present but not in a suitable state for being absorbed by the plants.

Manures, more especially farmyard or pen manures, may also improve the physical condition of the soil, rendering heavy clay land lighter and more porous, and sandy soils denser and more retentive of moisture. Growth in plants cannot take place without the main constituent parts of which they are composed being extracted from the earth. The continued production of crops, therefore, necessitates the withdrawal of an enormous supply of certain elements from the soil, and it is evident that if no means be taken to restore these the soil gradually becomes "exhausted" (see under *Soils*). According to Liebig, "the best fertiliser for any particular crop is that which contains the amounts of nitrogen, phosphoric acid, potash, etc., which are removed from the soil by a typical good yield of the crop in question"

The immediate effect of a manure depends, (1) on its solubility, (2) on its suitability to the crop or plant to which it is applied. Suitable *mixtures*, made up according to the special need of different crops, usually afford most satisfaction. (See *Composts and Mixtures*). Manures may be divided into two classes, viz.—(1) *Organic* or *natural manures*, as those composed of vegetable or animal substances; (2) *Inorganic* or *artificial manures*, which are of mineral origin. While most manures act directly by supplying the three chief elements of plant-food (nitrogen, potash, and phosphoric acid), certain kinds are of value chiefly on account of their properties of liberating the plant-food already in the soil, or of correcting soil acidity. Such substances are known as *indirect fertilisers* and include lime, marl, gypsum, charcoal, etc. An application of "artificial" manures to field crops should seldom exceed $\frac{4}{}$ oz. to the square yard at a time; this is equal to over $\frac{1}{2}$ ton to the acre.

ORGANIC MANURES.

Farmyard, pen or natural manure. By this is generally understood the manure produced by horses, cows, or other animals kept on the estate or farm. The excrements of different animals possess different fertilising properties, but for ordinary purposes general farmyard manures are best mixed together, both solid and liquid. The liquid portion should occasionally be thrown over the heap so as to keep the latter moist,

preventing over-heating, and inducing the decomposition of coarse litter. If left to dry, the manure may become almost useless.

Farmyard manure deteriorates by violent heating, but partial decomposition by slight fermentation before adding to the soil is essential in order to render its constituents more soluble. It is even injurious if applied in a "fresh" state, affecting both the crops and the nitrates of the soil. For improving the permanent fertility of soils, farmyard manure is the most important of all manures. In addition to its manurial properties, it has valuable physical effects upon the texture and water-holding powers of the soil, and in dry seasons these may count for more than fertilisers towards ensuring good crops. It restores humus in the soil, gives cohesion to sandy soils, rendering them more retentive of moisture and resistant to drought, and makes clay soils more porous and workable. It may be assumed that a ton of average well-rotted farmyard manure contains about 12 to 15 lb. each of nitrogen and potash, and 6 to 7 lb. phos. acid. 10 tons of such manure per acre may be considered a good dressing.

Stable or Horse manure. This is called a "hot" manure because, owing to its loose texture, it easily undergoes decomposition or fermentation, producing a high degree of heat. On this account it is very liable to lose more or less of its nitrogen in the form of ammonia. It is usually richer than cow manure, but is more liable to loss by keeping.

Goats' dung is sometimes procurable in the neighbourhood of cooly lines. It is a good manure, though its action seems to be comparatively slow. Firminger, in India, stated: "I have often used it for a manure; but not, as it seems to me, with any marked advantage. Sheep's dung, being similar, would probably give like results."

Poultry dung is somewhat similar to guano, though far less valuable than that material, weight for weight. The difference in quality is largely due to the fact that the food of fowls is very different from the fish diet of the sea-birds which produce guano. Fowl manure usually contains about 2 to 4 per cent. of nitrogen, while good Peruvian guano may contain as much as 20 per cent.

Night-soil. The supposed high fertilising value of night-soil is probably much overrated. The late Dr. Bonavia, of Lucknow, considered that it produced special "richness of colour in flowers, and vigour and succulence in vegetables," a statement which presumably lacks confirmation. On the continent of Europe and in some other countries night-soil is much valued as a manure, but it has to be made up in a special form for transport. It has, however, considerable disadvantages from a sanitary point of view, more especially in the tropics, where its use is not to be recommended.

Poudrette. In some large European and American towns, night-soil is dried and made into a transportable form which is sold under the name of poudrette; but as it is prepared by adding largely such materials as gypsum, ashes, earth, sawdust, etc., the mixture is considered to form but a poor fertiliser.

Blood meal is an excellent manure, being rich in nitrogen (10 to 12 %) in an active state. It may be applied to general field crops at the rate of about 200 lb. per acre.

Bones are rich in phosphorus and lime and are extensively employed as a manure for field and garden crops. When used in merely a crushed state their decomposition is slow, consequently their fertilising properties are lasting; reduced to a powder or meal, usually containing 22% to 25% phos. acid, they rapidly become available as plant-food. The usual commercial forms in which bones are supplied are: ½ inch bones, bone-meal, and bone-dust. Bones are especially beneficial when used on soils deficient in lime; they are commonly used on rice-fields in Ceylon and give good results. Soils rich in decomposing organic matters, as leaf-mould, are greatly enhanced in fertility by an application of bone-meal.

Guano. This valuable manure, obtained principally from islands off the coast of Peru and various other places on the coast of South America, usually consists of the excrement of sea-birds, deposited

during the course of centuries. It varies in quality, that found in the regions which are liable to heavy rainfall or shifting sands being of least value. The best guano is supposed to be that which comes from Chincha Islands, where, however, the supply has now become practically exhausted. The guanos of commerce may be classified under two heads:

(1) Nitrogenous guano, of which the " Peruvian " is a type ; (2) Phosphatic guano, of which the " Bolivian " is an example. Various forms of guano are now put on the market. Sulphate of ammonia added to nitrogenous guano forms what is known as " Fortified Peruvian Guano." It is customary to mix guano with about six times its bulk of fine earth, loam, or ashes, applying the mixture at the rate of about 4 or 5 cwt. per acre, according to the nature of the crop. For pot-plants, guano may very advantageously be applied in solution with water, the proportion varying according to the size and variety of plant for which it is required. About 1½ oz. to two gallons of water may generally be used with safety.

Fish guano. Dried and powdered fish refuse forms a very valuable fertiliser, a good sample of which contains from 10% nitrogen, 25% phosphates, and 12% sulph. of potash. In Ceylon, fish guano is used with good effect for tea, coconuts and other crops, being rapid in decomposition, and applied at the rate of about 500 lb. per acre. It should not be applied to soils above any water supply, as by polluting the latter it has been known to be a cause of dysentery, etc. Fish guano is obtained chiefly from fish-preparing factories in Norway.

Leaf-mould. Leaves, when thoroughly decayed and reduced to a state of mould, form a sort of manure known as leaf-mould. This contains a considerable proportion of potash and nitrogen, and is a most valuable growing medium, either alone or mixed with other substances, being especially suited to the growth of tender plants and seedlings. All fallen leaves and vegetable refuse in a garden should therefore be collected and thrown into a deep pit or trench, dug in some obscure corner, in order to provide leaf-mould. In dry weather, the leaves should be kept in a moist state so as to hasten decomposition. Leaf-mould is particularly suitable for the cultivation of ferns, and such plants as naturally grow under shade in the jungle. See pp. 6, 7.

Castor, Ground-nut, or Poonac-cake, etc.—These are the residues of castor-oil seeds, ground-nuts, copra, etc., after the oil has been extracted. They are esteemed as manures, being usually rapid in action, and are somewhat largely used on up-country estates in Ceylon. Bamber considers castor-cake to be one of the most useful manures for Tea. It is an excellent basis for other mixtures, the percentage of nitrogen in the best castor-cake being about 6%, though often only 4 or 5% in some grades. On all garden crops, and especially roses, castor-cake is considered to have excellent results. Rape and cotton-seed cakes are also valuable manures.

Jadoo, or Jadoo-fibre.—This potting material or " growing medium " was patented some years ago in England. It has for its foundation peat-moss of an exceedingly spongy and absorbing character, not unlike fine coconut fibre in appearance. This is said to be boiled, impregnated with nitrate of potash, bone meal, gypsum, soot, etc., and then fermented. When the substance is ready for use it is almost free from any smell, and is clean and light to handle. It is especially adapted for such plants as are required for growing in-doors. As a propagating medium, especially for germinating seeds, it has been highly spoken of. It used to be imported by a firm in Colombo, but apparently the cost of transport has prevented it becoming popular here and elsewhere in the tropics.

Humogen. A preparation of peat similar to the former, invented by the late Professor W. B. Bottomley, for which a high manurial action has been claimed. It is prepared by " neutralizing the peat and then causing it to undergo decomposition up to a certain point, after which the mass is sterilised and inoculated with a culture of nitro-fixing organisms."

Sea-weed (Kelp) is commonly used as manure where it can be cheaply transported, near the sea, being applied in the fresh state, either for digging into the ground

or for forming a mulch on the surface. The percentage of manurial ingredients, however, which sea-weeds contain is small, so that their effect on soils is not a lasting one. During the war they were employed fairly extensively as a source of potash, being applied to the land in a dried powdered form; or they were burned and the ash then marketed. See *Jaffna moss* and *Agar-agar*, p. 304.

Town-sweepings sometimes form a useful manure, though in some cases they consist largely of sand and are of little value. The refuse from the neighbourhood of markets is sometimes useful as a manure, while scrapings from side-drains often contain a large amount of humus and other manurial substances ; their liability to contain troublesome weeds is, however, an objection to their use on field crops.

Coir-dust decomposes so slowly that it can hardly be said to be of much value as a fertiliser. It has, however, a beneficial mechanical effect on certain soils, especially such as are deficient in humus. It may with advantage be used to give "body" to potting soils, but it should always be well leached in the open air and rain before use. In the neighbourhood of Colombo and coast towns generally, it is largely employed for pot plants. See *Potting Soils*, p. 79.

Woollen refuse, shoddy, &c. Waste materials from woollen and cloth mills, horn shavings, &c., are used in Europe to some extent in the manufacture of manures They usually contain from 5 to 10 per cent. or more of nitrogen, and their manurial effects extend over two or three years.

INORGANIC MANURES.

Sand, especially sea-sand, is of some value as a "manure" as well as for its physical properties in agricultural and horticultural practices. Where its transport is not costly, farmers apply sea-sand, which contains a large proportion of calcium carbonate from the shells of cockles, mussels, &c., to the land at the rate of 6 to 8 tons or more per acre. It is especially valuable for heavy land and for Leguminous crops. See under *Soils*, p. 5 ; also *Composts*, pp. 24 and 38.

Lime is a necessary element of the food of plants; it enters into the composition of every form of vegetable life, and there are few soils that do not contain it in some form. Though as a manure in itself lime rarely needs to be added to the soil, as an indirect fertilising agent it has a most beneficial effect.

Lime, in its hot or caustic condition, is one of the most powerful agents for effecting the decomposition of organic matter in the soil, which process is necessary in order to render the elements available as plant-food. Thus an application of lime to "acid" or "sour" land, or to heavy inert soils, often has most beneficial results, rendering the latter friable, and permeable to air and water, thereby encouraging the growth of soil bacteria. It is considered that any soil containing less than ½ per cent. of lime cannot be brought to a high state of fertility. Lime is valuable for pasture land, as well as for field and garden crops, whilst its effect as a preventive against fungus diseases (*e.g.*, club-root) and insect pests in the soil is well known. See pp. 6 and 495.

The proper quantity to apply varies according to the nature of the soil, 10 to 15 cwt. per acre being a moderate dressing, while 1-1½ ton per acre is a liberal one. In hot countries the soil requires less lime than in cool or temperate regions, owing to the more rapid rate of decomposition that naturally takes place in the former. In the case of Tea, lime is generally applied with the buried prunings. For gardening purposes 8 oz. to 12 oz. per square yard, according to local conditions, is a safe dressing. Clay soils require more lime than light loams or sands, and where but little humus is present lime should only be applied in very small quantities. Ground that is frequently manured, as an old vegetable garden, will be much improved by a small application of lime every second or third year, for it acts as a corrective of inertness resulting from heavy manuring.

The application of lime may, however, be overdone, and the exhaustive effect of continued liming, whilst adding insufficient organic matter to

the soil, is aptly put in the adage : " Lime pays the father, but ruins the son". This is also illustrated by the old maxim :

" Lime and lime without manure,
Makes both farm and farmer poor."

Lime is detrimental to certain plants, such as Rhododendrons and other species of the same family. It should never be added to a manure containing sulphate of ammonia, or to blood and bone manures, as this would result in loss of nitrogen.

Coral lime, which is almost a pure carbonate of lime, is generally employed for manurial purposes in Ceylon. It is imported from India and the Maldive Islands in hard lumps, and is either ground to a fine state and sold as *ground-coral*, or burned in kilns, when it is supplied as *burnt* or *quick-lime*.

Chalk acts both mechanically and chemically when applied to the soil. It renders soils which are light and incapable of holding sufficient moisture more compact and retentive, a quality which prevents the rain washing away the soluble substances necessary for the support of plant life. Chalk is a variety of carbonate of lime and, in addition to lime, contains to a varying extent clay, sand, potash, soda, oxide of iron, phosphoric and sulphuric acids.

Gypsum or Sulphate of lime is a combination of lime, sulphuric acid and water ; it belongs to the class of *indirect manures*, and exists to a large extent in ordinary superphosphates. Though opinions regarding its fertilising action are divided, its use is sometimes attended with much success. It may be applied at the rate of 4 to 5 cwt. per acre, or about 4 oz. per square yard, preferably in wet weather. It is especially suited to such crops as turnips, potatoes, leguminous crops, grasses, &c., and its effect is most noticeable on light sandy soils.

Ashes. Wood-ashes usually contain a large proportion of potash and soda besides other inorganic elements of plant-food,and therefore form a valuable manure. They are suitable for applying by themselves, or for intermixing with dung or other manures. The charcoal pieces which the ashes usually contain have the important property of absorbing ammonia and other gases, and again giving them off for the nourishment of plants. Wood-ashes are on this account valuable as a deodoriser. Coal-ashes also have some manurial effects in certain cases, especially on stiff clayey soils, owing to the sulphate of lime or gypsum they contain, and have been found to encourage the growth of leguminous vegetables.

Magnesia is essential to the growth of plants, it being always present in their ashes in varying proportions. Applied as a manure, it is considered that it may act directly by serving as food for the plant, or indirectly by uniting with insoluble mineral substances, and rendering these available as plant-food. It is supposed that the ratio of lime to magnesia in soils has an important bearing on many crops.

Ammonia is one of the most important components of manures, having a powerful stimulating action on the growth of plants, usually producing a luxuriance of dark green foliage. It is formed by the decay of organic matter in the soil, and also in the air, and is the source from which plants derive their nitrogen. Ammonia is supplied to plants by means of organic manures capable of forming it, or by the application of some of the salts of ammonia. Of the latter the most commonly employed is—

Sulphate of Ammonia, an excellent fertiliser for all crops, containing about 20 per cent. nitrogen. It may be applied at the rate of ½ to 1 oz. to the square yard, but is generally used with other ingredients in a mixture. As a liquid fertiliser, it may be applied at the rate of ½ oz. to 1 oz. dissolved in a gallon of water.

Nitrate of Soda (Chili saltpetre). Of all the nitrogenous manures, nitrates are the most rapid in action, as the nitrogen they contain is actually in a condition in which the plant can take it up at once without change. Being readily soluble in water, it is easily washed out of the soil by heavy rain or artificial waterings. Nitrate of soda is obtained from Chili, and is sometimes called *Chili saltpetre*. Owing to its high percentage of nitrogen (about 15%), it has very stimulating effects as a manure, and should be used in small dressings occasionally, rather than in one heavy application. It is readily assimilated by plants, and is considered especially suited for root and grain crops. For general garden crops an application of about 1lb. per 40 square yards, or ! cwt. per acre applied as a surface dressing, is

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recommended. It is computed that 3 cwt. of nitrate of soda is equal in value as a fertiliser to 80 tons of farm-yard manure.

Nitrate of Potash (sometimes called **Nitre** or **Saltpetre**). A very concentrated manure, containing both nitrogen and potash, especially adapted for fruit production. Its high price, however, prohibits its general use as a manure. It has been recommended for forking in among tea plants at the rate of about 100 lb. per acre.

Calcium nitrate is manufactured in Norway, and is obtained by extreme heat achieved by means of the electric arc flame, under which atmospheric nitrogen is made directly to combine with oxygen. The chemical combination produces nitric acid gas. The compound is afterwards passed through water and lime, and finally a solid nitrate of lime (calcium nitrate) is obtained.

Potash is found in large quantities in the ash of plants, and is a valuable constituent of manures. It is of special value to starch- and sugar-producing crops, as potatoes, beet, etc., as also to leguminous and fruit-crops; it constitutes the principal ingredient in the ash of fruits. Potash is of special importance in the process of assimilation, in which starch is converted into sugar. It is rarely used as a manure by itself, being usually applied in conjunction with nitrogenous or phosphatic fertilisers. Soils which are sandy or gravelly, or have become exhausted from continuous cropping or from lack of manuring, stand most in need of this form of manure. The chief source of potash salts, of various grades, lies in the saline deposits at Strassfurth and other places in Germany.

Sulphate of Potash usually contains about 50% of potash, and is considered to be the cheapest and best form of applying this fertiliser. In orchards it may be applied at the rate of about 1 lb. per tree; to tea plants, about 112 lb. per acre may be given with buried prunings.

Kainit. A compound of sulphate of potash and magnesia, now much used as a potash manure. It is obtained from Germany, and usually contains 12 to 14 per cent. of potash, and about 35 per cent. of common salt. It may be applied at the rate of about 4 cwt. per acre.

Muriate of Potash, also a product of German potash mines, said to contain about 60% of pure potash.

Superphospate is perhaps the most important and universally used form of phosphatic manures. It is made by treating rock-phosphates, bones, etc., with sulphuric acid, afterwards drying the product. As usually prepared, it should contain about 17% phosphoric acid soluble in water. The form known as "Concentrated Superphosphate" contains about 44% soluble phos. acid.

Basic slag, Basic cinder, or Thomas' phosphate, is a by-product obtained in the manufacture of steel, being the slag ground to powder, formed by the limestone used to extract the phosphorus from the iron ore. It may vary considerably in quality, but should usually contain from 30 to 40% phosphate, and be in a dry powdered state, not lumpy. Basic slag is a valuable fertiliser, especially for fruit trees, roses, lawns, etc., and may be applied at the rate of about 4 oz. per square yard, or to general field crops at the rate of about 5 cwt. per acre.

Phosphate of Lime. All organic manures, and some kinds of chalk and marl, contain phosphate of lime, which is also found in nearly all plants; it supplies phosphoric acid, and forms a valuable application to soils. Phosphatic manures are noted for stimulating plants into vigorous growth, thereby rendering them better able to assimilate the other e ements of plant food in the soil.

Chilinit is mainly composed of the fertilising ingredients in the waste from sugar refineries, and is described thus: "Nitrifying bacteria are cultivated in a portion of the molasses, which is then mixed with lime and sand, and gently dried at a low heat. The product usually contains 3 to 4% nitrogen and 8 to 9% potash."

Calcium Cyanamide, or Nitrolim. A comparatively new nitrogenous fertiliser in the form of fine friable powder, which is prepared by a process of "heating lime and coke to a temperature of 2,500 degrees centigrade in electric furnaces of the resistance type. Calcium carbide is thus produced; the carbide is then heated in retorts, and at 1,100° C. atmospheric nitrogen is introduced and absorbed." The compound thus formed is usually guaranteed to contain 20% nitrogen.

Salt (Sodium Chloride). Common salt, which contains sodium and chlorine, has been used for manurial purposes from very early times, and is considered beneficial, especially to such plants or crops as are naturally indigenous to the sea-side, such as Coconuts, Asparagus, Beetroot, Cabbage, Buckwheat, Mangels, Carrots, etc. Salt in itself is of little, if any, direct manurial value. As an indirect fertiliser, however, it is sometimes of importance in liberating potash and other elements of plant food in the soil. Applied with farmyard manure or guano, it renders these more efficacious by acting on the insoluble nitrogenous matter and forming ammonium chloride. As a preventive of rankness of growth, salt is also sometimes recommended. It is often employed as a manure for Coconuts in Ceylon. Bamber recommends its application at the rate of 1 lb. per tree. For other crops it may be applied at the rate of about 3 oz. per sq. yard. When applied in excess its action is most deleterious, 20% in a soil being considered sufficient to render the latter barren. It is, therefore, sometimes used as a weed-killer.

Manures may be classified under three main heads: (1) *Nitrogenous*, including nitrate of soda, nitrate of lime, sulphate of ammonia, Cyanamide (nitrolim), Peruvian guano, &c.; (2) *Phosphatic*, including superphosphate, basic slag, mineral phosphates, dissolved guano, bones or bone meal, fish guano, farmyard manure, general liquid manures, &c.; (3) *Potassic* (*potash*), including sulphate of potash, muriate of potash, kainit, wood ashes, farmyard manure, urine, green-manure, &c. To these may be added a fourth class, *Calcareous or indirect manures*, including lime, gypsum, chalk, corals, sand, gas lime, magnesia, &c.

Liquid Manure implies the urine of farm stock or drainings of dung heaps, stables, etc., but most manures may be diluted and used in a liquid state. Manure of this description should be applied only to crops or plants in a growing state but in want of a stimulant; it is especially beneficial and convenient to apply to pot-plants, vegetable and flower crops, to which a weak solution may be given as often as twice a week, and has the advantage of being quicker in action and capable of being more evenly and rapidly diffused than solid manure. Liquid manure may also be made simply by dissolving a small portion of some concentrated fertiliser in a can of water, and applied at once; care, however, has to be taken against the dose being too strong, ½ oz. Sulph. of Ammonia to a gallon of water being sufficient to begin with. Or some fresh manure, as cow dung, may be placed in a tank, cask or cistern with water, say in the proportion of one to four by bulk, and well stirred. Liquids or drainings of this nature may also be beneficially applied to manure heaps in order to produce rapid fermentation of coarse organic matter.

Soot or Soot-water. Soot is seldom obtainable in the tropics, except perhaps at certain factories or some up-country bungalows. In countries where it is available, it is considered a valuable manure as well as an insecticide, being used either in a dry state mixed with other manurial substances, or dissolved in water, the latter form being generally preferable. Soot-water is made by placing the soot in a canvas bag, along with a stone to sink it whilst dry, in a cask or tub of water: about ¼ bushel of soot to 10 gallons of water is sufficiently strong. As the liquid is taken out, more water is added until the virtues of the soot are exhausted. It is claimed that the application of soot-water to pot-plants increases the size and deepens the colour of flowers and foliage, and enhances the general vigour of the plants. On cold soils especially, soot is considered useful, as the dark colour of the latter favours the absorption of heat from the sun, and thus tends to the production of earlier crops. A ton of average chimney soot in England contains about 3 lb. of nitrogen, 15 lb. of potash, and 17 lb. of phosphoric acid. Apart from its manurial properties, soot is said materially to assist in controlling the larvae of destructive insects.

Soap-suds, said Dr. Lindley, "have an undoubted value, because of their potash,* irrespective of the organic matter they contain." For potted plants, an occasional application of soap-suds is considered very beneficial. FIRMINGER, in India, said: "I scarcely know of a better and more effective insecticide. By syringing and washing the leaves of potted plants with soap-suds, I have preserved them from the attack of blight, mealy-bug, and other enemies. Plants in a sickly condition have often been restored to health by merely washing their leaves with soap-suds. In fact, if you wish to keep your plants in a luxuriant growth, wash and syringe them with soap-suds once or twice a week, especially those exposed to dust."

* This must refer to soft-soap, since hard soap contains no potash.

COMPOSTS AND MIXTURES

A mixture of different soils, farmyard manures, and decaying vegetable or animal matter, is called a *compost*, whilst a combination of fertilisers, *i.e.*, artificial manures, is generally known as a *mixture*. The combined effect of a suitable mixture containing all the chief constituents of plant-food is more marked, and the application more economical, than if the different ingredients were applied separately. A more even distribution is also assured by a mixture, especially in the case of very concentrated fertilisers which have to be applied in very small quantities. These, if applied in an unmixed or undiluted state, may be actually injurious to the plants.

While many fertilisers may be mixed together with advantage, others are quite unsuitable for mixing, which would result in caking, rapid decomposition, and loss of valuable material Thus sulphate of ammonia, lime, bones, guano and basic slag should not be intermixed; kainit, lime and basic slag may be mixed just before use; nitrate of soda, sulph. of ammonia, bones, kainit, and guano may be mixed at any time, provided the mixture contains also an organic base, as fish guano or castor-cake, &c. See Geehens' Chart, p. 16.

For potting plants, useful composts are prepared by mixing loam or good ordinary soil, leaf-mould, well decomposed manures, and a small proportion of fine sand and charcoal; the proportions used should vary according to the nature of the plants for which they are intended and the texture of the ingredients, but, generally speaking, they may be in the proportion of 2, 1, 1, ¼, ¼, respectively. See p. 79.

A USEFUL GENERAL MIXTURE.

Quantity. Cwt.	qrs.	lbs.		Phos. Acid.	Nitrogen.	Potash.
2	0	11	Sulphate of Ammonia	..	18%	..
1	3	06	Blood Meal	..	11%	..
	3	17	Ordny. Superphos. ..	18%	..	..
	1	06	Bone Meal	22%	3%	..
	3	16	Sulphate of Potash ..	..	..	18%
6	0	00		40	32	18

Quantity per tree: Trees from 2 to 4 feet in height, ½—1 lb. each.
" " 4 " 6 " " 2—3 "
" " 6 " 8 " " 3—4 "

Apply the manure in a circle round the tree, not nearer than 3 feet from the stem for small trees. Forking should be deep, but without turning the soil over, so as to injure the surface roots as little as possible.

THREE GUIDING PRINCIPLES IN MANURING.

Professors Wilfarth and Wimmer have found that the appearance of plants will sometimes afford an indication of what food they are most in need of, thus:

Nitrogen deficiency. When the plants need nitrogen the leaves lose their normal green colour, and take on a light green or a yellowish tint, drying finally with a clear brownish-yellow colour. Nitrate increases the colour and vigour of foliage. So powerful is this influence, that the energies of a fruit-bearing plant may be diverted to the production of foliage by too liberal an application of nitrate.

Phosphoric acid deficiency is indicated by the leaves becoming a deep clear green, almost blue-green colour. With greater scarcity they show, first at the margin and later on the whole surface, dark spots, finally drying dark-brown. Phosphates promote fruitfulness and early ripening of fruit crops.

Potash scarcity is said to be coincident with spots appearing over the whole leaf, the stalk, mid-rib and veins retaining their green colour, the leaf finally curling with its convex side upwards. Potash improves the quality of fruits and flowers, increasing the sugar content of the former, and the scent, size, &c., of the latter.

CHAPTER IV.

GREEN-MANURE OR COVER-CROPS, MULCHING, INTER-CROPS & CATCH-CROPS

Green manuring consists in growing special crops, either alone or intermixed with others, for the purpose of digging or ploughing into the soil in a green state, when they have reached a suitable height, or before flowering. This mode of enriching the soil is one of the most economical as well as efficacious, the fresh vegetable matter being returned to the soil with greater benefit than when it has been decomposed and much of its goodness has been lost in the process of rotting and fermentation. For improving the condition of light sandy soils especially, the application of green-manure or cover-crops is of the greatest value. Briefly, the principal benefits derived are :

(1) The addition of humus or vegetable matter to the soil, which increases its capacity for retaining moisture.

(2) The prevention of surface-wash or soil erosion on steep land.

(3) The improvement of the mechanical condition of the soil by the action of the roots of the green-manure plants or cover-crops.

(4) The protection of the soil and roots of crops from the excessive heat of the sun.

(5) The suppression or reduction of weeds, and therefore economy of labour.

(6) The fixation of atmospheric nitrogen in the soil by leguminous plants, especially those of the sub-order *Papilionaceae*.

Whilst practically all plants are useful for adding organic matter to the soil when dug into it in a green state, yet all are not equally valuable. However well the first five of the foregoing benefits may be achieved by the use of non-leguminous plants, it is generally believed that only leguminous species have the power of utilising and fixing the free nitrogen of the air. See pages 14, 446.

In selecting plants suitable for green-manuring or cover crops, those which are more or less of a herbaceous character and rapid growth, capable of forming a good cover in a short space of time, should be chosen. Creepers or climbers are not usually so suitable as bushy herbaceous plants, and, if used, care must be taken that they do not twine round the stems of the growing crop. The following are recommended for the purpose, all belonging to the family of *Leguminosae* except where otherwise mentioned :

Astragalus sinicus. Small shrub, extensively grown in China and Japan as a soil renovator on paddy land.

Cajanus indicus. Pigeon-pea ; Dhall ; Rata-tora, *S.* Shrub, 6 to 7 ft. Sea-level to 3,000 ft. See p. 285.

Canavalia ensiformis. Sword-bean ; Wal-awara, *S*; Koli-avarai, *T*. Perennial twiner or creeper (also a bush form) suited to low-country. Young pods and seeds edible. Large seeds ; sow singly at 2 to 3 ft. apart, say 8 lb. per acre.

Cassia hirsuta. Perennial shrub, 4—5 ft., hairy foliage.

Centrosema Plumieri. Butterfly Pea. Small, annual, slender, creeper, of Trop. S. America, with trifoliate leaves, and large white flowers with a dark crimson centre. 1 lb. seed will sow an acre if dibbled in at 2½ to 3 ft. apart. Naturalised in Ceylon at low elevations. *Centrosema pubescens*, a similar species, of S. America, is used as a ground cover in Java, &c.

Cicer arietinum. Chick-pea ; Kadala, *S*. Annual herb, 1 ft. high. See p. 286.

Crotalaria juncea. Sunn-hemp ; Hana, *S*. An erect annual, shrub, 5 to 6 ft. Semi-dry low-country. See *Fibre Plants*, p. 424.

C.—striata. Herbaceous shrub, 3—4 ft. Low-country up to 3,000 ft. Sow in rows about 2 ft. apart, say 2 lb. seed to the acre.

C—Walkeri. (=C.—semperflorens). Perennial herb, 2—3 ft. Montane zone.

Desmodium Wightii. A perennial herb, 3—4 ft. high. Low-country.

D.—triflorum. Hin-undupiyali, *S*.—Very small creeping clover, small trifoliate leaves, sometimes forming close cover on dry rocky soil. Common in turf, drought-resistant. Does not thrive in shade. See *Lawns*, p. 71.

Dolichos biflorus. Horse-or Madras-gram ; Kollu, *S*. Small, close-growing, perennial, twining herb. See p. 310.

D.—Hosei. Creeper. Forms a dense covering in a short period. Considered by some to be one of the best plants for ground-cover. Does not seed freely.

D.—Lablab. Dambala, *S*. Low climber or creeper. See p. 286.

Indigofera aspalathoides. Sivanarvempu, *T* ; Rata-kohomba, *S*. Low shrub.

I.—endecaphylla. A small, close-growing plant, 12-15 in. high, forming a close cover.

I.—tinctoria. Indigo. Nil-awari, *S*. Shrub, low-country, 3—4 ft. See p. 438.

I.—viscosa. Annual, 2-3 ft., common in dry region.

Leucaena glauca. "Lamtoro." Small tree with very fine bipinnate leaves. See p. 206.

Mikania scandens. (*Compositae*). Loka-pa-lu, *S*. ("World ruin"). Annual, quick-growing, spreading, herbaceous creeper ; flowers October—January, scented. Cattle relish it. Sometimes known as "A mile a minute." See *Weeds*, p. 475.

Mucuna utilis (=Stizolobium deeringianum). Velvet-bean, &c. Annual twiner or creeper Thrives in low-country up to 3,000 ft. See p. 288.

Phaseolus lunatus. Bonchi, or Dambala, *S*. Herbaceous twiner. Thrives up to 3,000 ft. or higher. See under *Tropical Vegetables*, p. 289.

P.—trinervius. Jerusalem Pea. Perennial twining herb, with yellow flowers and hairy stems ; common in Ceylon, India, &c.; 1000-4,000 ft. elevation.

Psoralea corylifolia. Bodi, *S*; Kavoti, *T*. Annual, 1—3 ft., dry region.

Pueraria thunbergiana. Kudzu ; Ko-hemp. Herbaceous creeper, much cultivated as a ground-cover in China and Japan. Starch is obtained from the tuberous roots, and fibre from stems ; leaves and shoots edible. See *Fibres*, p. 431.

Sesbania aculeata. Danicha or Dhanicha (India). Annual, 3—5 ft. Common in low-country, especially dry region ; often a weed in paddy fields.

Tephrosia purpurea. Kavilai or Kolinchi, *T*; Pila, *S*. Perennial herb, 2—3 ft ; common in low-country. Used in Jaffna as green-manure for Tobacco.

T.—candida. Boga-medeloa. Shrubby perennial, 4—7 ft. high. Soft, pubescent foliage; white flowers. Suited up to about 4,000 ft. Yields 4 cuttings a year, or 58 tons green manure per acre. Re-sow after 3 years. Sow 3 seeds together in holes 3 ft. apart, between crops, using about 2 lb. seeds per acre. $.

Trifolium alexandrinum. Berseem, or Egyptian clover. Much esteemed in Egypt as a soil renovator and forage crop, especially on marshy land. See *Fodder Plants*, p. 452.

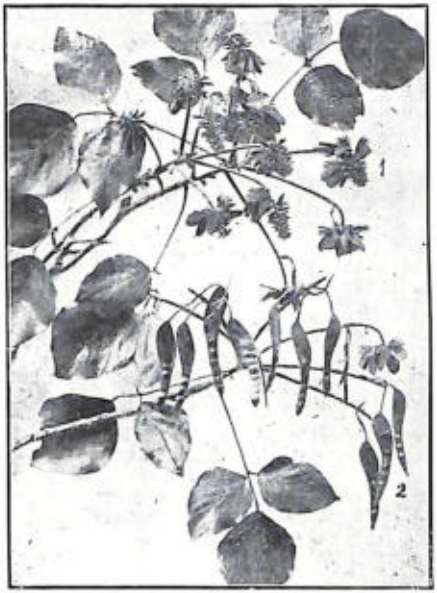
Vigna Catiang. Gas-me, *S* ; Cow-pea.—Perennial twining herb ; also a dwarf bush form. See *Tropical Vegetables*, p. 290.

V.—oligosperma. =Dolichos Hosei.

(For trees suitable for lopping or green manure, see p. 214.)

MULCHING OR SURFACE-DRESSING.

The practice of mulching or surface-dressing, as already mentioned, is of very considerable benefit to growing crops, and during dry weather its adoption is especially to be recommended. Mulching prevents the surface soil from forming a hardened crust, and thus retards the evaporation of moisture; it forms humus in the soil, and checks the growth of weeds. The mulch may consist of green vegetable matter or leaves, stable litter or other refuse, which may be spread over the surface of the ground, and either lightly forked into the soil or merely left on the surface as a protective covering. Leaves obtained from the jungle, or any rapidly decaying organic matter that may be available will answer the purpose, but certain plants, *i. e.*, the Leguminous family, are more valuable than others, owing to their larger nitrogen content. (See Page 25). The following are some of the principal shrubs or trees whose leaves or young twigs are commonly used for mulching in Ceylon. See also *Shade Trees for Field Crops*, page 214.



DADAP.—*Erythrina lithosperma.*
1, SCARLET FLOWERS; 2, PODS.

Adhatoda vasica. Adathodai, *T.* Shrub, 5—7 ft., commonly used in the north of Ceylon as a green dressing for field crops.

Aleurites triloba. Candlenut-tree; Kekuna, *S.* Leaves collected and spread on the field and ploughed in.

Azadirachta indica. Margosa; Kohomba, *S.* Leaves used as mulch in Tobacco cultivation at Jaffna, &c. See pages 206, 212.

Calotropis gigantea. Wara, *S.* Large, quick-growing shrub. See p. 429.

***Cassia auriculata.** Ranawara, *S*; Avarai, *T*; Matara Tea. A sea-coast shrub, 5—8 ft. See p. 378.

Croton lacciferus. Keppetiya, *S.* A small tree; leaves commonly used as a mulch in Betel cultivation.

***Erythrina lithosperma.** Dadap; Muringa-mara, *T.*—See p. 214. §

Ricinus communis. Castor-oil Plant. See under *Oils*, p. 388.

Tabernaemontana dichotoma. Divi-kaduru, *S.* A small tree; leaves used for mulching paddy fields in low-country.

***Tamarindus indica.** Tamarind; Siyambala, *S.* Leaves commonly used for surface-dressing for Tobacco, in dry region. See p. 213.

Thalassia Hemprichii and other species of Sea-weeds. Chatalai or Sathalai, *T.* Commonly used as mulch for coconuts and paddy fields near the coast.

Tithonia diversifolia. Mexican Sunflower. Used as dressing on paddy fields, &c. See also *Weeds*, p. 476.

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* Leguminous family.

INTER-CROPS AND CATCH-CROPS.

The growing of two or more crops together on the same land has certain natural advantages over the exclusive cultivation of single products, and although for economic reasons the latter system is usually adopted, it obviously lends itself to the spread of pests or diseases. Plants in their natural state, where numerous species and families are found growing together, are not so subject to such enemies as are large areas of single products.



BOGA-MEDELOA.—*Tephrosia candida.*

Advantages of subsidiary crops. From a practical standpoint the main advantages claimed for inter- or catch-crops are: (1) revenue may be obtained during the interim of waiting for a main crop which takes several years to come into bearing, *e.g.*, Rubber and Coconuts; (2) weeds are kept in check, and therefore costs are reduced.

Disadvantages. On the other hand, the practice of intercropping may have serious disadvantages, more especially when unsuitable combinations of products are chosen. The soil may become unduly exhausted, the inter-crop or catch-crop may retard the growth of the principal crop, and the proper attention of the management and labour force may be diverted from the latter, while the cost of harvesting may be considerably increased. Nevertheless, there is always a demand for suitable quick-yielding temporary crops for planting among slow-growing perennial crops, such as Rubber (Hevea) and Coconuts.

The following are examples of crops suggested for inter-cropping or catch-cropping. The former term implies crops of a perennial nature, while the latter indicates annual crops, or those of short duration and yielding quick returns.

Inter-crop examples.—*Tea with Hevea Rubber*, the latter at the rate of about 30 trees to the acre, at low elevations.

Cacao with Hevea Rubber, the latter at the rate of about 30 to the acre and serving as shade trees.

Cacao with young Coconuts, until the latter come into full bearing.

Coca (*Cocaine*) *with Hevea Rubber*, until the latter covers the ground.

Coffee, especially C. robusta and C. Quilou, much grown with young rubber in Java, Sumatra, &c.

Coconuts and Rubber, sometimes planted in alternate rows.

Citronella or other oil grasses with young Rubber, the latter being widely spaced.

Pepper as a creeper on shade trees among Tea or other crops, or on trees along roadsides, etc., at low elevations.

Vanilla as a creeper on shade trees, among Tea or other crops, or along roadsides, etc.

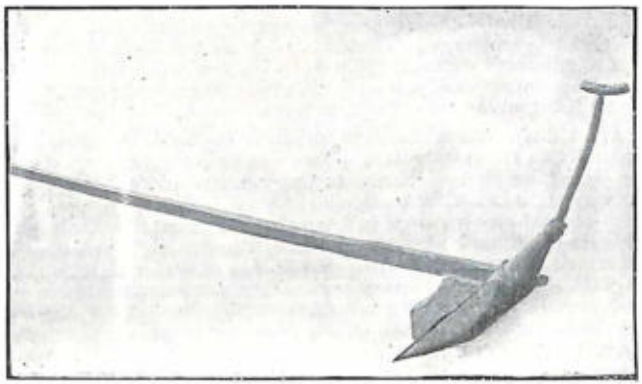
Ipecacuanha, grown as an inter-crop in Brazil, also to some extent on young Rubber plantations in Malaya.

Catch-crop examples.—Annual crops, such as cotton, cassava (tapioca), chillies, gourds, ground-nuts, arrowroot, tobacco (grown on young rubber clearings in Sumatra), &c.

CHAPTER V.

SOIL OPERATIONS

Tillage. The main objects of tillage, whether in the form of digging, forking, ploughing, or otherwise, are: to loosen the soil so as to facilitate the absorption of rain and the admission of fresh air ; to enable the roots of growing plants to penetrate the soil more easily, and to control the growth of weeds. Tillage should aim at maintaining a proper supply of moisture in the soil, rendering the latter permeable to rain and encouraging the activity of soil bacteria. It is the first essential of cultivation, more especially for root-crops. Plants can only obtain the full benefit of manures when the land is maintained in a proper state of tilth. Deherain showed that " trituration or pounding of the soil is a powerful method of causing active nitrification." According to an old adage,

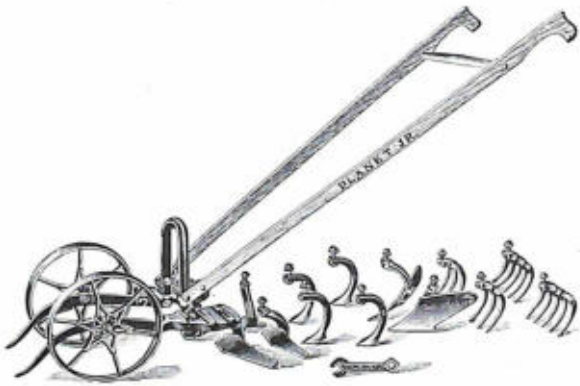


KANDYAN PLOUGH.

" Tillage hinders 'vaporation,
Tillage works weed 'radication,
Tillage helps food 'laboration."

Modes of Tillage. The different methods employed for tilling the land vary considerably in different countries, according to the means available, though the principle underlying all is the same. From the wooden spikes or flint spears which in early times served the purpose of stirring the soil, as they do even now in some primitive countries, to the modern steam or motor plough used on large farms, is a great stride in the evolution of agriculture. Digging by means of spade, fork, mamoty, or kodali (see *Tools &c.*, p. 60) is adapted to certain confined areas, as gardens, etc., but ploughing, followed by harrowing or similar means of levelling and smoothing the surface, is the most economical and practical method for preparing the ground for general field crops. Ploughing as generally carried out in the East, with buffaloes or oxen as draught animals, is usually of a very primitive nature, the soil being stirred or forked rather than turned over as a furrow. In

some cases it is merely puddled or churned by means of wading buffaloes or bullocks, being first softened by being flooded with water.



THE "PLANET JR." DOUBLE WHEEL HOE CULTIVATOR, RAKE, AND PLOUGH.

The so-called plough generally used by the peasants of Ceylon, India, etc., consists of a simple wooden implement with a small iron pointed socket for a coulter. The whole plough may weigh but a few pounds, so that a cooly can readily sling it on his shoulders and carry it to wherever desired. Heavier and more substantial ploughs have from time to time been introduced, but so far the natives generally prefer their own primitive article as being more suited to their requirements.

Use of explosives in Tilling. As a means of breaking up hard, impervious soil or sub-soil, more especially in the preparation of large holes for planting trees, the practice of exploding dynamite charges buried in the soil has recently been much advocated and is generally attended with beneficial results. The immediate effect is to break up the hard pan or lower stratum in a way which cannot be achieved by deep ploughing or trenching. A hard sub-stratum may thus be made penetrable to the roots of plants or crops, allowing of the free percolation of water and liberating essential elements of plant food. For ordinary sub-soiling, a 2 oz. cartridge to each hole (costing about 4*d*., or 25 cts. of a rupee) is sufficient. More powerful charges of 3 4 cartridges may be used for blowing up tree stumps or breaking obstructive boulders, but in this case the operator must seek protection behind a tree or other object after lighting the fuse.

For holing purposes, the method of procedure is thus: Bore a hole with a crow-bar where planting is to be done, about 2½ feet or more in depth. At the bottom of the hole, place the cartridge of dynamite, provided with a detonator and fuse. Then fill the hole with moist earth and press down gently, leaving about 15 in. of the fuse projecting on the surface. On exploding the cartridge, the surface of the earth will be seen to rise a few inches and subside, and after a few minutes smoke follows from the cracks in the earth. On removing the earth loosened by the explosion, it will be found that a round hole has formed at the point where the cartridge was laid, with innumerable fissures extending for a few feet into the surrounding soil. Dynamiting is especially beneficial in the planting of trees, the hard gravelly bottom of the holes being well broken up by exploding a charge as above.

Fallowing is sometimes adopted for restoring fertility to the land, after the crop has been harvested, as in the case of annual crops. The cropping being stopped, a rest is provided for the soil, during which a new supply of plant-food is stored up, and this becomes available for the succeeding crop. For the more permanent crops, however, such as Tea, Cocoa, Coconuts, and Rubber, fallowing cannot obviously be adopted, and manuring and tillage operations must then be relied upon to meet the requirements of the crops grown. Fallowing is considered to have also the effect of ridding the soil of plant diseases and insect pests.

ROTATION OF CROPS.

Plants differ, as shown by their ash, in the relative proportions of plant-food they require and obtain from the soil. Therefore when successive crops of one kind are grown on the same ground, those elements which are most consumed obviously become exhausted. Consequently the soil becomes "poor" or unproductive, the crop weak and sickly, and even the application of costly manures may not satisfactorily restore fertility. See p. 493.

The principle of rotation is to prevent two crops of the same kind succeeding each other. Its advantage is undoubted, and in some temperate countries its adoption is often made a compulsory rule in the farmer's lease. Nevertheless, there are cases in which the same kind of crop is, with suitable manuring, successfully grown in the same soil for many years without change, as rice, sugar-cane, etc. In the tropics rotation is often impracticable, owing to the fact that many of the crops grown are of a perennial nature and, once planted, last from a few to a great many years, *e.g.*, Rubber, Tea, Coffee, &c. But wherever possible, as in the case of garden or annual crops, whether vegetable or flowering plants, the principle of alternating crops should be practised. This is more especially necessary in the case of the wasteful method of chena cultivation, common in parts of the tropics, by which virgin land is cleared, cultivated for a season or two and then abandoned for a number of years.

In the practice of rotation other benefits accrue. Certain roots penetrate the ground deeper than others; these aerate the subsoil and, when the crop is removed, remain in the ground to rot. Fungus diseases and insect pests are checked, as these may die of starvation when a crop on which they do not live or feed intervenes. Weeds, too, are thus checked or exterminated. When plants of one kind are grown together in great numbers and for many succeeding years, they are prone to attacks of insect pests and diseases. Any system of rotation adopted must, of course, vary according to the variety of crops it is desired to grow. Willis recommended the following 4-year course for chena lands in Ceylon :—

First Year: Tobacco, Indian-corn or Maize, Cotton.

Second Year: Root crops, *e.g.*, Cassava, Sweet-potatoes, Yams, Arrowroot, Onions, Ginger, Turmeric, etc.

Third Year: Dry grains, (*e.g.*, Kurrakan,) Chillies, Gingelly, Gourds, small fruits, Castor-oil plant, grasses for fodder, Mustard, Murunga.

Fourth Year: Gram, Ground-nuts, Peas or Dhal, or other leguminous crop.

For Tobacco land, Mr. C. Drieberg recommends a 3-course rotation, thus :— (1) Tobacco; (2) Cotton, or leguminous crop, *e.g.*, Beans, Grams, Ground-nuts, etc.; (3) Grain-crop, *e.g.*, Paddy, Kurrakan, Amu, Maize, etc.

For garden crops, the following rotation is recommended :—(1) Cabbage, (2) Carrots or Beet, (3) Peas, (4) Celery, (5) Potatoes.

IRRIGATION.

Irrigation is practised chiefly in dry countries, where the cultivation of crops may be entirely dependent upon it, as in the northern part of Ceylon. In a moist climate, as in the south-west of Ceylon, irrigation is necessary only in the cultivation of Rice or other aquatic crops. Intermittent irrigation may, however, be applied with good results to other crops, especially fruit crops, in localities where the rainfall is limited or unevenly divided over the seasons.

The methods of accomplishing irrigation are variable and depend upon the facilities which the situation offers, the water being conveyed from natural sources or artificial reservoirs to the land by means of canals, streams, pipes, or spouts, or raised from artesian or other wells. In parts of India and in the dry districts

of Ceylon, irrigation water is hauled up from deeply sunk wells by means of a long pole or tree-trunk balanced on the principle of a see-saw over the well, the balancing being done by 3 or 4 coolies who walk up and down the pole, the heavy end of which each time it comes up from the well brings up a bucket-ful or bag-ful of water, which is emptied into channels by a man standing at the well side.

A mode of raising water in general use in India is by means of a large bag made of bullock-hide ; the bag is suspended from a pulley over the well, and is drawn up by a pair of bullocks as they are made to run down a declivity. The " Persian wheel " method of raising water is commonly adopted in Northern India. This consists of a large vertical wheel, fixed in the mouth of a well ; over it a looped chain of earthenware pots is suspended, the lower of which reach the water. As the wheel revolves, one length of the chain is continually rising with pots of water, which discharge themselves into a trough fixed at the summit, and return empty to be filled again. The vertical wheel is worked by means of bullocks tied to a beam and a horizontal wheel. Wind-mills also are sometimes employed very successfully for raising water from wells.

Different systems of irrigation are adapted to different countries, according to local circumstances. A simple method is to conduct the water through the land in small channels, the soil obtaining its supply by the water percolating through the porous earth. The " catch-work " method is adapted for sloping land, and consists of a series of transverse trenches or channels; the water is conducted through the upper trench, runs along the surface and escapes through regular outlets into the next trench, and thence to the one below, and so on. Similar to this is the " terracing system," which is carried out extensively in rice cultivation on hill-sides in Ceylon, where it forms a striking feature in the landscape. (See *Rice*, p. 363). Artesian wells and tube-wells are largely used in some countries, as in Australia and parts of India, being especially suitable where the soil is loose and sandy, but are not adapted to localities where the latter is of a clayey or hard laterite nature.

In some countries, where large rivers run through low-lying land, as in the case of the Nile in Egypt and the Ganges in India, the river itself is allowed to run over the land when in flood and full of rich mud. As the water subsides the mud is deposited on the land, which is thus greatly increased in fertility. Sir W. Willcocks estimated that one good deposit of slime or mud, brought down by the Nile from the detritus of volcanic rocks, could produce six excellent crops in succession. With such extensive irrigation works as have recently been made in Egypt and India, irrigation becomes less dependent upon the fluctuating rises of the great rivers. Some of the larger irrigation tanks in Ceylon have an area of over 4,200 acres, and resemble large and beautiful lakes. An important principle of irrigation is that the water supplied must neither be excessive nor allowed to remain on the land so as to become stagnant. Therefore provision must always be made for its overflow and free movement. See page 3.

DRY FARMING.

The term " dry farming " is applied to a system of cultivation adopted in dry districts, without irrigation, the object being to conserve moisture in the soil, or to increase the capacity of the latter for storing water, mainly by the following means :

(*a*) Deep and thorough preparatory tillage ; (*b*) level culture ; (*c*) " packing " the soil with a " sub-soil packer " and heavy rolling. A sub-soil packer is an implement the object of which is to press the soil under the surface, while the surface-soil is left in a loose condition.

Supplementary to these operations are frequent inter-tillage, deep sowing, wide spacing, and the selection of deep-rooting and drought-resistant varieties. In the case of grain crops, the seed should be soaked for a brief period before sowing so as to ensure rapid and uniform germination, while planting should be followed by pressing the soil round the plants. By observing these rules increased crops are said to be obtained in districts where the annual rainfall is small.

DRAINAGE AND SOIL EROSION.

Proper drainage, whether natural or artificial, is essential to all cultivated soils. The objects of drainage are, briefly, to enable the rain to become absorbed by the soil and pass through it; to render the soil porous, whilst maintaining a sufficiency of moisture for the crops; to remove superfluous moisture and prevent stagnant water remaining in the soil. A porous soil contains small spaces between its particles, and these, when not occupied by water, are filled with air, which conduces to bacterial activity and nitrification and is essential to plant-growth.

Some lands are naturally well-drained, so that when rain falls on them it percolates through without leaving the soil sodden or saturated. Soils which are not properly drained become water-logged, acid, and cold, causing the crop, if any, to suffer from "wet feet," or the roots to rot off from the ends. Water is colder than air, and a wet soil is therefore always colder than a porous one.

Surface or Contour drains. Open trenches at certain intervals are essential on steep lands, so as to prevent or check soil erosion, *i.e.* the washing away of the surface soil caused by torrential rains. This system of drainage is extensively employed throughout the Tea-planting districts, and is indispensable to the preservation of the soil. The drains are usually about 1½ to 2 ft. in depth, with a gradient of about 1 in 25, or preferably 1 in 40. The distance apart varies according to the gradient and physical characteristics of the land. On very steep land and in dry localities the gradient may be reduced to a minimum, while the distance between the drains should not be more than 25 to 30 ft.; on gentle slopes the latter may be as many yards. Catchment pits should be made in the drains at intervals of 50 ft. or so.

Drains in the tropics should, whenever possible, be open, not closed over. In gardens or ornamental grounds, however, open drains are unsightly, if not impracticable, and for that reason they should as a rule be covered, notwithstanding the extra cost thus incurred. In making a covered drain, drainage tiles or stones should be placed in the bottom of the trench, large spaces and crevices being left in the bottom, finishing with a layer of smaller pieces; brushwood, fibre, or straw should be placed over this, and the soil then filled in. See *Drains and Culverts*, p. 65. By terracing steep land, as in a garden, the necessity for drains is largely obviated.

Horizontal Hedges of Leguminous shrubs, as *Tephrosia candida*, *Indigofera arrecta*, *Clitoria cajanaefolia*, &c., planted across steep hill sides is an excellent method of preventing erosion. They may be planted at intervals of 10 to 20 yards, or more or less according to gradient.



CHAPTER VI

PROPAGATION

Plants are propagated in various ways; some which increase at a rapid rate by one method cannot be similarly raised by another, while in some cases all methods of propagation fail. The following are the principal modes of propagation in use:

Propagation by Seed. This is the most natural mode of increase, and is the one by which the vast majority of plants naturally spread and produce their kind, the offspring being more or less true according as the flowers are not disposed to be fertilised by foreign pollen, or cross-fertilised. The production of seed may be said to be the aim of the life of every plant in a state of nature. But exact counterparts of the parent plants cannot be ensured by raising from seed; therefore, propagation by vegetative means, as by cuttings, buds, grafts, etc., is often resorted to in high cultivation. See p. 229.

Selection and Saving of Seed. In the raising or saving of seed of most kinds, it is important that selected plants or trees should be set apart as seed-bearers and cultivated with special care, so as to encourage the production of perfect and well-nourished seed.

The seed from each should be sown separately, each batch of seedlings transplanted to a separate plot, the crop measured or weighed, and the results recorded. In this way the parental plants are tested by their performance. It is also advisable, where practicable, to select seeds individually, eliminating weak or inferior ones. Unproductive plants or imperfectly formed flowers or fruits should be removed where possible. Vigour may be concentrated in the seed by thinning out the fruits, retaining only the best. This not only applies to annuals grown for ornament or use, but also to fruit-trees, Tea, Coconuts, Cacao, Coffee, Cotton, Rubber, and other products. It is of importance that seeds should be perfectly ripe before they are gathered, as otherwise their germination and the vitality of the seedling will be affected. Change of seed from one district to another has often a beneficial result on the crop, and the practice is generally to be recommended. See *Plant Breeding*, p. 46.

Vitality of Seeds. It may be assumed that most seeds germinate best if sown as soon as ripe. In the case of some species, however, the seed, if carefully stored, may retain vitality for several years, *e.g.*, many leguminous and palm seeds; but after full maturity, all seeds, it may be stated, decline appreciably in vigour with age, and the progeny of old seed is generally less robust than that from seed recently harvested.

In the case of plants of the Gourd family (*Cucurbitaceae*), however, seed which is not quite fresh is sometimes preferred, as this is considered to yield plants of a more fruitful and less leafy nature. Certain hard-coated seeds, as Manihot (Ceara-rubber), are said to germinate best when at least a year old. See *Testing Vitality of Seeds*, p. 36.

Sowing Seed. Seeds vary in size and character so much that no hard and fast rule can be laid down for sowing. Most seeds, however, are best sown in fine, light soil which has been well worked and made easily permeable to the young roots and plumule. The soil surface should be lightly and evenly pressed; this will ensure the seeds being sown at a uniform depth and aid in maintaining a moist surface. If the presence of insects or snails' eggs be suspected, boiling water may first be poured over the seed-bed in order to kill those within reach. The proper depth at which seeds should be sown varies according to their size. A good general rule is to cover seeds to a depth equal to their smallest diameter, but to this rule there are many exceptions. Large seeds should not be buried much below the surface, whilst very small seeds may as a rule be covered $\frac{1}{2}$ of an inch. Peas, beans and seeds of similar size may be sown at a depth of about 2—3 inches, whilst for smaller seeds, as onions, carrots, beet, etc., about half that depth is sufficient. Seeds sown in a field, plot, or nursery-bed require to be buried deeper than is necessary for germination, so as to protect them from vermin, etc., and to allow for soil-wash by heavy rains. Seeds which take long to germinate, as nutmeg, palms, etc., should be sown at least an inch below the surface. In all cases of garden or field crops, the seed should, whenever practicable, be sown in rows, never broadcast if avoidable. Sowing in rows economises seed and facilitates attention to the crop in regard to weeding, watering, thinning out, etc. See p. 46.

Sowing at stake, or *in situ*, which is sometimes adopted in the case of field crops as Rubber, Tea, etc., consists in sowing seed in the position which the plants are to occupy when grown up; thus, holes are prepared in lines and filled in, the centre being marked by the stake used for lining; 1-3 seeds are sown close to the stake, the weaker seedlings being afterwards removed as may be required.

Bulking Fine Seed. In sowing very small seeds, as those of some annuals and vegetables, one is very liable to sow too thickly. A good plan is to "bulk" such seed by mixing with it finely sifted dry soil or saw-dust, as this enables the seed to be sown more thinly and evenly than could otherwise be possible. When seedlings are large enough to handle they should be carefully thinned out or regulated, retaining the stronger ones and discarding the weaker. Large seeds are in some cases affected in their germination by the position in which they are sown, although this is a matter seldom taken into account by cultivators. Deformity in seedlings is often due to faulty position of the seed in germination, the shoot or plumule in consequence becoming entangled with the stalk of the seed-leaves (*cotyledons*). Generally speaking, the micropyle or root end of a seed should be downwards. Petch found that out of 50 Hevea seeds sown horizontally, with the inner or flat surface downwards (considered the proper position), 48 germinated normally, while from a similar number sown vertically with the micropyle uppermost, only 9 normal plants were obtained. In the case of Coconuts, it is customary to sow the nuts on their side, with the stalk or broad end slightly raised, half covering the nuts with soil.

Basket-or Bamboo-plants. For most trees or shrubs, an excellent plan is to sow the seed in plant-baskets or bamboo pots; if plentiful but of uncertain germinative capacity, two or three seeds may be sown together, the weaker seedlings being afterwards removed, leaving only one in each basket or bamboo. This method of raising plants not only facilitates transport, but also enables the plants, with their roots in the soil intact, to be planted out almost irrespective of weather conditions. Thus, the advantage of basket-plants over "stumps" or seedlings from nursery-beds is obvious, and the former are usually well worth the extra cost entailed. Where baskets are not obtainable, sections of bamboo with one node left intact, except for a hole pierced through it for drainage, will answer the purpose; but these, unlike the plant-baskets, must be removed when planting out. This is easily accomplished thus: split the bamboo pot along two sides with a blow from a knife; lay the plant on its side and invert the two halves of bamboo; thus the latter can be easily removed when the plant is fixed in position in the hole, and the soil filled in around it.

Germination of Seeds. The seed consists of three distinct parts, viz., the germ, the body, and the skin. The germ (*embryo*) comprises a rudimentary plant, with the leaves and stem in an undeveloped state. The body (*endosperm*) is the reserve food which nourishes the embryo in the process of germination, until the root is advanced enough to derive nutriment from the soil. The skin or shell (*testa*) of the seed is for the purpose of protection. Four conditions essential to

successful germination are : (1) a certain amount of moisture, (2) a favourable degree of heat, (3) fresh air, and (4) protection from strong light. In the absence of any of these conditions successful germination cannot take place. When the seed-coat or shell is hard and horny, it precludes air and moisture from the embryo, and thus prevents germination until it has sufficiently decayed. Seeds with a very hard shell or endosperm take a long time to germinate, varying from 3 or 4 months, *e.g.*, nutmeg, to a year or more, as in the case of certain palm seeds. In some cases, however, germination may be assisted by filing or rasping the horny shell, as in the case of Ceara-rubber seed (*Manihot*), while in the case of seeds with a very hard endosperm, as *Canna*, or hard testa, *e.g. Acacia* and other leguminous species, they may be soaked for about 3 days in almost boiling water.

The rasping or filing process may be carried out by holding the seed for a few seconds against a revolving grind-stone. A cooly with a seed in each hand, while another cooly turns the handle, will thus soon get through a large number of seeds. The "bush method," sometimes adopted for hard-shelled seeds, is to burn a bundle of hay or ferns over the seed-pot or bed, afterwards watering the soil with a fine rose. Another successful way of facilitating the germination of very hard seeds is to place them in a hot fermenting dung-heap for 2 or 3 weeks. This has been found successful in the case of *Canna* (Indian-shot), *Manihot* (Ceara-rubber), *Elaeis* (Oil-palm) and others. Soaking such seeds for about 5 minutes in a solution of sulphuric acid is also reported to have had good results. Other aids in hastening germination are : soaking the seeds in a solution of camphor with water, or in chlorine water (2 drops chlorine to 60 CC. of water), or in a weak solution of formic acid (1 in 500), or in a solution of ammonia. Some seeds germinate naturally in the fruit, *e.g.*, *Sechium edule*, *Rhizophora*, *Vateria*, etc.

Testing vitality of seeds. A popular way of testing the vitality of seeds is to place them in water ; if they float, they are presumed to be bad, and the reverse if they sink. This, however, is sometimes misleading, as some seeds float though perfectly germinable or sink when in a bad condition. Seeds will either sink or float according to their specific gravity often irrespective of their germinative capacity. However, those which sink when good are of doubtful character when they swim, and *vice versa*. A strong saline solution, made with common salt, is employed in Japan for testing rice and other seeds. In this case all seeds that float are rejected and those that sink selected for sowing. A practical test is to cut or break open a certain percentage of seeds from a representative sample ; if in good condition the interior of the seed will present its natural firm consistency. The surest test of vitality, however, is to sow a small representative quantity under the most favourable circumstances, as in specially prepared pots or beds under shelter, or on wet flannel or blotting paper under cover. The proportion of seeds which thus germinate will afford proof of the quality of the seed. It is a good plan when seeds are of doubtful quality to soak them in hot water previous to sowing ; very often this may add 20 per cent. or more to the rate of germination which would otherwise be obtained. See p. 34.

Acclimatized seed. This term is applicable to seeds of any introduced and acclimatized plant, but in India it refers to "English" annuals and vegetables which thrive sufficiently well to produce good seed, capable of yielding satisfactory crops. It has been found that in some cases such seeds give better results, at least for a time, than imported seeds. Certain flowering annuals produce good seeds in the hill districts in the tropics, but seed of "English" vegetables grown here is seldom worth saving. As a general rule, cultivation in the tropics has a deteriorating effect on the quality of all flowering plants and vegetables from temperate climes. Therefore, imported seeds and fresh strains usually give the best results, and these are easily procured fresh from nurserymen.

Seeds of Aquatic Plants (water-plants), such as *Nelumbium*, *Nymphæa*, *Victoria regia*, etc., should be sown in clayey soil in pots submerged in shallow water. The pots should be raised on bricks or such like supports, so as to bring them close to the water surface, thus securing greater warmth from the sun's rays than if placed deeper. Shallow still water is always the warmest.

Fern Spores should be sown upon fine sandy loam in well drained pots or boxes. The spore-cases should be gathered before they have burst, and the spores sown at once. The top soil at least should be sterilised by watering with boiling water, afterwards scattering the spores over the surface. The box or pot in which these have been sown should then be stood in a saucer of water, with a pane of glass placed

over the top. Instead of separating the spores from their cases (*sporangia*), fragments of mature fronds may be laid on the surface of the prepared soil, when the fine spores will drop out. Neither covering of soil nor watering is required, it being sufficient to keep the vessel in which the pot is placed filled with water, as already described.

Orchid seed. See *Orchids*, page 144.

Propagation by Cuttings is, with the exception of seeds, the commonest method of propagation, and has the advantage of reproducing the characters of the parent as if the cutting were still a part of it, whereas the special characters of the parent are not always perpetuated from seed. In the tropics, a very large proportion of plants and trees may be readily propagated by cuttings, provided these are inserted in damp soil during rainy weather. Some species, as Dadap (*Erythrina lithosperma*), *Gliricidia*, &c., strike root so easily that if stems or branches are used as fence posts they will rapidly develop roots and sprout into leaf. In other cases, however, as with species characterized by hard wood or hollow stems, it is difficult, if not impossible, to induce cuttings to strike root. For successful propagation by cuttings, the following conditions are important: (1) firm and sufficiently ripened shoots from which the cuttings are taken; (2) a suitable rooting medium composed of a light porous sandy soil, or fine, wet sand only; and (3), if possible, a higher temperature with closer atmosphere than those in which the plants grow normally.

All cuttings should have the soil well pressed around them. It is believed that cuttings usually strike root more readily if inserted in the ground sloping-wise instead of erect, and in the East the native gardeners invariably practise the former method, not only in planting cuttings of general ornamental plants, but also field crops, as Cassava, Sugar-cane, as well as hedges, &c. The explanation probably is that the cutting is thus more firmly fixed, and that there is less evaporation of moisture from the buried end.

Preparing Cuttings. The end of the shoot to be in the ground should be cut across with a clean slanting cut, through or just below a node or leaf-bud. The lower leaves should be cut off, leaving 3 to 4 eyes or buds to be under the soil when planted; the upper leaves, if of a large size, may be reduced to half. The best size for a cutting depends upon the nature of the plant. In hard-wooded species the cuttings are best small, but with soft-wooded kinds it is necessary to take rather large cuttings with a certain amount of firm woodiness; cuttings of young, succulent, immature growth are liable to decay. Conifers and laticiferous plants will, it is considered, strike best if the lower end of the cutting is plunged into almost boiling water, the effect being to prevent the resin or latex from forming a hardened mass at the end. Some cuttings succeed better at one season than another, and the most suitable period can only be ascertained by trial. Generally speaking, however, cuttings will strike best at the commencement of the active growing season.

In taking cuttings of plants which are grown for their fruits or flowers, the upper shoots should be chosen, as it is well-known that these are more productive and yield earlier crops than those obtained from the lower shoots, *e.g.*, Pepper, Cubebs, &c. Similarly with flowering plants, cuttings taken from near the extremity will flower early and in a comparatively small state. Thus, plants raised by cuttings from the flowering shoots of the climber *Camoensia maxima*, which usually takes several years to attain a flowering condition if raised from seed, have been found to blossom at Peradeniya in the nursery-bed when only about 16 inches high.

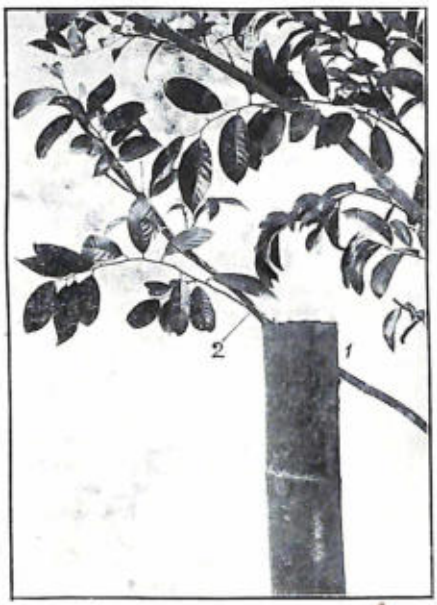
Although most kinds of cuttings may be propagated in a nursery bed of fine, sandy, moist soil under shade, others require special conditions, as in fine sand under glass or other transparent covering. In glass-houses, where artificial heat and moisture are under control, and bell-jars for covering the cuttings are available, certain kinds of cuttings may be made to strike root which refuse to do so by ordinary means. The bell-jars prevents excessive evaporation and maintains a warm and moist atmosphere around the cuttings. Cuttings will strike better when placed against a porous substance, as the inside of a flower-pot half full of sandy soil or sand only. This fact has lately been taken advantage of in establishing a low hard-wooded plant, *Malpighia coccigera*, as an edging to

some of the drives and paths in Peradeniya Gardens, where cuttings planted against the edging tiles struck root readily and formed an excellent dwarf edging, not unlike Boxwood of cooler climes.

An effective method of striking obstinate cuttings is thus : Fill a flower-pot half-full of sand and soil ; insert cuttings of a length sufficient to reach, within a little, the rim of the pot ; sink the pot in the earth, and cover with a pane of glass. Another method : Procure a large flower-pot ; in the bottom, place large loose pieces of brick, just so high that a small flower-pot placed inside upon them may have its rim on the same level as the rim of the large pot. Fill in the space between the pots with dry sand or earth. Then fill the inner pot with pure sand, and there insert the cuttings. Take another pot just of a size that when inverted it may fit in on the earth between the rims of the large and small pots ; break out its bottom, and lay over it a piece of window glass. Water the cuttings as they require it with tepid water, allowing none to fall on the earth between the pots. When condensation of moisture takes place on the glass, merely turn it over. Fine river sand, kept moist and under shade, is an excellent medium for striking cuttings or for layering. See *Sand*, pages 5, 20.

Striking cuttings in bottles filled with water is sometimes practised with ornamental plants, *e.g.*, Crotons, Panax, &c., and with but little trouble is often successful. The essential conditions are : (1) cuttings to consist of the ends of young vigorous shoots ; (2) capacious, opaque or shaded bottles ; (3) water to be changed often to avoid its becoming foul, replacing it with tepid water when changed ; (4) protection from wind and direct sun. Aquatics, or plants adapted to growing in water, can usually be multiplied by means of cuttings kept in water or mud.

Cuttings of Cacti. Striking cuttings by partial drying in the sun is sometimes effected in the case of Cactus and similar succulent plants. Sections of these placed on dry sand will, when become partially shrivelled, produce roots, whereas if placed in moist soil in a freshly cut condition they are liable to rot.

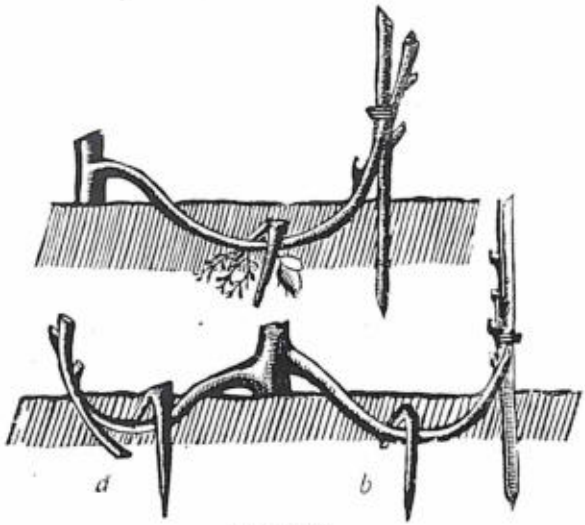


LAYERING THE NUTMEG TREE.

A bamboo about 5 feet long is fixed in the ground. The top end, through which a slit (1) is made for the layered branch (2), is filled with fine soil which is kept moist.

Propagation by Layers. When propagation by cuttings fails, layering may be resorted to, the latter, though a slower process, being generally a more certain method. The usual procedure is as follows : select a branch of ripened wood that will bear being bent down to the earth without breaking ; cut the branch half-through with a sharp knife just under one of the leaf-buds, towards its extremity, passing the knife upwards, and slitting the branch about an inch or two up. The slit piece, with the leaf-bud at its extremity, called the "tongue," should be kept open by inserting a small pebble. Bend the branch down, and where the tongue falls remove the earth to the depth of 2 or 3 inches ; the tongue portion is held down and secured in position by a forked peg, and then covered over with a mixture of fine sand and leaf-mould. This must be kept shaded and moist, and may be protected by an inverted flower-pot or other means.

Various modifications of this method may be resorted to to suit individual plants or trees. When the branch to be layered is too rigid to bend down it may be made to pass through a broken flower-pot or other receptacle, the latter being filled with a mixture of sandy loam and placed on a support. Or a stout bamboo stem may be fixed in the ground and the top end of it slotted and partly filled with soil, the layered branch being passed through this and, if necessary, held in position by being tied firmly to another bamboo fixed near it for support. Another simple method is to pass the branch through two half-round tiles, the space between these being filled with fine soil as above, and the ends with moss or fibre to prevent the soil running out; the tiles are then tied together, and the whole watered regularly.



LAYERING.



GOOTEE METHOD OF LAYERING.

Showing bandage of earth tied with fibre, bamboo containing water suspended from a branch above, and rope (coming through a hole at bottom) along which water is constantly conducted to the bandage.

Gootee-layering or Marcottage, a form of layering or ringing, has been practised in India and China from early times. It is adopted in the case of trees which are difficult to propagate by cuttings, or to which other methods of layering cannot easily be applied. The *modus operandi* is as follows: select a firm healthy branch with well-ripened wood; immediately under a leaf-bud or node make a slanting deep cut upwards, placing a small stone or a piece of stick in the groove to keep it slightly open. Round this apply a ball of adhesive soil, holding it securely together with coir fibre, tow, or moss, bandaging all firmly round the branch. A little above this hang an earthenware pot, and through the hole in the bottom of the latter draw from within a piece of thin rope; a knot tied at the end of the rope should fit tightly against the hole inside the vessel. The rope, secured by its knotted end within the pot, is carried on at full stretch and coiled round the "gootee". By this means the water with which the vessel is kept supplied, oozes slowly out, along the rope and around the bandage of earth, which is

thus maintained in a moist condition. In from three to four months, according to species, young roots should be seen protruding through the gootee, when the branch may be severed from the parent tree and potted, or planted where intended to grow. The operation should be carried out in the wet season, commencing when active growth in the tree begins.

A modification of the "gootee" contrivance is a piece of thin tin plate, folded in the shape of a funnel, and fixed with clips round the branch. This is filled with moss or soil, which is kept moist by a drip from a bottle of water inverted and fixed above, with the cork pierced so that the water can drip slowly through and on to the branch, into which a slit has been made as already described.

Ring-barking, in which a ring of bark is removed from a stem or branch which it is desired to propagate, is also sometimes adopted as a means of propagation, the bared portion being bandaged with a ball of earth as above described. See also under *Pruning*, p. 53.

Propagation by Suckers. A sucker is a stem or shoot which springs from a subterranean portion of a plant or tree. Two kinds of suckers may be distinguished, namely *root suckers*, which arise from adventitious buds on the roots, and *stem-suckers* or *ratoons*, which spring from the base of the stem, *e.g.*, Pineapple. The former can be severed from the parent plant and removed with roots attached, *e.g.*, Bananas (Plantains), and Bread-fruit. *Stem suckers* are sometimes called "gourmandisers," as their growth is at the expense of the part of the plant above them. Plants which have been heavily pruned or pollarded, often produce stem-suckers freely. The latter, when required for propagation, may be encouraged to produce roots by partly severing them with a deep cut, and bandaging them up with some good sandy loam, which should be kept moist.

Propagation by Leaves. Many succulent plants, as Begonias, Gloxinia, Bryophyllum, etc., may be increased from leaves. The latter, if placed on a damp surface of light sandy soil, and kept in position by being partly buried or held down with small wooden pegs, will produce buds at the margins which will develop into plants.

Propagation by Eyes. Many plants, especially those of a succulent nature, may be propagated readily by eyes or buds. The method is simply to take a plump shoot or stem on which there are buds not yet developed; cut this in a slanting direction into short lengths, about ½ inch above and below the bud. The pieces, having at least one eye or bud upon each, are planted in a pot or box of fine sandy soil, with which they should be just covered, being firmly pressed down. They should be kept moist and shaded, and may be covered with a sheet of glass.

Propagation by Roots. Some plants may readily be increased by cuttings of the roots, these being inserted in a sandy mixture of leaf-mould, etc., and kept damp and shaded. Aerial roots, developed from the upper limbs or branches of species of Ficus and other trees, may sometimes be used as a means of propagation. When these reach the ground they at once fix themselves in the soil, and in a short time form stout independent columns or trunks. The latter will afford support to the parent tree and thus prolong its life; or they may be severed, and thus become independent trees. The method adopted in Peradeniya Gardens for enabling the aerial roots of certain species of Ficus to reach the ground and strike root is as follows: Long bamboo stems (preferably of the Giant-bamboo) are split into two, the transverse divisions being cut out; the two halves are placed together round the aerial root and tied at intervals, the lower ends being securely fixed in the ground. The top end is filled in tightly with moss to prevent the ingress of rats or squirrels, which are apt to damage the young roots.

Division of Root-stock. By this means plants which grow in clumps, or have a fibrous or tuberous root-stock, as herbaceous perennials, are easily multiplied. "Division" consists in separating portions of the main plant, each portion bringing with it some of the stems or buds as well as roots; if planted under suitable conditions, either in pots or in the field, these soon become established and form new clumps. To many plants of this nature the process of lifting, dividing, and replanting each year is beneficial rather than otherwise, as if left undisturbed for a long period the soil becomes impoverished and the plant more or less exhausted. Orchids and herbaceous perennials are generally multiplied by division.



PROPAGATION OF *Ficus altissima* BY MEANS OF AERIAL ROOTS.

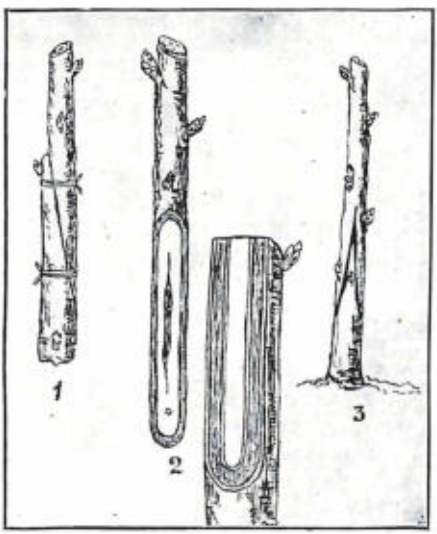
Propagation by Bulbs, Corms, and Tubers. Bulbs or tubers may appear on plants either underground, or on the stem or branches above ground. In some Yams (*Dioscorea*) both underground and aerial tubers are found on the same plant. A bulb is composed of either modified leaves in the form of scales, as in *Lilium*, or of the thickened bases of leaves folded round each other, as in the onion and *Crinum* ("Tolobo," *S*). *Bulbil*, a term intended for a small bulb, is also applied to *aerial buds* when they resemble small bulbs, as in *Agave*, *Furcraea*, certain ferns, etc. Sometimes such bulbils are produced in large numbers (*e.g.*, Sisal-hemp), and function as seeds as a means of reproduction, the seeds themselves being habitually abortive or infertile. These bulbils, if planted in a nursery, will in due course grow into large plants. A *corm* is a short, solid, conical tuber or a modified underground stem, from which "offsets" or "eyes" arise from the upper surface as buds, which are a means of propagation, as in Caladiums and other Aroids. A *tuber* is a thickened rhizome or stem, bearing buds or node-like scars, examples of which are Yams, Sweet-potato, Arrowroot, and Artichoke. Propagation of these is readily effected by division. The fleshy subterranean growths of the Dahlia are not true tubers, but enlarged succulent roots, which do not bear buds.

Propagation by Runners, Rhizomes, &c. This natural mode of propagation is well seen in the strawberry plant and in many "running" grasses and sedges, *e.g.*, doob-grass, nut-grass (*Cyperus rotundus*,) &c. A slender branch is sent off from the base of the stem: it runs along the ground, and at its end produces a new plant. Some plants have creeping stems (*rhizomes*), which root along their under surface, and develop new plants from buds on the upper side. This is characteristic of the Ginger family and most grasses. *Crowns* are a means of propagation in the case of pineapples, a prolongation of the main axis forming a tuft of leaves at the top of the fruit.

Grafting consists in placing together two cut surfaces of parts of the same or of different plants in such a way as to cause them to unite and grow together. The plant on which the graft is inserted is called the *stock*, and the part inserted the *scion*. The action of the one on the

other is in some cases very marked, sometimes producing what are called "graft-hybrids." Fruit-tree grafts may grow freely on a certain stock but scarcely bear any fruit, whilst on another stock they produce abundant crops; therefore the selection of suitable stock is important. The possibilities of grafting are of the greatest importance in horticulture, and through its medium stock of valuable trees, etc., may be raised when other propagating means fail. Among its advantages are: the good qualities of a certain selected variety are retained in the scion; fruit-trees of uniform and desirable qualities can be multiplied and brought into bearing early; in some cases the two sexes of dicœcious trees may be brought together on one stock in order to ensure the pollination of their flowers. In Ceylon, however, as in most tropical countries, grafting is seldom practised.

Scion and Stock. Certain conditions are essential for the success of the operation of grafting. The scion and stock should have a natural affinity to each other, either as varieties, species, or genera of the same natural order; also the natural vigour of the stock and scion should be similar. The operation should be carried out in the shade, in moist, growing weather, and the parts protected from the sun until the union is complete. In all cases, it is necessary to exclude air from the graft by covering it with grafting-wax or clay, bound round with matting or fibre. A fundamental principle is the necessity of forming a direct contact between the cambium, or formative tissue under the bark, in both the scion and stock, without which contact no union takes place. Various methods of grafting may be practised, according to the size and variety of the subject which it is intended to propagate, and each method may be varied to some extent as may be desired. The following are the modes most generally employed:



1. ORDINARY GRAFTING; 2. WHIP GRAFTING; 3. SADDLE GRAFTING.

Whip or tongue grafting is one of the best methods and is extensively practised in cool countries. The stock is cut in a sloping direction, just above a node. The scion is then similarly cut through obliquely; a thin tongue is cut in this in an upward direction, and a corresponding cut made in the stock; the scion is fitted into the latter so that the inner barks of stock and scion come in contact with each other. The graft is then bound firmly and covered with clay or grafting wax.

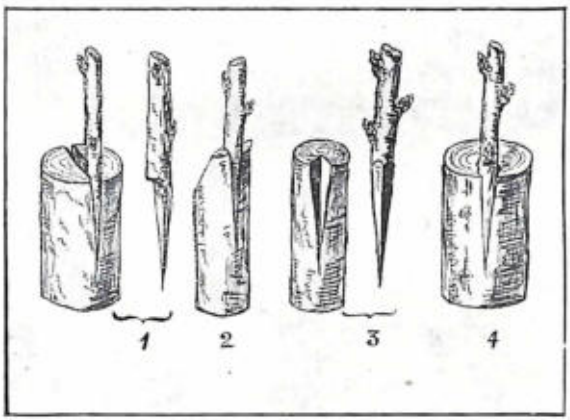
Cleft grafting. The stock is split open by a chisel, and the scion, being cut wedge-shaped, is fitted into the cleft, so that the inner barks of both may meet. This mode has obviously certain objections, and is chiefly adapted for old stocks.

Graft-Budding, see *Bud-grafting*, p. 45.

Saddle-grafting. In this the stock and scion must be of nearly equal thickness; the former is cut sloping on each side, like a wedge, so as to allow of it fitting accurately into a corresponding notch made in the scion. This method is suited to shrubs and young-wooded plants.

Wedge-grafting is the same as the preceding form, with the position of the parts reversed.

Crown or Rind-grafting is applied to trees of considerable size. A scion about 6 inches long is selected; the lower half is cut in a sloping direction, and the notch or shoulder thus formed is made to fit on top of the stock. A slit is then made in the bark of the stock and, the two sides being carefully raised from the wood, the scion is inserted between the latter and bark. This can only be done at the commencement of the growing season, when the bark and wood easily separate.



1 & 2. CLEFT-GRAFTING; 3, NOTCH-GRAFTING
4. CROWN-GRAFTING.

Side-grafting consists in inserting scions into the branches or sides of the stock, without cutting away the head of the latter. It is useful for supplying, where deficient, a branch or stem to any part of a tree. The scion, being splice-cut and thinned out, is inserted under the bark, the union being bound up and covered with clay or wax.

Veneer-grafting is chiefly used for propagating trees and evergreen shrubs. The scion is cut with an even splice cut about 1-2 in. long; a corresponding portion of bark is taken off the side of the stock; both are then fitted together, without a cleft or incision being made in the wood.

Grafting by approach, or Inarching, an excellent method and easy to perform, of which natural examples may not infrequently be seen in trees. It is specially suited to the tropics, and is successfully applied to Mangoes and other fruit trees. The stock in this case must be grown in a pot or bamboo, so as to be movable, or planted close to the scion. In the case of large trees which it is desired to increase in this way, a temporary platform may be erected under the tree, upon which the stock-plants are placed in pots; the shoots of the tree may thus be easily bent down to reach the stocks. The mode of procedure is to remove a similar portion of the wood from both the parts intended for joining; these must then be carefully fitted together and secured with tying material and a bandage. When the parts have united, dissever the scion from the parent plant below the bandage. The grafted plant must afterwards be kept in a shaded place until it has commenced active growth and stock and scion have become thoroughly incorporated.

Herbaceous-grafting is sometimes adopted for increasing in size individual plants of a herbaceous nature. By its means the Melon, for example, has been grown successfully upon the Cucumber, the Tomato on the Potato, etc. The stock and scion being nearly similar in texture, the former is carefully split, and the scion prepared, wedge-shaped, and inserted rather deeply, allowing the barks to coincide, as in all other methods. Tie with worsted, cover the cut with grafting-wax, and shade from the sun.

Budding is a form of grafting which consists of taking an "eye" or bud attached to a portion of the bark, and inserting it in the stem or branch of another plant. It is essential that the sap be in active circulation, so that the bark may readily become detached when lifted from the wood. This condition is found to be most marked where very

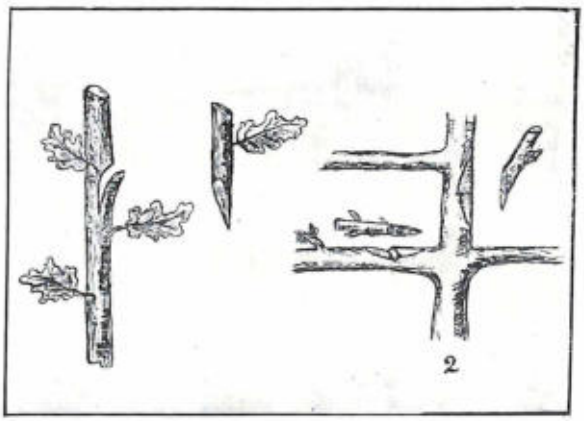


INARCHING THE MANGO.

Stock in pot. The junction is exposed to show method of tying, previous to bandaging up with earth as described.

distinct seasons of growth or "flushes" occur. In equatorial regions, where the seasons are not so marked as in temperate countries, the operation of budding is not always successful. "In the upper provinces of India," said Firminger, "budding may be performed with great facility at two seasons of the year; but for some reason I am unable to explain I have not found such in the vicinity of Calcutta, where budding can so seldom be performed with success that it is rarely or never attempted." The same remarks apply to some extent to other parts of the tropics, not, however, because the operation is difficult to perform, provided certain necessary conditions are observed. Cacao has been successfully budded in the West Indies, resulting in vigour and productiveness, and Hevea rubber in Ceylon, Java, &c.

There are various forms of budding, each being better adapted to particular circumstances, as *Shield* or *T-budding*, *Flute* or *Tube-budding*, *Annular-* or *Ring-budding*, and *Patch-* or *Graft-budding*. The first-named form is the one chiefly practised for roses and fruit trees, and is performed thus: select a shoot well furnished with plump dormant buds from the plant desired to be increased; cut off the leaves at half the length of the leaf-stalks. Remove a bud from the shoot by entering a knife ½ an inch below the bud, between the inner bark and the wood, sloping the knife outwards above the bud. The small portion of wood taken with the bud is carefully removed. In the bark of the young shoot in which the bud is to be inserted, make an incision in the form of a



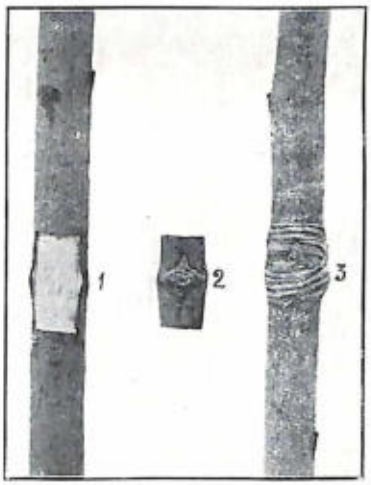
1, HERBACEOUS-GRAFTING; 2, SIDE-GRAFTING.

(See p. 43).

"T"; raise the bark carefully, push the bud gently into the opening, bind it securely with tape and budding wax to exclude air, leaving only the point of the bud exposed.

Dull cloudy weather and morning or evening should be chosen for budding, and the operation must be performed as quickly as possible, as both bark and bud are injured if exposed to the air for any length of time. Special knives are made for the operation of budding.

Patch-Budding or Bud-Grafting has been practised with success in Queensland and the Southern United States in the propagation of the Mango, etc., and more recently in Java and Ceylon with Hevea rubber. Seedlings 2 to 3 years old, with stems about the thickness of one's little finger, are selected for stocks. A rectangular piece of bark is removed from the stock, and in its place is inserted a piece exactly similar in shape (the *scion*) with a bud in the centre, taken from the variety which it is desired to propagate. Full and well-formed buds from matured and healthy shoots, not less than 2 years old, should be selected. Precision in fitting the bud-bark with the incision in the stock, prevention of the admission of air and water between the scion and stock, and shade from the sun's direct rays are important factors for success. Grafting-wax should be smeared over the edges of contact, and the graft then tied firmly with strands of bast, or preferably grafting-tape, or strips of cotton dipped in melted paraffin wax. If the plants are not in the shade, a shield of tin or stout paper should be fastened over the graft to protect it from the sun. After union of stock and scion has taken place, which should be in 3 to 6 weeks, or later according to species, the bandaging may be removed, and the stock pruned back.



BUD-GRAFTING OR PLAK BUDDING.

1, Section showing bud with patch removed; 2, bud with patch as removed; 3, bud with patch placed and tied on stock, a patch of bark exactly similar in size having been first removed from the latter.

Grafting-clay is a composition used instead of grafting-wax for covering grafts for the purpose of excluding air and moisture until a union of the stock and scion is effected. It may consist of two parts of clay and one of cow-dung, which should be beaten together and thoroughly mixed until of the consistency of fresh putty, some time before it is required.

Grafting or Budding-wax is employed chiefly for budding, especially for graft and patch-budding. To make grafting-wax, take: Resin (crushed), 4 parts by weight; beeswax, 2 parts; tallow, 1 part. Melt in a metal utensil, and stir thoroughly. Melted paraffin-wax will also answer the purpose, to some extent.

Grafting-tape. To make grafting-tape, procure ½-inch cotton tape, or tear narrow strips of cotton. Soak these well in the grafting-wax while in a melted state, and afterwards spread out to dry. As a substitute for grafting tape, strips of thin pliable fibre, as may be obtained from the inner bark of *Hibiscus tiliaceus* and other allied species, or the prepared raffia tape of shops, may be employed, but these are not of a durable nature.

NURSERIES

A necessary part of the equipment of a garden or estate is a nursery for the propagation of plants, whether for garden or field purposes.

The essential points of a good nursery are shelter from wind, a plentiful supply of water, light shade, and fine, loose, well-drained, loamy soil. On an estate, a sheltered hollow with a stream running through should be selected as the most suitable site for the purpose. The ground should be cleared of brushwood, rough stones, roots, etc., the soil trenched or deeply dug, and formed into beds of uniform level. The beds may be made of any convenient size, but for facility of working they should not be broader than 3½ or 4 ft., and an alley of about 15 inches must be left between them.

It is customary to raise the beds a few inches above the ground level, which is advisable in low or wet ground, but in a locality with dry sandy soil and subject to prolonged drought, it is best to have level or slightly sunken beds. A high bed is liable to get damaged by heavy rain, exposing or washing away the seeds, while a low or depressed bed retains moisture and affords protection for young plants. The surface soil must be brought to a fine tilth and freed from stones, especially for seed-beds. No stable or farmyard manure should be mixed with the soil, unless it be in a thoroughly decomposed state; alluvial or loamy soil, with some well decomposed leaf-mould and fine sand added, forms the best medium for germinating seeds as well as for striking cuttings, layering, etc. Temporary shade for nursery beds must be afforded. This is easily provided by fixing forked sticks about 2 ft. high, alongside the beds, light bamboos or other sticks being placed over these lengthwise and across, while cadjans or other leaves suitable for shade can be laid on the top and regulated or removed as required.

Nursery or Propagating-sheds. In the hill districts some protection from wind and rain is usually indispensable. A serviceable shelter may be afforded by erecting a half-span roof of thatch, either over the beds where formed, or in a sheltered corner specially set apart for propagating purposes. The roof should be about 4 or 5 ft. off the ground at the back, about 6 ft. in front, and facing the morning sun. Such structures are also useful for the cultivation of certain crops, as Tomatoes, Cucumbers, Violets, etc., which thrive best under partial protection.

Propagating Pits. A useful means of propagation in the tropics, especially during dry weather, is a pit dug about 3 feet deep in a sheltered corner, being covered over with palm leaves or other temporary light shade. A layer of sand may be placed at the bottom, on which pots, &c., may stand. By maintaining in this a moist, even atmosphere, cuttings may be encouraged to strike root, hard-shelled seeds to germinate, and plants in a backward state to form new growth. At the higher elevations, more permanent pits may be built, with glass-covered roofs. See page 78.

PLANT BREEDING AND SELECTION.

The term plant-breeding is applied to the improvement of plants by producing new strains, whether for economic or ornamental purposes. The results, upon which the profitable cultivation of many crops or races of plants depends, are of the greatest importance to the planter, farmer, or gardener. The process is based upon the intelligent selection of desirable strains or varieties, and the improvement and fixing of these by hybridising or crossing. The latter operation, it may be mentioned, consists in transferring the pollen (male element) from the flower of one plant to the pistil (receptive organ) of another of the same or closely related family. When practised with skill upon species or varieties of specially desired characters, valuable new races may thus be evolved. Most of the choicest flowers of the garden, and the most luscious and prolific fruits and vegetables have originated in this way, and been perfected with the aid of high cultivation and careful selection.

Until comparatively recently, the possibility of producing a hybrid was considered to be confined to plants of different species belonging to one genus, it being generally believed to be impossible to produce a cross between different genera. Now, however, we have bigeneric and multigeneric hybrids, and new generic names have been created for them; *e.g.*, *Citrange*, a cross between a citron and an orange, and *Plumcot*, a hybrid between the plum and the apricot. Great advances have been made especially in the bigeneric hybridisation of orchids, so that we are now familiar with such bigeneric names as *Odontioda* (a hybrid between Odontoglossum and Cochlioda), *Miltonioda* (a hybrid between Miltonia and Cochlioda), *Vuylstekeara* (a multigeneric hybrid between Miltonia and Odontioda), *Laelocattleya*, and others. See also under *Selection and Saving of Seeds*, p. 34.

MENDELISM

The law of heredity, known as Mendel's Law, or Mendelism, was discovered in the sixties of the last century by the Abbé Gregor Mendel. It is the basis of the study of heredity, and is of great value in scientific plant-breeding. Previously all breeding or cross-breeding was effected largely without any certainty, and although as a general rule the peculiarities of the present generation might reasonably be expected to reappear in the progeny, what would actually happen could only be guessed at beforehand. Mendel conceived the idea that the puzzling results of cross-breeding must be governed by some settled law, and therefore set himself to investigate it, starting experiments on the simplest lines he could conceive.

He selected the various forms of the edible or garden pea, for the following reasons: *Firstly*, the flowers are so constructed that from the outset their anthers and stigmas are protected from outside pollen (which would, of course, produce unwished-for crosses) by being enveloped in the keel of the flower, and by opening this keel before the flower was fully grown he could extract the unripe pollen-bearing anthers and insert instead the ripe pollen he desired to use, thus ensuring the desired cross. *Secondly*, these plants show definite and distinct characters, such as differently coloured flowers, and variously coloured and shaped peas as well as pods. *Finally*, as they are annuals, a fresh generation could be obtained every year for the purpose of studying and tabulating results, and starting fresh experiments. From these experiments Mendel discovered that the characters aforesaid fell definitely into two distinct categories, *viz.*, (a) *dominant* and (b) *recessive*. A dominant character is one which appears to the exclusion of the other in the immediate offspring of a cross, the character which fails to appear being recessive.

The next discovery was that in a cross involving a dominant and a recessive character, all the offspring resembled the dominant one, so that apparently the recessive parent had failed altogether to act, even though it was this parent which bore the seed, for the same result occurred whichever was the seed bearer. This first family of "dominants" being self-fertilised, the next remarkable result was that from their seeds arose two kinds of plants, *viz.*, *dominants* and *recessives*, like the grand-parents, but always in the proportion of three dominants to one recessive when the average of a large number was taken. Here then was an obvious law, and long series of crossings and intercrossings proved that these characters, dominant or recessive, never intermingled absolutely, but only temporarily; so that when another period of reproduction occurred they were capable of dissociation or segregation.

"In the reproductive cells," says LOCK,* "the dominant and recessive characters separate completely only on being represented in each cell. Such cells occur in equal numbers. When the reproductive cells unite, they do so at random, so that in the long run the combination

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* *Variation, Heredity and Evolution*, by R. H. Lock, M.A., D. Sc.

DD, DR, RD, and RR are equally recessive. DD is a pure dominant like the dominant parent, and will always breed true to this character unless again crossed ; the same applies to RR, DR and RD which are crosses like the original cross ; like it they are dominant in appearance, and their further behaviour is exactly the same. The apparent 3 to 1 ratio is thus explained. It is really a ratio of 1 : 2 : 1.—*i.e.*,1D : 2 DR : 1 R. D and R breed true. DR makes up again like the original cross."

In Mendel's experiments the same ratios of " dominant " and " recessive " came out in all cases where sufficiently distinct characters presented themselves ; and, above all, the same " dominant " prevalence in the first family was found to assert itself. This, for the plant-breeder, was in itself an invaluable discovery, since without this knowledge it often took years to establish a really reliable strain. He now knows that, instead of rejecting his crosses as failures, he has in them probably precisely the cross he desires, and has only to cross them again to obtain it in the succeeding family. Furthermore, he now knows exactly how to proceed in order to obtain a pure and constant strain on systematic lines. To those who may desire to pursue experiments on Mendelian lines, it is advisable to point out that it is only by doing so to a fairly large extent that this ratio becomes clear on averaging the results. The principle underlying the 3 to 1 ratio has been compared to that shown by mixing a large number of black and white shots in a bowl, three black to one white, and employing a blind man to pick out 4 at a time ; the law of chance will then determine that the groups of four will average out three blacks to one white.

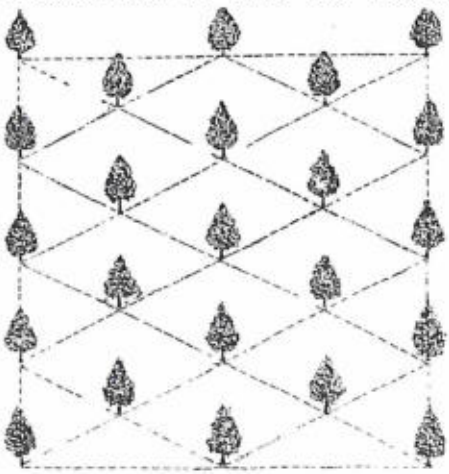


CHAPTER VII

CULTURAL OPERATIONS

PLANTING.

Planting, or the transference of plants, trees, shrubs, etc., from their pots or nursery beds to places in the open ground where they are intended to grow, may usually be done in the tropics at any time, except in very dry seasons (see under *Climate*), the most essential condition being that the soil be in a moist, though not excessively wet, state. Thus in Ceylon, for example, planting operations may commence at the setting in of the monsoon rains in June and October, but should not as a rule be attempted during the months of January to March. Late in the afternoon is the best time to plant, and a good watering should always follow the operation, except perhaps in very wet weather. Care should be taken not to injure or double back the roots of young delicate plants. As annual crops should be sown in drills, so all shrubs or trees that are cultivated as crops should be planted in rows, preferably on the quincunx system, in which the plants in each row alternate with those in that next to it.



QUINCUNX OR ALTERNATE PLANTING.

Lining. In the case of plantation or perennial crops, the ground is first marked out in lines at equal distances apart, pegs being driven in at regular intervals to mark the position of the holes. The latter should be dug by the side of the pegs, leaving each peg in position and always in the same direction with regard to the hole.

Holing. It is very important, especially in poor soils, that sufficiently large holes be made in the first place, for otherwise the plants are liable to languish and become stunted in growth. The proper size of the hole depends upon the nature of the plant or tree to be planted and on the character of the soil. For moderate-sized shrubs, the holes may be about 2½ ft. in diameter and about 24 inches deep, while for fruit and other trees they may be 3 to 4 feet deep by 4-5 ft. in diameter. In the case of large, deep holes, it is well to place a layer of broken bricks or stones in the bottom to form drainage, placing over this a layer of dry grass, straw, or coir

fibre to prevent the drainage from clogging. The top soil taken out should be mixed with some manure or any well-decayed organic matter available, before filling it in again. Always remember that the top soil is the best and should not be placed at the bottom of a deep hole.

It is important that the soil be pressed firmly about the roots when the plant is being placed in position. In wet or cold localities, planting should be shallow rather than deep, with the soil well raised around the plant, so that when quite settled the latter is slightly higher than the surrounding level ; this avoids the risk of stagnant water accumulating round the young plant.

In dry or windy districts, however, and especially on steep land, it is advisable to plant rather deeply, leaving a depression around the plant in order to retain moisture and collect beneficial mulch. The good effects of this principle are seen in the customary method of planting coconut seedlings in Ceylon, *i.e.* in deep holes only partially filled. The young plant is thus afforded beneficial shelter, its roots obtain a deep and firm hold of the soil, and the hole becomes filled up in course of time by the process of weeding and weathering. See *Use of Explosives.*

Puddling roots. An excellent practice, either in planting or transplanting, is to puddle the roots in mud immediately the plants are taken out of the ground. A mixture for puddling may be made simply by adding water to some adhesive earth, and stirring it until of the consistency of thick paint. If the soil be too porous for the purpose, it can be made adhesive by adding cow-dung or clay. By dipping the roots in the mixture a coating adheres to them which has the effect of excluding the air, thus to an important extent keeping them moist. This method is especially beneficial in the case of plants which have to be carried over long journeys or are unavoidably out of the ground for a considerable time.

Transplanting. It is often necessary in gardens or on plantations to transplant shrubby plants or small trees, either to more suitable places or for the purpose of filling vacancies, or replacing weakly plants. In the case of large bushes or spreading trees, it is advisable to cut these well back first, so as to reduce their foliage or transpiring surface, thus balancing the latter with the check received at the roots. Having well soaked the ground with water, dig a trench a few feet away in a circle round the tree or shrub, so as to leave a good ball of earth adhering to the roots. The size of the circle may be gradually reduced by using a fork carefully, so as to injure the roots as little as possible. Removing the soil from below, the ball of soil and roots should be kept intact by means of sacking tied tightly round. By means of planks placed slanting underneath, the tree may be slid out and safely removed. After cutting off any injured portions of the roots, fill in the hole with good soil, pressing or ramming it firmly around the roots as you proceed. Finish by giving a thorough soaking of water and placing a layer of mulch on the surface ; fix supports round the tree to prevent its being moved about by wind, and shade well until new leaves have developed.

Shading. In the tropics it is necessary to protect all young plants, on being first put out in the open ground, from the powerful rays of the sun, by means of some temporary shade. Even when well established, many plants are always liable to be injuriously affected by direct exposure to the sun during the hot dry season, and are greatly benefited by partial shade. For certain young seedlings, as tobacco, vegetables, etc., it is sufficient to shade them for a few days after planting with any large leaves or fern fronds that may be at hand, these being fixed in the ground by their stalks and bent over the tender seedlings. Twigs or fern fronds which do not readily drop their leaves or leaflets when withered are the best for the purpose, as for example the pretty fern *Gleichenia*, whose wiry persistent fronds are especially suited for inserting slanting-wise in the surface of nursery beds. Plaited palm leaves, especially those of the coconut (cadjans), afford excellent temporary shade, these being loosely woven into a basket-like shape, which is placed over the plant and held in position by means of three sticks fixed in tripod fashion in the ground.

Watering. Though it is always best to plant in rainy weather, it is often impossible to follow the progress of the elements, and as moisture as well as shade is usually a necessary condition for newly planted plants, watering by artificial means must be adopted when the rain fails. A good plan is to form a shallow hole by the side of the plant, filling this with water at intervals, and afterwards covering it up with earth. See *Watering*, page 80.

Tree-guards and Supports. Especially in public grounds or along roadsides or streets, protection of some sort is without exception indispensable to young plants which are intended to form shapely or ornamental trees. A fence of the "solid" or "male" bamboo forms a substantial protection for a time, as does also a circle of teak scantlings with the lower ends tarred; but the most effectual and durable supports, as well as barriers, are iron tree-guards, and those in which the uprights are pointed at the top and bent outwards are preferable. In exposed or windy situations, it is often necessary to support plants individually, especially those with slender stems, by fastening them to firm stakes or poles fixed in the ground. Such support should as a rule be provided at the time of planting, and care must be taken that the plant does not chafe against it, and that the tie is not left on long enough to cut into the tree.

Planting Distances. The proper distances for planting vary, of course, according to the nature of the plants or crop and also, to some extent, of the soil and climate. As a general rule every individual plant or tree should be afforded sufficient space to allow of its healthy and profitable development. Such distances, in this work, are usually given under the crops mentioned, except where a repetition is unnecessary or impracticable, in which case the necessary spacing may be inferred from the approximate size of the respective species at maturity. When planting in rows, the latter should be at equal distances apart. In the case of field crops, the distances between the rows should be greater than that between the plants in the rows, thus facilitating working between the latter. The plan known as the *quincunx* or alternate planting is generally the best method of placing the plants, and is applicable to any spacing. In this (see figure, p. 49), the plants in each row alternate with those in the row on either side, while they are also in straight lines in whichever direction looked at.

TABLE OF PLANTING DISTANCES.

The following table shows the number of plants to the acre at distances of one to fifty feet apart, and the area in square feet available for each plant:

Distance apart in feet.	Area for each plant in square feet.	Number of plants to the acre.	Distance apart in feet.	Area for each plant in square feet.	Number of plants to the acre.
1 by 1	1	43,560	15 by 15	225	193
1½ by 1½	2¼	19,360	16 by 16	256	170
2 by 2	4	10,890	17 by 17	289	150
2½ by 2½	6¼	6,970	18 by 18	324	134
3 by 3	9	4,840	19 by 19	361	120
3½ by 3½	12¼	3,556	20 by 20	400	108
4 by 4	16	2,722	22 by 22	484	90
5 by 5	25	1,742	24 by 24	576	75
6 by 6	36	1,210	26 by 26	676	64
6 by 7	42	1,037	28 by 28	784	55
7 by 7	49	889	30 by 30	900	48
8 by 8	64	680	32 by 32	1,024	42
9 by 9	81	537	35 by 35	1,225	35
10 by 10	100	435	37 by 37	1,369	32
12 by 12	144	302	40 by 40	1,600	27
13 by 13	169	257	45 by 45	2,025	21
14 by 14	196	222	50 by 50	2,500	18

For numbers not given in the above table, divide 43,560 by the square of the distance apart the trees are required to stand, in feet; the result is the number of plants required per acre.

PRUNING.

The various modes of pruning as practised for different crops or plants are based on the same general principle, viz., the concentration of vigour into certain parts of the plant by the cutting away of other portions, either of the stem, branches, roots, or leaves. The object in view may be the production of a larger yield or better quality of fruits or flowers, straight clean trunks (as in timber and rubber cultivation), twisted or bent stems (as for furniture making, etc.), wide spreading branches (for shade), or an abundance of young shoots and foliage, as in tea cultivation.

By means of pruning, trees or bushes may be induced to assume a form which will not only add to their productiveness, but also facilitate the harvesting or plucking of the crop. The plants should be encouraged when young to form an evenly balanced head, with the branches radiating regularly from the centre. The more upright and straight a shoot grows, the freer will be the circulation of its sap, and therefore, as a rule, the more active its vitality. The effect of pruning is analogous to that of manuring, and this fact is sometimes taken advantage of by "hard pruning" bushes which become stunted or "sick." Pruning may also be resorted to in order to rid plants of certain fungus diseases or insect pests. In the tropics, the practice of pruning is affected by the absence of a well defined resting period, but the principles, generally speaking, remain the same (see *Fruit Culture*, p. 229). The proper pruning of fruit trees varies according to locality and species or even individuals. The operation should be carried out as may seem necessary in individual cases and need not be confined to any definite time; but periods of severe drought should be avoided for pruning of any kind.

In India, a similar effect to that of pruning is sometimes produced by the crude practice of either stripping off the leaves, or subjecting the trees to a "good thrashing," as in the case of unfruitful Mango trees, by means of a long pliable bamboo. Although too crude to be recommended, the result of this treatment in retarding exuberant growth, and so tending to fruitfulness, is said to be sometimes fairly successful. Thus an old adage might be adapted:

> A wife, a dog, and a mango tree,
> The more you beat them the better they be.

Volumes of smoke, as from burning wood or rubbish, are regarded in some countries as a remedy for barrenness in fruit trees, for which also a form of ring-barking (see p. 53) is sometimes recommended.

General Principles of Pruning. The following principles are of general application, whether for large or small trees:

(1) For fruit-bearing trees, thin out branches so as to allow free access of light and air; remove all dead wood, snags, superfluous suckers and shoots.

(2) Always use a sharp knife or saw, and cut in a slanting or upright direction, so as to throw off the rain; leave a smooth surface.

(3) When cutting back lateral branches, always cut at a fork.

(4) In removing a large branch, saw it off roughly (cutting the underside first, and then the upper a few inches further from the stem than the first cut) a foot from the trunk, and finally saw off the stump left and plane the surface.

(5) Smear coal-tar over large cuts; otherwise the action of sun-heat may crack the wound, thereby allowing moisture to enter and enabling parasitic fungi to obtain a footing.

(6) When cutting branches, especially large ones, avoid leaving stumps several inches long; always cut a branch in a line and flush with the outside of the stem or branch from which the portion removed issues.

(7) In general, pruning should not be performed during severe drought, nor when crops are in active flush.

Pruning of Shade or Flowering trees. The object in regard to the pruning of these should be to obtain a form which, while developing the natural beauty of the tree, will tend to prolong its life and usefulness. The longest-lived trees are those with a straight, erect, and undivided main central axis or trunk. An upright, evenly radiating system of branching, commencing from a height of about 6 feet from the ground, is generally desired, and this may be induced by careful attention to the tree when young.

Collar pruning, *i.e.*, sawing off the main stem or stems at, or a little below, the surface of the ground, is occasionally resorted to when tea bushes become old and unproductive, or in order to eradicate a formidable pest. It differs from *cutting down*, which is more common, the bush in the latter case being cut at a height of from 6 to 10 inches. In either case the operation should be carried out in the rainy season, and the bushes should be liberally manured some three weeks previously.

Thumb-nail Pruning. A term applied to the nipping off of the terminal young bud, as done by the thumb-nail and forefinger, being a form of pruning conveniently applied to tender plants. At one time it was recommended for young Hevea rubber trees, being adopted when the trees were about 6 to 8 ft. high, the object being to induce a more rapid increase in girth of stem and a branching top.

Root Pruning is sometimes employed in the cultivation of fruit trees with the object of counteracting a too luxuriant woody growth, which results in paucity of fruit. A trench is cut round the tree at a suitable distance from the stem, and three to four feet deep. All the roots as they are found are cleanly cut, and if a long tap-root is suspected of entering the sub-soil it should be searched for, by careful undermining, and severed. In the north of Ceylon, where the climate is dry for the greater part of the year, the practice in regard to the Grape-vine is to remove the soil from around the base of the stem, and cut away some of the smaller roots. After exposure for a week or two the trench is filled in with manure, which is covered over with the soil previously removed. Similar treatment is applied in India to the Mango and other fruit-trees. "This," said Firminger, "though apparently opposed to theory, is in fact more efficacious in practice, and the trees treated thus bear prodigiously." In the cultivation of fruit generally, the object should be to encourage the growth of fibrous roots near the surface, and prevent the development of strong woody roots into the sub-soil.

Cavities in Tree-trunks. Very often when a tree has been long neglected, the trunk is seriously injured by cavities caused by the decay of dead or broken branches. With skilful pruning the progress of this evil can be arrested. The edge of the cavity should be cut smooth and even, and all decomposed matter in the interior carefully removed. A coating of tar should then be applied to the surface of the cavity, and the mouth plugged with a piece of well-seasoned hard wood, securely driven into place, the end of the plug being then carefully pared smooth and tarred. Or the cavity may be carefully filled with a mixture of cement and tar. If cement alone is used it is liable to crack and form fissures.

Bark or Hide-bound trees. It is believed that in some cases cortical or bark pressure becomes so great as to retard the growth of trees, preventing the formation of the normal amount of new wood. In temperate climes this unhealthy condition is considered to be indicated by the natural shedding of the leaves being impeded. Longitudinal incisions made in the bark, without removing any tissues, are supposed to relieve the bark pressure, being followed by a natural increase in thickness of the affected stem.

Ring-barking, or Ringing. These are terms applied to the removal of a strip of bark, varying in breadth from a few inches to as much as two feet, according to the size of the tree, from near the base of trees which it is desired to kill by starvation. It is commonly adopted in some countries for killing large or other trees which would be costly to cut down. To be successful it must be performed during the period of greatest cambial activity, *i.e.*, when the sap is up, as it is popularly called, and the cambium and bast layer must be removed as well as the bark. The direct effect of this is to cut off the downward flow of sap and food material between

the leaves and the roots. Where trees are required for timber, the process of killing by ring-barking is considered to improve the quality of the latter. A form of *ringing* is sometimes adopted to hasten the ripening of fruits, or, as a last resource, to render unfruitful trees productive. The principle is also employed in different methods of propagation, as a means of inducing the formation of a *callus* on cuttings or layers. See p. 40.

Pollarding or coppicing is commonly applied to trees which have become too large or ungainly, or for the purpose of retaining trees within certain desired limits of growth, as in the case of roadside trees. It is also commonly practised with shade or green-manure trees among plantation crops, the loppings being employed for mulching or green-manuring. Briefly, the operation consists of cutting back the main stem at a convenient height, say 6 to 8 feet or more according to requirements, also the branches periodically. In effect, it is applied to certain cultivated crops, *e.g.*, Tea, Camphor, Coffee, &c., in the routine of harvesting and cultivation.



ZOOLOGICAL GARDENS
CALCUTTA

CHAPTER VIII

GARDEN ADORNMENTS, LABELS, IMPLEMENTS, Etc.

Seats are always an essential part of the equipment of a garden, more especially in the tropics, and it is safe to say that much of the enjoyment of a garden may to a large extent depend upon them. Commanding views, overlooking terraces, spots of special interest, or under a shady tree—these are the kind of positions where seats should be placed.

The ground underneath the seat should be gravelled or paved, so as to avoid the discomfort of damp grass or the intrusion of land-leeches, ants, etc. The form of seat used may vary from a plain wooden bench to elaborate cast-iron designs. Rustic seats made of knotted branches, though sometimes admired, are generally very uncomfortable. The most satisfactory and economical seats in Peradeniya Gardens consist of wrought-iron ends, with narrow strips of wood forming the seat and back. All seats, with perhaps the exception of rustic ones, should be painted, and this requires to be renewed at least once a year. The most suitable colour, for the low-country at any rate, is light grey. This does not become discoloured so rapidly as other tints, and does not appreciably deteriorate in colour by exposure to the weather. Both green and chocolate paints quickly lose their colour and become dirty-looking. Zinc or other good kind should always be used in preference to lead paints.

Adornments. Gardens in the tropics are seldom embellished with such artificial adornments as statuary, beautiful vases, elaborate fountains, etc., such as are met with in gardens of temperate countries. Other and simpler devices in the form of arbours, arches, and trellis-covered walks on which ornamental creepers or climbers may be trained, can, however, be adopted with very pleasing effect. Any adornments used should, as far as possible, take a practical form and serve a useful purpose ; thus a fountain may be utilised for the growth of water plants, rearing fish, etc.; vases should be adapted to the successful display of ornamental plants ; while pergolas may be made to provide cool shade as well as a means for the effective display of ornamental climbers.

Pergolas. A pergola consists of an archway over a walk, and may be formed of rustic stems, pillars of masonry, or iron arches on which climbing roses or other suitable plants are trained.

A pergola is especially agreeable in the tropics owing to the cool shade it affords. It should for preference be on level ground, and not curve or twist : it may be of any length, but should not be less than 7 ft. wide and 7 ft high. A pergola in Peradeniya Gardens consists of a number of iron arches covered with different species of Aristolochia (" Fly-catching " plants), Ipomoea, Bignonia, etc.

Arbours may be of various designs to suit circumstances. A simple and cheap form may be made of iron frame-work, fixed in the ground by means of sections of bamboo, buried in the earth and then filled with concrete ; wire-netting is fastened

over the iron frame-work, and on this showy creepers are trained. Arbours made of wood-work, with the sides formed of rustic and knotted branches, and the roof covered with shingles, are very appropriate to the hill districts. Some pretty examples of these may be seen in Hakgala Gardens and Nuwara Eliya Park, in Ceylon, being made of Rhododendron wood.

Visitors' shelters. No public garden in the tropics should be without some structure that will provide shelter for visitors, and this should to some extent be made to combine ornament with utility. In Peradeniya Gardens, memorial structures, erected to the memory of past directors, serve the purpose of useful shelters to the public.

Fountains are well adapted to gardens in the tropics, where, during hot dry weather especially, the spray or the rippling sound of water is particularly pleasant. The base of the fountain, while serving as a useful reservoir, may be turned to good account by cultivating various water-plants in it. See p. 55.

Vases for Gardens. Very fair imitations of out-door vases are sometimes made in Ceylon of cement, from given moulds. Good specimens of these may be seen in the Gordon Gardens, Colombo, where, being painted white, they are very ornamental, especially when filled with well-grown and suitable plants. The Sinhalese potters make earthenware urns on elaborate hollow pedestals which, though liked by some people, are very fragile and only suited to a verandah or other position under cover.

POTS AND OTHER RECEPTACLES.

See also Chapter 10.

Pots. The Sinhalese potters can sometimes turn out very satisfactory pots to a given pattern, but those which they make on their own initiative are often ungainly and unsatisfactory, being either too deep and perpendicular, bulging in the middle, or disproportionately narrow at the base. Good pots should become gradually narrower from the top towards the bottom. If the sides are perpendicular, the plant with its ball of earth cannot be turned out without breaking the pot. Generally speaking, pots of large sizes should not be so deep as they are wide at the top; while in the case of small-sized pots the depth should equal or slightly exceed their top width. A very common mistake in Ceylon gardens is to use pots unnecessarily large, for these are both obtrusive and unsuitable for the healthy growth of plants.

Hanging Pots may be made in quite a variety of forms. The perforated kind in which Maiden-hair ferns, Selaginella, etc., may be successfully grown, is perhaps the most effective. Those made of cement are not desirable, being very heavy and devoid of porosity. Quite effective are some of the bottle-shaped earthenware urns, around which a layer of loamy soil is held in position by means of close wire-netting; into this dainty ferns and suitable plants are dibbled, and these obtain a constant and regular supply of moisture by absorption through the urn, which is kept full of water.

Bamboo-pots. Sections of bamboo, which may be obtained of various sizes, with the transverse division left in one end and a hole punched through the bottom for drainage, make very useful pots for temporary purposes. They are extensively used in Peradeniya Gardens for propagating work, and the larger kinds, to some extent, as receptacles for growing orchids, &c. For the latter purpose they are cut into small sections, resembling shallow pans, several holes being made in the sides and bottom for aeration and drainage.

Horizontal hanging-bamboos, bamboo-vases, etc. Sections of the Giant-bamboo can be utilised in various ways for the purpose of growing ornamental plants, and also as temporary "flower-vases" in corners of drawing-rooms, corridors, etc. They are not durable, however, as even under cover they soon

split or decay. As horizontal hanging "pots," single joints of any large bamboo can be used very effectively. For this purpose, leave the division in each end intact, cut out one side to about one-third its diameter, and fasten two wires near each end for hanging: a few holes should be made in the intact (lower) side for drainage.

Tubs. Wooden tubs, either made for the purpose or consisting of empty whisky or wine-casks cut into two, make useful receptacles for growing large plants, as palms, etc. Such tubs may be painted green with the bands white, or *vice versa*, and should be raised off the ground on bricks. An iron handle fixed to opposite sides of the tub will facilitate removal when necessary. A simple and effective form is a square tub made in 4 separate sides, which narrow slightly towards the base; these are fastened together at the corners by means of a couple of clamps with pegs at both ends, and can be taken to pieces when desired. When painted white, with the clamps in green, these look neat and ornamental.

Tins and other receptacles are sometimes usefully employed for growing plants in, but their use cannot be generally recommended as, apart from their ungainly appearance, they are impervious to moisture. When, however, such makeshifts for pots are used, their appearance may be improved by painting them green with white bands. A few small holes should be made in the bottom, and a quantity of potsherds or small pieces of brick placed over these for drainage.

Clean Pots. Earthenware pots look best in their natural colour and when kept clean and free of lichenous or mossy growth. To paint them green or other colour is, it need hardly be said, a mistaken idea of beauty and destroys their porosity.

Seed Pans are most useful in propagating work, whether for seed or cuttings. They may vary in size, but should not exceed 12 inches in diameter by about 3 inches in depth: if too large, they are less portable and more liable to be broken.

Seed boxes are almost indispensable, especially in the hill districts, both for raising seedlings under protection, or for pricking these off afterwards before finally planting out. The boxes should not be less than about 3 inches deep, and should be provided with free drainage.

PLANT LABELS.

The utility of and interest derived from a garden, especially a public or botanic garden, must to a large extent be in proportion to the use made of neat, legible labels, bearing the names of or other information regarding the plants, trees, etc. Labels should not, however, be made too conspicuous or obtrusive. Small plants should as far as practicable have small labels in proportion to their size, but large trees need not have unnecessarily large labels. The upkeep of labelling in tropical gardens is a matter of considerable difficulty, owing partly to the attacks of termites, which destroy most forms of dead wood, and partly to the liability of metal labels being stolen or becoming corroded. Various sorts and designs of labels have been resorted to, and the following are some of the principal kinds now used.

Wooden labels are perhaps the most convenient form for ordinary purposes; they may be of any size and shape, can easily be altered to suit requirements, and are neat while they last in good condition. Those which are intended to remain in the ground should be of the hardest wood. Deal-wood labels in the tropics are only suitable for very temporary use, as for seeds in pans or boxes under cover. They should be planed and rubbed over with white-lead paint, as they are then easier to write on, look best, and last longer. Large stout wooden labels made of hard woods, as Pehimbiya (*Filicium*), She-oak (*Casuarina*), Iron-wood (*Mesua*), Palu (*Mimusops*), are employed at the Royal Botanic Gardens in Ceylon, for trees, shrubs, etc. These are painted black, and the name is printed in white zinc paint with a fine brush; the stem of the label is afterwards dipped in tar, and

allowed to dry before being put out to the trees. An improvement on this form is to stamp the name on the smoothed surface by means of steel dies, the impressions being then filled in with good white paint.

Bamboo-splint labels. A splint of hard bamboo, with one end sharpened for fixing in the ground, and the other flattened and planed, makes a cheap and serviceable label. When writing upon it, first rub some white paint on the planed surface, and use a soft lead pencil.

Lead labels are perhaps the best permanent kind for trees and shrubs, and are used exclusively for such at the Royal Gardens, Kew. Each consists of a piece of sheet-lead, about 3 inches long by 2 inches broad, with about ½ inch of one long side turned over to form a rim, below which 2 holes are pierced for suspending by wire. The letters composing the name of the plant, etc., are punched in with punch-type, the impressions being filled with white lead or zinc, and the surface afterwards rubbed over with an oiled rag.

Brick labels. To obviate the destructive effects of termites, brick labels, made to a given mould, have for many years been largely used in the Botanic Gardens, Ceylon. The top has a sloping, smooth surface, which is painted black, the name and other particulars being printed on in white-lead or zinc paint. Though not durable, this type of label is comparatively cheap, and is also, of course, termite-proof.

Zinc labels. Narrow pieces of clear sheet-zinc make excellent labels for pot-plants, orchids, hanging baskets, etc., and are extensively employed in the Ceylon Botanic Gardens. They are written on with an indelible ink, which can be obtained ready-made. See *Indelible Ink*, below.

Sheet-iron labels. Strips of sheet-iron painted black, with the name, etc., written on in white, are often used for labels in India.

The " Imperishable Stratford " labels. These excellent labels are made in England to order, being obtainable in almost any size and shape, and may include any name, description, or notice as may be desired. The " Stratford label " is cheap while satisfactory, and differs from the " Acme " in being made of white metal, with the raised letters in black. These labels are commonly employed in Botanic Gardens in India, Ceylon, and the West Indies. They may be kept in a legible condition by an occasional cleaning, followed by a coat of paint over the raised type. In order to effect this, mix some paint to the consistency of printer's ink; spread this out on a smooth hard surface, pass a rubber roller or squeegee over the paint and then over the raised letters.

The " Acme " labels are made of stout zinc, with raised letters on black ground. They are supported on stiff wire stems, or suspended by wire, or nailed to a wall.

Ivorine label is a composition of thick parchment-like substance of the appearance and consistency of ivory, and is now largely used in Europe, &c., for labelling pot-plants, especially orchids. It is of neat appearance, is said to be imperishable and unbreakable, and can be written upon by either pencil or pen, the writing being indelible, except when hard rubbed with soap.

Waterproof labels. For the temporary labelling of plants, etc., as in packing for transport, these labels are most serviceable and convenient. They are made of " manila " substances, with a parchment surface and are easily written upon with ink or pencil.

Preservatives for wooden labels. Wooden labels should always have the part to be fixed in the ground treated with some preservative before being put out. Various compounds of creosote, copper sulphate, carbolic acid, etc., are used for the purpose, all with more or less success. Dipping the labels in boiling tar or oil, and then plunging them into fine dry sand or coal dust, has an excellent preservative effect. Charring the ground end of the label and then tarring, has a similar result. See " Silvertown," p. 514.

Indelible ink for zinc labels. A solution of platinum bichloride (one tube of 15 grains to about 2 fluid oz. of water) forms one of the best and most durable forms of writing fluids for zinc labels. It can be used either with a steel pen or a hard pointed piece of palm-leaf petiole. Special writing fluids may be obtained from nurserymen, but when neither these nor the platinum chloride are procurable, a useful substitute may be made as follows: Dissolve 1 oz. salammoniac and 1 of

verdigris in 6 oz. of water; stir well together and keep in a glass-stoppered bottle; shake before using. A strong solution of copper sulphate will also answer the purpose to some extent, but is less efficient.

GARDEN AND ESTATE TOOLS AND IMPLEMENTS

Though the number of tools actually required for a garden or plantation in the tropics is not large, there are many not generally known which would not only facilitate various operations in connection with garden or field work, but also prove to be a considerable saving of labour. The stock-in-trade of a garden coolie is often limited to a mamoty, watering-pot, and a sickle, and it is only at the expense of time and labour that he gets over the work with these.

The quality of the work done, however, is not always as it should be. Of late years the number of useful and labour-saving implements for the farm and garden has been considerably augmented, more especially by inventions from America. Though many of these are obviously unsuited to the conditions of labour in the tropics, others are of easy application and effect a considerable saving of labour as well as of individual energy. Needless to remark, it is true economy to employ the best and most suitable tools. Though the following list includes many that are not necessary for a small garden, all are more or less indispensable in a large or public establishment, while most will also be found useful for general work.

PRINCIPAL IMPLEMENTS REQUIRED FOR GARDEN OR ESTATE USE

AND PURPOSES FOR WHICH THEY ARE MAINLY REQUIRED.

Alavango or Crowbar. Digging holes, levering, etc.
Ant-exterminator. Fumigating ant-nests; very effectual.
Antipest or Knapsack sprayer. Fine fluid-spraying.
Averruncator. See Tree-pruner.
Axe. Porowa, *S*; Kodali, *T*.—Felling trees, chopping wood, etc.
Basket, manure. Kooday, *S*.—Removing manure, soil, gravel, etc. Usually carried on the head by coolies.
Basket, transport (large). Removing leaves, grass, light rubbish, etc.
Bill-hook. Wak-pihiya, *S*.—Lopping branches, &c.
Branch-pruner. Useful for cutting stout branches.
Budding-knife. See under knife.
Crowbar. See alavango.



COMBINED MAMOTY & WEEDING FORK

Disc-harrow. See plough.
Dibber or Dibbler. Holing for small seedlings, cuttings, &c.
Edging-iron. Cutting turf-edges, as of paths, beds, etc.
Edging-shears with long handles. Trimming grass-edges.
Flower-cutting scissors. Convenient for cutting flowers of thorny plants.
Fork, digging. Mulluwa, *S*.—Digging, turning manure, etc.
Fork, weeding. Weeding, stirring up surface soil.
Fruit-picker. Kekka, *S*.—Long handled; picking fruit or flowers, &c., from branches not easily accessible.
Garden "engine". A water-barrow with a force-pump and hose. Useful for syringing, spraying, or watering plants over-head.
Gloves, pruning. Enabling spiny plants to be pruned or handled with ease.

Grind-stone. Indispensable for sharpening tools.
Grubber, various forms. A draught implement, with or without wheels, furnished with several long, broad teeth ; cultivating the soil between crops.
Hand-cart. Ath-karatthe, *S.* Removing plants, soil, manure, etc.
Hoe, Dutch, or thrust. Weeding loose paths, beds, etc.
Hoe, draw. Weeding, earthing up crops, etc. Preferred by coolies for weeding paths, borders, &c.
Hoe, grub. Digging, cutting trenches, etc.
Hoe, roller. Suitable for weeding soft soil or loose gravelly paths.
Hose, garden. Watering lawns, borders, &c.



DUTCH HOE

Knife, budding. Budding plants, cutting flowers, &c.
Knife, grass. Sickle, or "hook;" De-kettha, *S.*—Cutting grass, grain crops, etc., instead of with scythes.
Knife, pruning, or grafting. Pruning, grafting, etc.
Lawn-mower. See mowing-machine.
Lawn sprinkler. Watering lawns, flower-beds, etc., being fixed to a hose.
Lawn-weeder or Daisy grubber. Extracting deep-rooted weeds, as "Etadi."
Mamoty. Udella, *S ;* 'Mamoty," *T ;* Kodali, *Hind.*—Digging, weeding, &c. The implement most generally used by coolies, with the blade at right angles to the shaft.
Mamoty-fork. Pohara-mulluwa, *S.*—Digging, grubbing, stacking manure, &c.
Mattock. Cutting roots in digging or trenching.
Monkey-jack. See stump-extractor.
Mowing-machine, chain-gear. Indispensable in a large garden.
—, cog-wheel gear. Light and portable ; suitable for small garden.
Peavy, American or "Cant-dogs." Levering large logs, stones, &c.
Pick (both ends pointed) ; Pickaxe (one end pointed, the other broad for cutting roots). Pickasia, *S.*—Loosening hard soil in trenching. picking roads, &c.
Planet Jr. cultivator. An excellent combination of tools, including drill, grubber, drill-harrow, surface scarifier, hoe, ridger, &c.
Plough. Nagula, *S.*—Ploughing paddy fields or other soft ground.
Plough, disc or harrow. Bullock-draught; cultivating open sandy soil.
Posthole-digger. Making holes for fence posts or for plants.
Quintane. A long narrow form of mamoty with a sharp edge for cutting roots, &c.
Rain-gauge. Measuring rainfall.
Rake, iron. Smoothing and levelling the surface of seed-beds, paths, &c.



CATTIE OR JUNGLE CUTTER



MAMOTY WITHOUT HANDLE



HAND-FORK



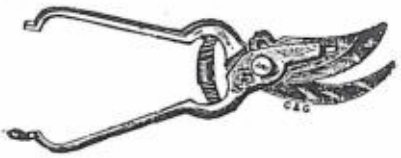
QUINTANE



WEEDING SCRAPER

Rake, hay (wooden or wire). Raking grass or leaves off lawns.
Raffia. Tying material, much used in gardens of temperate countries.
Reel, garden. An iron reel with stout cord ; useful in making or cutting straight or curved edges.
Roller, garden. Rolling and levelling paths, lawns, greens, etc.
Root-puller. A fork for extracting plants with long tap-roots from lawns.
Saw, pruning. A saw with a short, narrow blade.
Saw, cross-cut. Cutting logs, trees, etc.
Scrape, weeding. Used by coolies on Tea estates, &c.
Scythe. Cutting long grass, &c. A small pattern can be worked successfully by coolies.
Scythe-stone. Sharpening scythes, sickles, &c.

Secateurs, or pruning scissors. A powerful instrument for use in one hand in pruning.
Shears, hedge-cutting. Clipping hedges.
Shears, spring or sheep. Popular with coolies for trimming grass verges.
Shovel. Iskoppay-henda, *S.* Removing gravel, earth-work, etc.
Sieve. Peneray, *S.* Sifting soil, etc., for potting composts; different sizes, from ¼ to 1 inch mesh.
Soil stirrer or aerator. A central fork with revolving arms set at different angles.
Spirit-level. Taking levels of plots, roads, buildings, etc.



SECATEURS OR PRUNING SHEARS.

Spade. Iskoppay, *S.* Mixing or turning soil, cutting turf, earth, etc.
Sprayer, Knapsack. See Antipest.
Stump extractor or Monkey Jack. Excellent for removing stumps or roots.
Sulphurator, or powder-sprayer. Distributing sulphur or tobacco powder on plants affected with mildew or insect pests.
Syringe, garden. Vasthi-kooduwa, *S.* Spraying water on plants, both for cleansing them and moistening the atmosphere; also spraying with insecticides.
Tree-pruner. Pruning tall shrubs or trees.
Trowel. Kuda-iskoppay, *S.* Planting out small plants.
Watering-can. Watura-kendiya, *S.* Watering plants in pots, beds, &c. 2-gallon capacity is a convenient size.
Weeding-fork, hand. Stirring surface of beds or borders.
Weeding-fork and hoe combined. Weeding and surface-stirring.
Weeding-hook. Useful in weeding rocky soil.



EDGING IRON.



STUMP EXTRACTOR.



DRAW HOE.

CHAPTER IX.

LAYING OUT A GARDEN

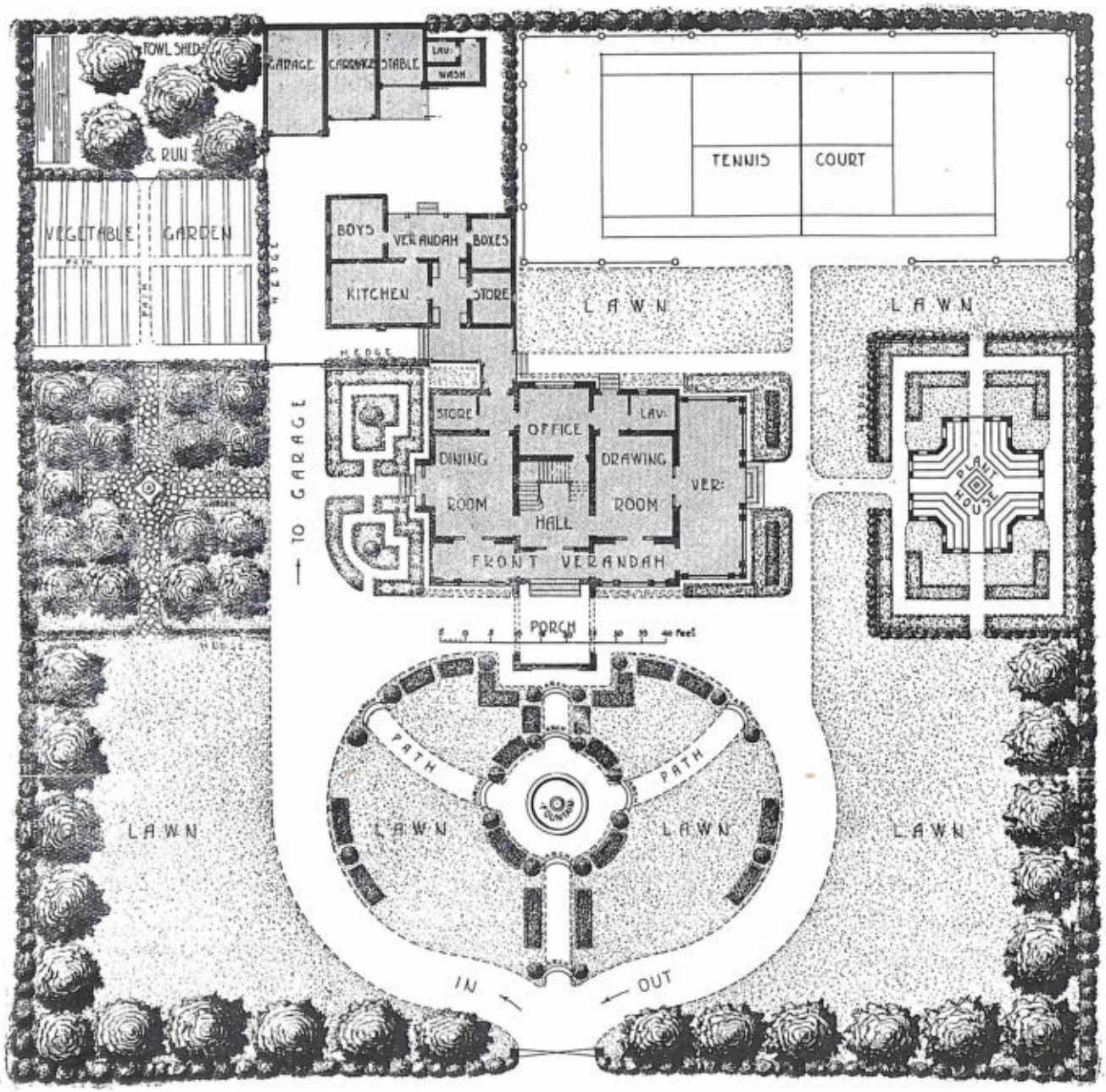
SEE ALSO CHAPTER XVIII.

The laying out of a garden is often a vexing problem, yet it is capable of affording the most absorbing interest and mental recreation. Though much of the success of a garden depends upon its original design and apportionment, the work of laying out may be said to be progressive, and can hardly ever be considered to have attained a finished state. It is in this fact that much of the charm of gardening lies,—the ever-varying opportunities of effecting changes and carrying out new schemes and ideas. In giving the following suggestions, it must be remembered that no hard and fast rules can be laid down, as so much depends upon individual taste, local circumstances, climate, lay of land, water-supply, labour available, etc.

Position. A favourable position may be said to be the most valuable asset that a garden can possess. Much can be done, however, to overcome physical disadvantages and obstacles, so that the most unpromising situation may sometimes be converted into a delightful garden. The first consideration usually is, how to transform and beautify present conditions with the least possible expenditure of time and labour. It should be remembered that it is often easier to transform than remove an ugly object, and that immovable obstacles may sometimes be turned into ornaments.

Improving Existing Conditions. In commencing a garden, the mistake is sometimes made of cutting out all the existing vegetation, forgetting that this, although it may be "jungle," may not only have certain ornamental features, but may also be capable of furnishing useful shade or shelter until at least other trees will have had time to grow up. Moreover, where virgin vegetation exists, a good effect may be quickly obtained by selecting portions and isolating them into clumps, or separating the best trees to form solitary specimens, levelling and turfing the ground between. Details can be attended to later, and a choice variety of plants may gradually take the place of the less desirable ones.

Aspect and bungalow. Much of the success of a garden depends on aspect (see page 3), not only with regard to the points of the compass, but also lay and contour of land. Natural shelter from prevailing winds, commanding views, a constant and liberal water supply, and gently undulating ground are important factors. The bungalow should be regarded as the centre of the scheme, and special features or views should be commanded from the front verandah and windows. See plan, p 63.



WHAT A GARDEN PLAN MIGHT BE.

Shewing also ground plan of a modern 2-storeyed bungalow in Ceylon.

Designing or Planning. It has been said that a garden is best planned on the ground; nevertheless a sketch or diagram on paper, however crude, will help to materialise the mind's plan. The ground may thus be easily apportioned, and space allotted to the various purposes as may be required. This will not only save time and labour, but probably also confusion and disappointment later. At the outset it is essential to distinguish between the front and back of the garden. The main features should first be marked out, starting with the drive or leading walk, followed by the secondary walks; these as well as the borders, etc., may be traced on the ground by means of string and wooden pegs. Lawns should predominate, especially at first, for it is easy to convert these afterwards and make beds, &c., as may be desired. See under *Lawns*.

Water-supply. This is, of course, an essential provision for every garden, and the laying out must to some extent conform to it. In the low-country or on the plains, the garden is not unusually supplied from a well; while up-country, a diverted stream or specially constructed channels can generally be made to meet requirements. It is important that the source of supply should be placed where the water will have the readiest access or be easiest carried to all parts of the garden. If a well, it should be somewhat concealed from view by having shrubs or small trees planted around it.

Preparation of the ground. The ground must be thoroughly trenched and drained, the soil being turned over to a depth of 16 inches or more, and all large stones, roots or other obstacles removed. A certain amount of levelling will be necessary, it being important to obtain a uniform, even, surface with a fine tilth, while the condition of the soil may require to be improved by the addition of suitable manurial material. If the land be steep, it should be formed into terraces, which often lend themselves to a very pleasing effect.

Planting-out. In the low-country, the first consideration should be to provide a certain amount of shade or screen where such does not already exist, while at the higher elevations it is equally important to furnish shelter from strong winds by means of wind-breaks in the form of trees, supplemented, if necessary, by hedges and shrubberies.

Walks and Paths are, it has been said, a necessary evil in a garden; yet in the tropics, as ladies especially will admit, they are particularly indispensable, owing partly to the presence of land-leeches, ants, etc., which infest the grass at different seasons. Though essentially for convenience, paths may, however, be made to contribute to the general effective appearance of a garden. But they should not be made for appearance alone, and only where actually required. Their width should depend upon their position and the purpose they serve, a breadth of 4 to 5 ft. being a good average size for a small garden. This allows for two persons at least to walk comfortably abreast. In more extensive gardens or in parks, the main walks may be at least 12-15 feet in width. The Long Walk at Windsor Castle in England is about 50 feet wide and two miles long.

In large or public gardens in the tropics, where walking is often an exertion, the principal walks or roads should be sufficiently wide to admit of their use by carriages and motor cars, as in Peradeniya Gardens, Ceylon. If left to the garden cooly, he will invariably make the paths absurdly narrow and numerous, his object usually being to make a garden of paths, rather than of flower-beds and lawn.

In making paths, good foundation and drainage are essential. Having removed the surface soil, place a layer of 3 or 4 inches of drainage material (stones, broken bricks, etc.) in the bottom; cover this with coarse binding gravel, and finish off with a layer of finer gravel, watering and rolling the surface well down. It is often advisable in the tropics, owing to the heavy plumps of rain frequently experienced, to make a small parallel side-drain on either side of the path, below the level of the latter, leaving a strip of turf not less than 12 inches wide between

the drain and the path; small sloping channels should be made at intervals to lead into the side-drains,so as to facilitate the escape of surface water from the path during heavy rainfalls.

Paths should not have too steep a gradient, or they will be liable to get washed away by heavy rains. This can be obviated on steep slopes by introducing graceful curves or flights of easy steps; these will also render the path pleasanter to walk upon. To maintain the paths in a clean and even condition, free from weeds and hollows, is a matter of first importance. The grass verges should always be cut evenly and straight, not notched at the edges, and this is best done by the use of edging-shears. Weedy paths, with crooked margins, give an unfavourable impression of their surroundings.

Flag-stone, Cobble-stone, or Crazy Paths. These have a certain pleasing old-world effect. They are also useful on steep slopes or in situations exposed to heavy drip, but are not always appreciated for walking on.

Drains and Culverts. Provision for the escape of waste or excessive rain water must have early attention, for even the most absorbent and best drained soils are liable to be flooded, or, if on a slope, to serious slips or soil erosion by the heavy showers characteristic of a tropical climate. Paths, roads, terraces, etc., must therefore have ample surface drainage; good culverts, with a cemented and sloping foundation, should be made wherever water is liable to accumulate. It is advisable to build at the higher end of each culvert a silt-pit; this will not only collect the washed-away gravel, which may again be used on the paths or roads, but also prevent leaves and rubbish from entering and choking the culvert. Small surface channels, as inconspicuous as possible, should be made wherever surface-wash is liable to occur, whether in the flower-or vegetable-garden, or elsewhere.

THE FLOWER GARDEN.

Background. Though a special background is not always necessary, its presence as a rule does much to enhance the beauty of the flower-beds or lawn in the foreground. A bank of mixed tall foliage and flowering shrubs serves the purpose to advantage, the taller kinds being placed at the back, and gradually smaller ones towards the front. In this way all the plants, when they have grown up to form a sloping bank of foliage, will be seen at once from the front. In the case of borders which are to be seen from both sides, the taller plants should, of course, be planted towards the centre.

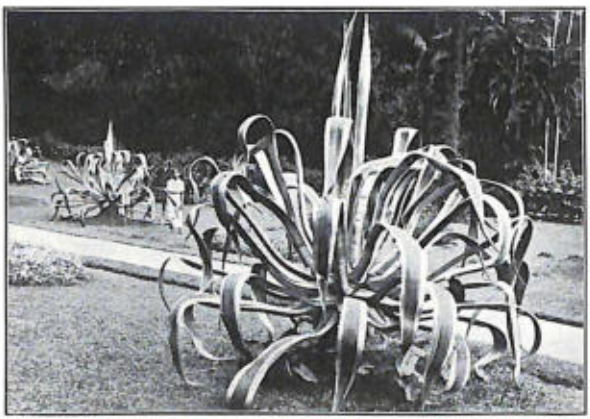


EFFECTIVE FOLIAGE GROUPING.

Bedding, Grouping, etc. As a general rule, either flowering or foliage plants look most effective when massed in large beds or groups, or in rows, circles, irregular patches, &c., as component parts of these.

Frequently, however, the effect of *mixed* planting, according to some definite colour arrangement, is very pleasing, the beauty of many species being thus enhanced both by contrast and harmony with others.

The beds should be of simple designs, such as the square, oval, circle, and rectangle. A large circular bed, formed of a sloping mass of harmonious colours from centre to margin, is always a pleasing sight. Beds of elaborate designs, with many points and acute angles, should be avoided; they involve much more labour than simpler forms, and it is impossible to find plants which can be adapted to very small nooks and corners. An exception may, perhaps, be made in favour of the star-shaped or carpet bed, which, when space permits and suitable plants are available, can be made very effective. It should be remembered that the beauty of a garden does not consist in fantastic designs and serpentine wriggles.

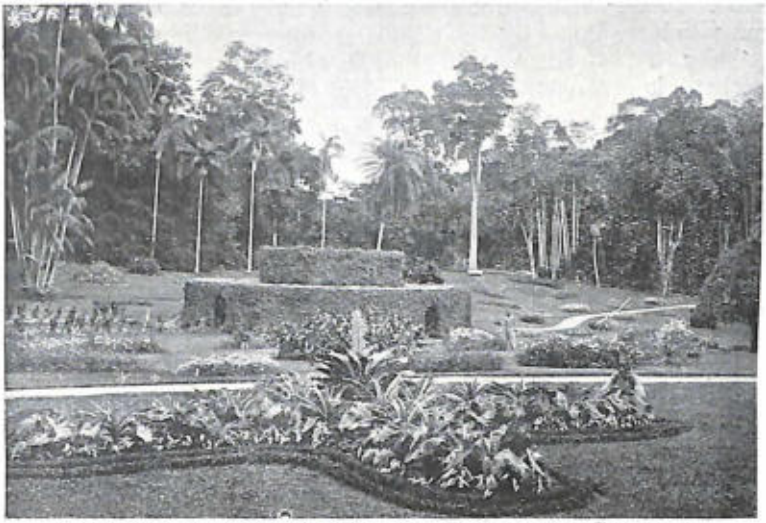


EFFECTIVE USE OF VARIEGATED AGAVES.

In order that the beds and borders may be maintained in a proper condition and be capable of being seen and admired, they should not be placed too close together; sufficient space must be left to enable the coolies to work them, and for spectators to walk comfortably between them. The ground-work should, as far as possible, be of lawn, which if well-kept will always afford the most beautiful setting. Plants of even mediocre quality will present an effective appearance when set in well-kept green sward. If the grounds be large enough to admit of it, the grouping of the larger plants, as palms, shrubs, etc., in what is called the "natural style," has much to recommend it. In this the object is to group the plants harmoniously, according to their habit, colour of flowers or leaves, forming them into isolated clumps to suit the contour of the ground. Irregular clusters of ornamental shrubs may be planted with good effect at the bends and curves of walks or drives. The effect of either beds or borders can sometimes be enhanced by raising the soil well in the centre.

Massive and Isolated Groups. As has already been said, many plants which are comparatively inconspicuous individually may present a striking effect when planted in masses, whether they be "foliage" or "flowering" plants. Thus, a very ornamental display may be made by large isolated beds of a suitable combination of foliage plants, such as Palms, Heliconias, Cannas, variegated grasses, Caladiums, variegated Pineapple, etc. These have also the recommendation that, when once planted, they do not require much attention or frequent renewals.

Ribbon Borders, in which different small plants of contrasting colours and approximately the same size are planted in lines, may have a pleasing effect. This is all the more striking when carried out on a fairly long and broad border or in large beds, but, as already stated, violent contrasts of colour should be avoided.



VIEW IN FLORICULTURAL SECTION, PERADENIYA GARDENS.

Foliage plants for colour effect. In a garden where a continuous rather than a periodical display is aimed at, free use must be made of coloured foliage plants. These may, in fact, be arranged so as to present by their striking colours an effect equal to or surpassing that of flowering plants (see p. 15). It is to such foliage plants that much of the fine effect of the flower-garden in Peradeniya Gardens, Ceylon, is due. Flowering plants also should, however, find a place when suitable kinds are obtainable; these make the most striking display when each kind is grown by itself in groups, instead of mixed with others. Unfortunately, in the tropics the flowering period of many of the most showy plants is of a brief duration. At the higher elevations, however, a beautiful display of flowering annuals may be obtained throughout the dry season, while various bulbous plants (see pp. 190-202) may supply a succession of flowers during the intervening period.

Banks or Double-cuttings, which usually occur in a garden, may be so treated as to render them interesting and ornamental. Where sufficiently shaded, they may be occupied by a pleasing variety of ferns and small foliage and flowering plants, which should be planted in pockets filled with rich humous soil. If the ground be much exposed, it may be either covered with smooth turf, or planted with showy forms of sun-loving creepers, bulbous plants, &c.

Ornamental Water.—Water in almost any form adds greatly to the attractiveness of a garden, park, or pleasure ground, and should be introduced, if possible, when not already present. An expanse of water is most appropriate in a hollow, in imitation of nature, and should not be too close to the dwelling house, especially in the tropics, where it may serve as a breeding ground for mosquitoes, except perhaps at the higher elevations. An island with an irregular outline, planted with suitable shrubs and perennials, has a pleasing effect, so long as it does not look too artificial. The water margins should not be too thickly planted and, in order to provide a mirror for the reflection of the banks, at least two-thirds of the water surface should be kept clear of plants. For a selection of water-plants, see pp. 173-175.

Cascades or Waterfalls.—Rippling streams or small cascades in a garden have a charm all their own, and should be introduced whenever

possible. Even when the fall of water is only a few feet, a pleasant rill may be introduced by the skilful arrangement of rough stones laid irregularly so as to form small cascades, imitating as far as possible a natural rustic arrangement.

Rockeries. A taste for rockeries in gardens has much developed in recent years, and in temperate countries most charming schemes may be seen. Success depends largely on locality, water supply, and suitable rocks or stones. The latter should be rough, bold and angular, arranged so as to resemble natural strata and laid in one direction, leaving fissures and pockets for earth, with patches of good soil here and there between. Intricate and irregular arrangement, with winding paths paved with flat stones, and rustic steps should be aimed at. Informal pools of water and small cascades rippling over rocks produce a pleasing effect, while the rill of a concealed streamlet has a special charm. In the tropics, it is not easy to get quite the desired conditions, except at the higher elevations, where the climate more resembles that of a temperate country. In the low-country, shade by means of evergreen trees is essential, though it has the objection of encouraging mosquitoes, especially where there is water. At higher elevations such shade is not necessary or desirable, but shelter from wind is indispensable.

Much depends also, of course, on the plants chosen. Unfortunately the number of these suited to tropical conditions is limited, but quite a good selection can be made from low-growing, bulbous, and succulent plants. For up-country the following are examples: Agapanthus, Bambusa Fortunei, Begonia (fibrous-rooted, &c.), Bellis (Daisy), Cineraria maritima, Cotyledon (Echeveria), Indigofera decora, Salvia patens, Vinca minor, Violets, Vittadinia, Zephyranthes, Selaginella, and small ferns. A selection for the low-country should include such as dwarf Caladiums, Alocasia, Amaryllis, Achimenes, Anthurium, Dracaena sanderiana, variegated Pine-apple, Cryptanthus, Costus elegans, Moraea, Anthericum, Verbena, Eucharis, Belamcanda, Coleus Rehneltianus, Zephyranthes, Streptocarpus, Ophiopogon, Phalaris, Kalanchoe, Karatas, Peperomia, Impatiens repens, Ruellia colorata, Selaginella, ferns, &c.

Fernery. Where suitable conditions exist, as shade, shelter from wind, and moderate water-supply, a well-formed fernery affords a pleasing variety in a garden. For laying out, the same remarks as applied to rockeries may generally be offered. Moderate shade is essential, whether from growing trees, bamboo-tats, or open coir-netting, for all ferns thrive best under moist and shady conditions, as may be seen when growing in a state of nature. For culture and selection of ferns, see page 158.

LAWNS.

It has been well said that a lawn is to a garden what a background is to a picture. An expanse of smooth and green sward has a special restful effect and a distinctive charm; it enhances the beauty of surrounding objects, whether they be trees, shrubs, or flower-beds, and forms a most pleasing setting to a bungalow or dwelling house.

Levelling, draining, &c. In making a lawn, it is essential that the ground be first properly prepared, the surface being thoroughly dug and uniformly levelled, coarse stones, roots and other obstacles being removed and the surface raked smooth.

If the nature of the ground requires it, provision must be made for drainage and for the escape of excessive rain-water, but if the ground be undulating or the sub-soil of a gravelly nature, artificial drainage may not be necessary. Where the soil is very poor or sandy, the turf is liable to become patchy in dry weather; therefore a good layer of heavy adhesive or cabook soil should be laid on the surface. During periods of severe drought nothing but daily and liberal watering, preferably given at night, will prevent the grass becoming parched and brown. In order to ensure a uniform or level surface, pegs should be driven into the soil at the extreme points and at intervals between these. The desired level or gradient from peg to peg can be obtained by means of a spirit-level and a long piece of wood having a straight edge, if a theodolite is not available.

Turfing. Laying turf by hand is the quickest and, at least for low elevations, the most satisfactory method of forming a lawn in the tropics, seed-sowing being generally precarious. The turfs should be obtained from close-grazed pasture land, and cut as nearly as possible of uniform thickness. This is best done with a spade,* though for ordinary purposes a mamoty will answer the purpose, and this is the easiest tool for coolies to handle. The turf should be used fresh, placed close together, the soil being worked in between to fill up all interstices, finally sprinkling some fine soil on the surface and brushing it in with a stiff broom. The turfs being beaten down into position with a flat, heavy piece of wood, the whole surface should afterwards be thoroughly rolled and watered.

Turf-grafting. In the case of a large area, or when turf or labour is scarce, economy may be effected by laying small portions of turf a foot or less apart, sinking them level with the surface. These will soon spread and cover the intervening spaces.



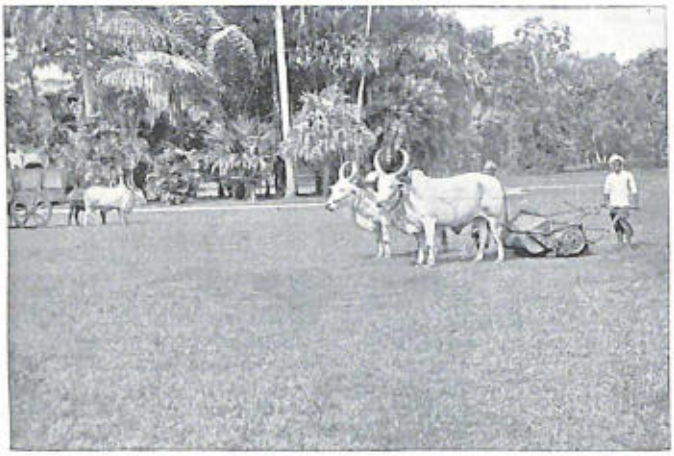
LAWN-MAKING BY DIBBLING.

Dibbling or stippling in small selected grass roots, obtained from close-grazed local pasture, is a rapid and economical method of forming a lawn, the soil being first brought to a fine tilth and uniform level, also manured if necessary. If the roots are dibbled in a few inches apart in wet weather, and the surface afterwards rolled and watered, a green sward is soon formed.

Mud plaster with chopped grass stems is a method commonly employed in India for making lawns. The grass roots and stems are chopped up, mixed with mud of about the consistency of mortar, which is spread evenly over the surface. This is especially suited to a dry climate.

Lawns from Seed. Although lawn-making by sowing seed is not usually satisfactory on the plains, at the higher elevations it is sometimes fairly successful. Here certain "English" lawn-grasses may thrive for a time, but unless carefully watched for weeds, &c., they are soon superseded by coarse indigenous species. The quantity of seed usually allowed for forming a close sward is about 75 to 100 lb. per acre. For putting-greens or bowling-greens, double this rate may be sown. At low elevations, however, a uniform green sward can seldom be obtained by sowing

* In England a horse-drawn turf-cutting machine is sometimes used, which, it is said, is capable of cutting at the rate of ½ an acre of turf a day.



MOWING LAWNS IN PERADENIYA GARDENS.

seed, owing to the rapid growth of weeds, prevalence of bird and ground pests, and the liability of the seed to being washed away by heavy rain, or injured by drought. Whichever method is adopted, the margins of walks and flower-beds should always be laid with a continuous strip of turf, even if it be but a foot in width, to form a verge.

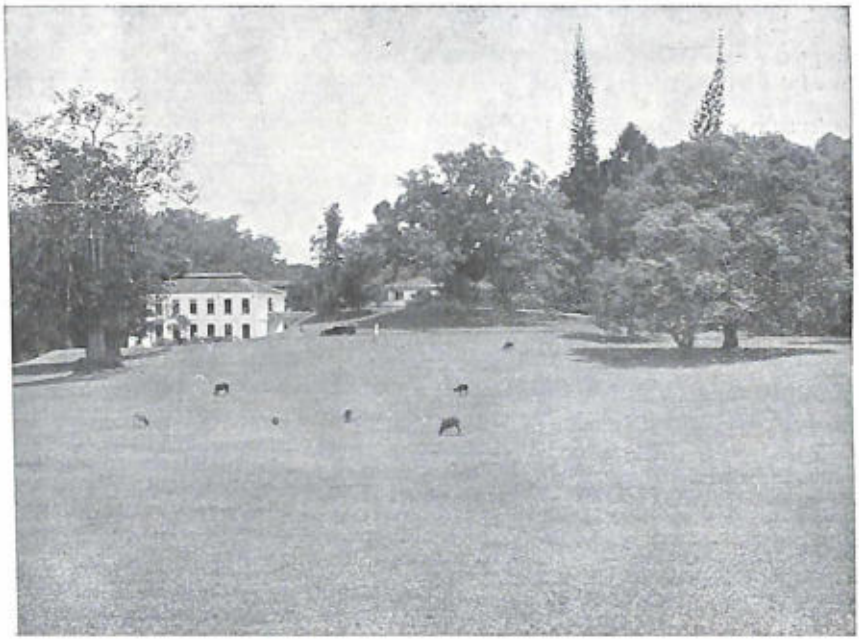
Up-keep of Lawns. The success of a lawn depends upon its proper upkeep ; it should as far as practicable be kept free of weeds, mowed at brief intervals with a mowing machine, and never allowed to produce seed-stalks or wear a neglected appearance. A heavy roller should be used frequently, but not when the ground is either very wet or dry. A mower should not be employed until a firm green sward has been formed, the grass at first being cut with a scythe or sickle.

When lawns become impoverished, a top-dressing of a compost consisting of loamy soil, sand and well-rotted manure should be given, this being raked well in, and the surface afterwards rolled and watered. The dressing should not be sufficient to hide the grass completely from view. An application of artificial manures may be given as a stimulant when needed, the most suitable being basic slag and nitrate of soda, which may be given at the rate of about 2½ oz. or 1 oz. respectively per square yard. If the soil be of a heavy or sour nature, a dressing of lime at the rate of about 4 oz. per square yard will be found beneficial. See below.

Enemies of Lawns. Among the most troublesome of these are different species of termite, more especially the common white-ant, whose "nests" should be looked for and destroyed at the earliest signs, either by digging for the queen-ant, or pouring poison, or pumping poisonous fumes, down their crevices. Watering the lawn with a solution of sulphate of ammonia (say 2oz. per sq. yd.) is also recommended for termites and black ants. Cockchafer larvae and beetle grubs are often destructive to the roots of grass. Crows and birds search for and devour these.

Certain weeds are particularly partial to lawns, one of the worst being the "Elephant's foot" (*Elephantopus scaber*). These should be dug up with a spud or "daisy fork," or they may be killed by dropping poison into their centre. Worm-casts in lawns are particularly objectionable, though their presence is considered a sign of good soil, as the worms' food consists of decayed vegetable matter, which after being digested is ejected in the form well known as worm-castings. Watering the soil with Vaporite, or with a weak solution of ammonia or lime-water, will cause the worms to come to the surface, when they may be collected and destroyed.

Moss on Lawns. The appearance of moss on lawns suggests that the drainage is at fault ; therefore, afford efficient drainage, rake out the moss with an iron-toothed rake ; then top-dress with a good compost as recommended above, adding lime in the proportion of 1 of the latter to 4 of soil. Apply the mixture at the



PORTION OF GREAT-LAWN, PERADENIYA GARDENS.

rate of 5 cart-loads per rood (¼ acre). Should the soil be of a dry nature, add 7 lb. of bone-meal to each rood; if moist, use a similar amount of basic slag. Once a year apply 1 lb. of nitrate of soda to each 30 square yards in the case of dry, and a similar quantity of sulphate of ammonia in that of moist, soils. See *Upkeep of Lawns*, p. 70.

Puff-balls (a fungus) are not often troublesome on lawns in the tropics. The usual remedy consists of a few applications of dissolved sulphate of iron, say 8 oz. of the latter to 1 gallon of water. The same remarks apply to **Fairy-rings**, caused by the mycelium of a fungus, but these require more frequent applications to eradicate.

Suitable grasses for lawns. As to what constitute the best grasses for lawns, much depends on climate and soil. Often, selected kinds from close-grazed local pasture are the best, and of these the finest-leaved species should be chosen. Among the most suitable are: *Cynodon dactylon* (Doob, Bermuda- or Devil's grass; Arugam-pillu, *T*) with fine leaves and long, slender runners; *Panicum longiflorum* (Blue-grass; Sellaipillai, *T*), forms fine bluish turf when young (see p. 452); *Paspalum sanguinale* (Guru-wal, *S*); *Chrysopogon aciculatus* (Love-grass; Tuttiri, *S*), which resists drought well, forms excellent turf in the moist low-country, in spite of the objection to it when allowed to seed, owing to the sharp hooked awns which adhere to and penetrate one's clothes. To these should be added the very small-leaved clover-like perennial, *Desmodium triflorum* (Hin-undupiyala, *S*), which has small purple flowers and is specially suited to dry, rocky soils. The ordinary self-formed turf on the lawns in Peradeniya Gardens consists chiefly of the above in addition to the following—*Ischaemum ciliare* (Rat-tana, *S*), *Setaria glauca* (Kawulu, *S*), *Sporobolus diander*, and *Anthistiria tremula*. Under the shade of trees, the principal turf-grasses are *Paspalum obtusifolium*, *Paspalum conjugatum*, *Panicum trigonum*, *Oplismenus compositus*, and *Apluda aristata*. The grass known locally as the "Barbadoes Sour grass," and in the Philippines as "Bitter grass" (*Paspalum conjugatum*), is an introduced species from the West Indies which

has become completely naturalised in Ceylon; it is specially adapted to shady situations, and when kept closely cut forms very fair turf. At the higher elevations, certain "English" grasses will thrive, at least for a time, in well prepared ground, and grass-seed mixtures adapted for different purposes may be obtained from seed-merchants in Europe and elsewhere. *Panicum repens* (Couch-grass; Etora, *S*), which is deep-rooted and drought-resistant, forms good turf as does also *Paspalum dilatatum* when closely mown. See p. 450.

HEDGES AND BOUNDARIES

For several reasons a garden in the tropics should be enclosed by a hedge or fence, that is if exclusion of cattle and vermin, shelter from wind, and privacy be considered essential. Well-kept hedges can be ornamental as well as useful; they form protective boundaries, shut off private quarters, divide portions when necessary, or conceal unsightly parts. The suitability of a plant for a hedge depends upon the purpose and locality for which the latter is required.

An effective hedge of coloured foliage may be formed of Acalypha, Croton, Panax, Pisonia, Cordyline, etc., either mixed or singly; whilst for a hedge of flowering plants, different varieties of Hibiscus, Ixora, Poinsettia, Thunbergia erecta, etc., make a striking display. It is always advisable to give a hedge a good foundation, *i.e.*, a trench dug deeply and filled with good soil; otherwise gaps or unevenness of growth are likely to occur. When a hedge has to answer the purpose of a barrier, a good plan is to run a few strands of barbed wire along the centre; or, if the wire-fence is already in position, the hedge may be planted (or sown) by its side; otherwise the fence may be beautified or concealed by growing light ornamental climbers over it. An excellent barrier hedge may be formed by means of some formidable prickly plant, as Yucca, Agave, Euphorbia, &c. See over.

Ornamental hedges are usually formed from cuttings planted where intended to grow, but certain hedges, especially those of a permanent nature, are best formed from seed sown *in situ*, as Madras-thorn, Malpighia, Logwood, Phyllanthus, Triphasia, &c. The quantity of seed required varies according to the size of the latter, which should be sown thinly, about 6 inches apart. Thus 1lb. of seed of the first named kind should be sufficient to sow 50 running yards.

Clipping Hedges. In clipping or trimming a hedge, it should always be remembered to keep it narrower at the top than at the bottom, otherwise it becomes bare and leafless towards the ground. Hedges of large or broad-leaved plants should not be clipped, but trimmed with a knife or secateurs.

SELECTED HEDGE PLANTS.

(A).—FOR LOW ELEVATIONS.—(ORNAMENTAL OR SCREEN).

[Letters in brackets indicate usual means of propagation; (C)=cuttings; (S)=seeds; (Div.)=division; (Su.)=suckers; (Tu.)=tubers. Figures=usual height in feet.]

Acalypha. Different varieties. Quick-growing, 6-10; large coloured leaves. (C.)

Aralia filicifolia. (Panax). Erect shrub, 6-8; handsome fern-like foliage, yellow when young. (C).

Aralia Guilfoylei. Quick-growing, erect; leaves variegated. (C).

Bambusa nana. "Dwarf" or Chinese Bamboo. 6-8 or more. (Div.) See pp. 73, 172.

Barleria cristata. Dense shrub, free-flowering, 4-6; flowers white, mauve, or rose-pink. Quick-grower. Commonly grown as a hedge plant in Colombo. (C).

Bougainvillea glabra. Shrubby, spiny cl.; ornamental and barrier. (C). See p. 123.

*Brunfelsia uniflora. Erect flowering shrub, sweet-scented. 4-6. (C or S.)

Casuarina equisetifolia. "She-Oak." See pp. 57, 97, 99, 179, 206, 216. Quick-growing, can be kept low for several years. Makes a good dense hedge, especially near the sea. (S.)

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* Suited also to up-country.

Croton (Codiaeum). Different varieties. Variously coloured, handsome leaves. (C). See p. 119.
*Duranta Plumieri. "Duranta." Large shrub or small tree, 6-8 or more, (C or S).
Ehretia buxifolia. Ceylon Boxwood. Slow-growing, dense foliage, 3-4, (C or S).
Eranthemum maculatum. Several var's. 6-8. Variegated and coloured fol. (C).
*Hibiscus rosa-sinensis. Shoe-flower. Numerous varieties. Quick-growing, free flowering if not clipped. 6-10. (C). See p. 111.
Justicia gendarussa. Small bushy shrub, 3-4. (C).
Logwood. See selection (B).
Malpighia glabra. Barbadoes Cherry. Close-growing prickly shrub, 4-6; much used for hedges in W. Indies, &c. (S). The cherry-like fruits are edible.
Murraya exotica. (Limonia). 6-8; (S.) See page 113.
Panax fruticosum. (Aralia) Erect shrub, 6-8; handsome, deeply-cut foliage. (C).
Pithecolobium dulce. Madras Thorn. Quick-grower, thorny, 5-8 or more. (S).
*Phyllanthus myrtifolius. Ceylon Myrtle. Slow-grower, 5-6 or dwarf; small leaves, dense foliage. (S or C). See next page, also p. 121.
*Punica granatum. Pomegranate. (S or C). Quick-grower, 5-6. ft. Showy, scarlet flowers, especially suited to a dry climate. See pages 208, 269.

(B)—FOR BOUNDARIES OR BARRIERS.

Acacia tortuosa. "Cushaw." Spiny sh., forms dense hedge; suited to dry districts. (S).
Agave americana variegata. American Aloe. Slow-growing, 5-6. (S or Su). Numerous other species.
Balsamodendron Berryi. Mul-kilivai, *T.* Dense and spiny; makes a good hedge. (S).
Bambusa nana. Dwarf Bamboo. 6-8; ornamental and barrier. (Div). See p. 72.
Bougainvillea spectabilis. Shrubby climber, spiny, free-flowering, very ornamental when in flower. (C or S).
Bromelia Pinguin. (*Bromeliaceae*). Trop. America. Long, narrow leaves, with sharp, hooked spines. Several other species. (Div or S). See p. 429.
Caesalpinia Sappan. Sappan-wood. Spiny, straggling shrub. Interlaced branches form strong barrier. (S).
Citrus decumana. Pomelo. Small spiny tree, 10-15 or more. (S). See p. 258.
Clerodendron aculeatum. "Wild Coffee." Rather slow-grower, 5-6, spiny. (S).
Euphorbia Antiquorum. Daluk. Quick-grower, 6-15. Very thorny branches, milky juice poisonous. (C).
E.—Tirucalli. Milk-hedge; Nawa-handi, *S.* Quick-growing, commonly used in Ceylon as boundaries for paddy fields. (C).
Flacourtia Ramontchi. "Governor Plum." Forms close, spiny hedge; much used as such in W. Indies and elsewhere.
Furcraea gigantea. Mauritius Hemp. Large, fleshy, prickly l., 5-7. (Su. or Bulbils).
Gymnosporia emarginata. Straggling, spiny shrub. (S).
Haematoxylon campechianum. Logwood. Slow-growing, small, spiny tree; good barrier. (S). See p. 439.
Jatropha Curcas. Physic-nut; Rata-endaru, *S.* Quick-growing, 5-6; commonly used for paddy field boundaries. Juice poisonous. (C).
Pereskia Bleo. Interlaced spiny stems form good barrier. Fl's small, pink.
Pithecolobium unguis-cati. Bread-and-Cheese Plant of the W. Indies, where it is commonly used for hedges. (S).
Triphasia aurantiola. Macanchi, *S*; Myrtle-lime. Upright, spiny shrub. Slow grower. (S).

(C).—FOR UP-COUNTRY HEDGES OR BOUNDARIES.

See also those marked * in Selection (A).

Acalypha marginata. Copper-leaf. 5-6. Creamy white or pink margins. (C).
Berberis aristata. Berberry. Thorny shrub; barrier and ornamental. (S).
B.—Fortunei. Chinese Berberry. Slow-growing, prickly shrub, 3-4. (S).
Caesalpinia sepiaria. Quick-growing, straggling, spiny shrub. (S).
Ceratonia Siliqua. Suited to dry warm countries. See *Sub. Trop. Fruits*, p. 275.
Cestrum fasciculatum. Fairly quick-grower, 6-8, fine flowering. (S. or C).
Colletia cruciata. Slow-growing, very thorny shrub. (S).
Cryptomeria japonica. Japanese Cedar. 6-8 or more, evergreen. (S).

* Suited also to up-country.

Cupressus macrocarpa. Quick grower; makes excellent evergreen, dense hedge. (S). See p. 180.
Furcraea gigantea. Mauritius Hemp. See selection B, also p. 424.
Habrothamnus elegans. See *Cestrum fasciculatum*. (S. or C).
Ligustrum ovalifolium. Privet. (*Oleaceae*). Japan. Close-growing sh. L. small, oval(C).
Olea europea. Olive. Makes good hedges in sub. trop. countries. (S). See. p. 279.
Reinwardtia tetragyna, and R. trigyna. Erect shrubs, 4-5, yellow fl's. (C).
Spiraea peruviana. Peruvian Spiraea. Slender, rather straggling shrub. See p. 185.
Tecoma capensis. Slow-grower; fl's bright orange-red. (S. or C).
Ulex europea. Gorse; Furze; Whins. Slow grower, good barrier, ornamental, 5-6. (S). Introduced and now naturalised about Nuwara Eliya, Ceylon.

(D).—HEDGES FOR DRY REGION.

Acacia modesta. "Phula". Slow-growing small tree, much used for hedges in India.
Agave americana. American Aloe. Leaves pointed with long sharp spines; also margins sometimes spiny. Numerous other species. (Su). See p. 73.
Balsamodendron Berryi. Mul-kilivai, *T*. Dense, spiny, good barrier. (S.)
Capparis zeylanica. Dense, thorny, fine-flowering shrub. (C).
Carissa spinarum. Hin-karamba, *S*. Chirukila or Kilatti, *T*. Dense, thorny shrub. (S). C.—grandiflora (see page 257), much used for hedges in Natal, &c.
Dichrostachys cinerea. Andara, *S*. Vidattal, *T*. Slow-grower, upright, thorny, shrub. (S).
Euphorbia Antiquorum; and E.—Tirucalli. Milk-hedge. See Selection (B).
Furcraea gigantea. See Selection B.
Jatropha Curcas. Physic-nut. Quick-growing shrub. See Selection (B).
Lantana. Different species or var's, commonly used for hedges in India, &c.
Lawsonia alba. Mignonette Tree. Henna. See page 438.
Opuntia Dillenii. Prickly Pear; and other species. See p. 267.
Pandanus zeylanicus. Okeyiya, *S*. Slender screwpine, used as boundaries for paddy fields in Ceylon. (S or Su).
P.—utilis. Commonly planted as boundaries in Mauritius, &c. See p. 431.
Parkinsonia aculeata. Jerusalem Thorn. Thorny shrub, good barrier. (S).
Pedilanthus tithemaloides. Vetahiriya, *S*. Commonly planted around paddy fields in Ceylon. (C).
Pithecolobium dulce. Madras Thorn. (S). See selection (A).
Streblus asper. Geta-netul, *S*; Pirasu, *T*. Gnarled shrub; coppices well. (S. or C).
Tecoma capensis. Ornamental; fl's bright orange-yellow. (C. or S).

PLANTS SUITABLE AS EDGINGS FOR PATHS, BORDERS, ETC.

(A)—FOR LOW ELEVATIONS.

*Also suited to up-country.

*Alternanthera. Several var's. 6 in. or more. Foliage bronze or greenish yellow, quick-growing. Suitable for ribbon effect. (C).
*Amaryllis (Hippeastrum). Several var's. Large, showy flowers, 1-1½. (Bulbs).
*Anthericum liliastrum variegatum. ½-1. Long, narrow, variegated leaves. (Div).
Caladium Humboldtii.=C. argyrites. ½-1. Small leaves, prettily variegated. (Tu).
Caladium bicolor. 1 ft. Leaves with pink centre and green margin.
*Caralluma campanulata. Dwarf, leafless plant, with square stems. (C).
Malpighia coccigera. Small shrub, adapted for keeping dwarf like Boxwood.(C. or S).
*Ophiopogon intermedius. Grass-like plant; suited to shady places; 1. (Div).
*Phalaris arundinacea. Ribbon-grass. Variegated leaves, ½-1. See *Grasses*, p. 172.
Pilea muscosa. Dwarf moss-like plant. ½. See p. 225.
*Phyllanthus myrtifolius. Ceylon Myrtle. Dense, evergreen shrub, with fine foliage, adapted for dwarfing. (S).
Stapelia grandiflora. Small succulent Cactus-like plant. (C).
Telanthera sp. (*Amarantaceae*). Soft, velvety, small, purplish leaves. (C).
Zephyranthes carinata. "Rose Amaryllis." ½-1. Fl's large, bright rose. (Tu)
Z.—tubispatha. ½-¾. Fl's white, resembling Crocus. (Tu).

(B)—FOR UP-COUNTRY.

Those marked * on previous page are also suitable.

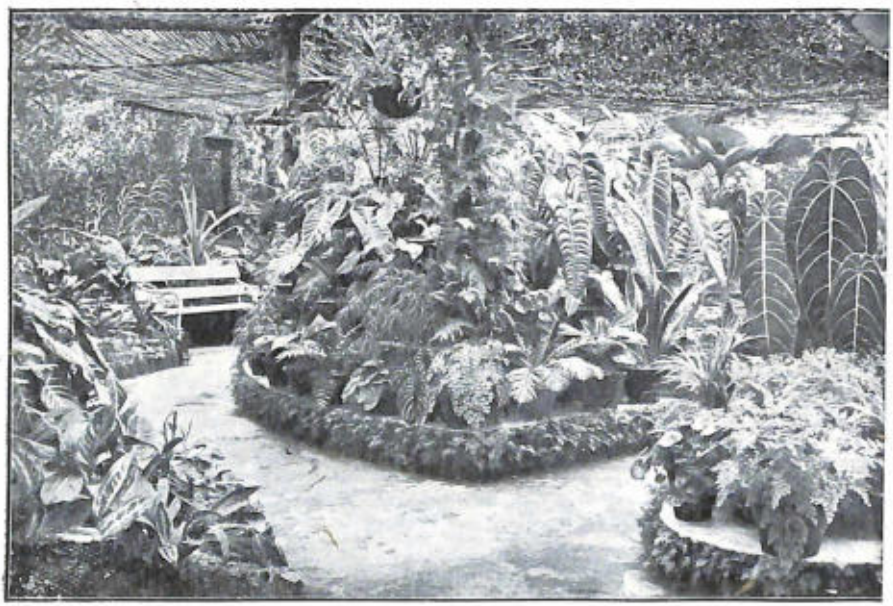
Boxwood (*Buxus sempervirens*). Small, slow-growing shrub, with small oval leaves, adapted for dwarf edging. (C). See p. 186.
Cotyledon (Echeveria) metallica and C. glauca. "Oyster Plant." ½-½. Small, succulent, rosette-like plants. (Tu). See p. 186.
Cyrtanthus Mackenii. "African Bride." Fl's creamy white. (Tu).
Golden Feather (Pyrethrum aureum). Handsome yellow foliage. ½-¾ (S. or C).
Santolina chamaecyparissus. "Cotton Lavendar." Whole plant glaucous grey, strongly scented. (C).

CHAPTER X.

PLANT-SHEDS, CONSERVATORIES, AND GREEN-HOUSES.

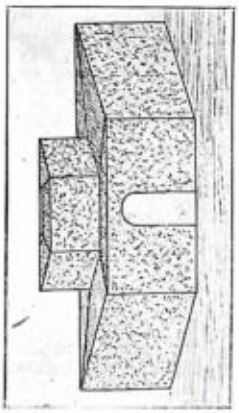
SEE ALSO UNDER NURSERIES.

The object of a plant-house in the tropics is not, except in the hills, to protect plants from the cold, but rather from the fierce sun's rays and strong winds, while also maintaining a uniform, cool, and moist atmosphere. A suitably constructed plant-house of this nature, with free circulation of air and filled with a choice selection of plants, will form a delightful retreat during the heat of the day, in addition to affording the essential conditions for the cultivation of showy, tropical, shade-loving plants. A modest structure of bamboos, covered with a few palm leaves, may temporarily answer the purpose of a plant-house, lasting for at least a year or so, but a more substantial and permanent building should have the framework composed of teak or other hard wood, or better still of iron.

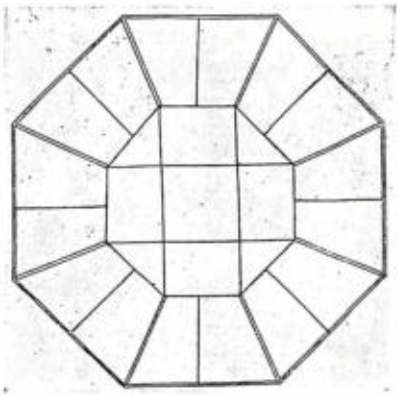


VIEW IN OCTAGON CONSERVATORY, PERADENIYA GARDENS.

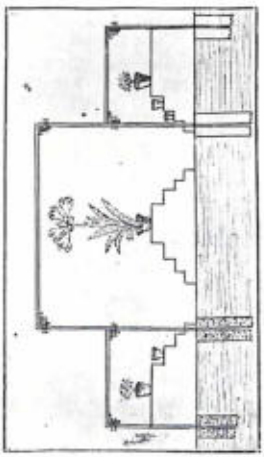
OCTAGON CONSERVATORY IN ROYAL BOTANIC GARDENS, PERADENIYA, CEYLON.



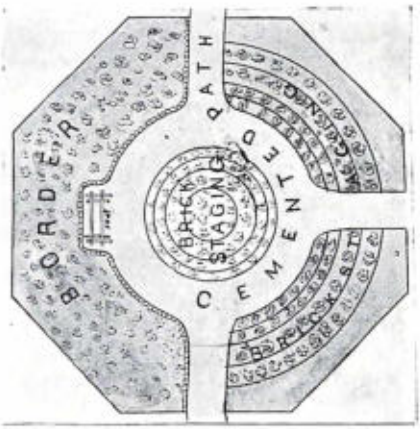
ELEVATION.



PLAN OF TOP SECTION.



UPRIGHT SECTION.



GROUND PLAN.

The iron octagon "conservatory" in the Royal Botanic Gardens, Peradeniya, Ceylon, might be taken as a model of an economically built and eminently satisfactory type of tropical plant-house (see page 77). The upright supports consist of old rails, 12 ft. long, 3 ft. of each rail being buried in concrete. The top is flat for a distance of 12 ft. from the circumference, and rests on horizontal rails with iron bars placed transversely at intervals of a few feet. In the centre rises an octagon "dome," the upright rails forming the angles; these are 21 ft. long, with 4 ft. buried in concrete. The circumference of the house is outlined by a half-brick wall, 3 ft. high, the outer edge of which is flush with the iron posts. The whole structure is covered over with a 3 in. mesh wire-netting. Over the flat tops are placed split-bamboos, strung together like tats and tarred. The handsome evergreen climber, **Passiflora laurifolia*, is planted around the house and trained on the wire-netting of the upright portions, forming a useful and effective screen. The interior is occupied with graduated plant-stages on one side, and a broad sloping border on the other, the centre being furnished with 5 plant stages, rising in tiers; all the paths and stages are cemented over. Here numerous shade-loving species thrive to perfection. §

An excellent and commodious shade-house or conservatory in the Maharaja's garden at Bangalore has tall stone slabs, easily obtained in the vicinity, instead of iron uprights, and is covered with the creeper *Banisteria* (*Stigmaphyllon*) *laurifolia* over strong netted wires, supported by cross iron bars.

Effective shade or screen for plant-houses may be provided by means of suitable evergreen climbers with small leaves, as *Ficus repens*. These should not, however, as a rule be permitted to grow over the roof, as they thus excessively reduce light and ventilation and interfere with the healthy growth of the plants. In India, strips of woven grass placed on the roof are often used for shade, while in Ceylon coir-netting or bamboo tats are generally employed for the purpose. In the hill districts, the growing of tender tropical plants can usually be carried on only by means of a greenhouse, or at least a well-protected or glazed verandah. A greenhouse may be easily heated by a flue passing from a fire and stoke-hold outside to within, and then under the plant-staging. An excellent greenhouse, built on this principle, may be seen in Hakgala Gardens.

Propagating frames. Glazed frames are most useful adjuncts to up-country gardens. These may vary in size according to requirements, and should always be movable, *i.e.*, not fixtures. Bottom-heat may be provided for a propagating frame by means of a hot-bed made of fermenting horse-dung, the latter being heaped in a deep pit, covered with a layer of fine soil, and the glazed frame placed over it.

CULTIVATION OF POT-PLANTS

The successful cultivation of the choicer kinds of ornamental plants in pots is a branch of horticulture which demands special care and a certain amount of skill. A knowledge of the plants' requirements, gained by observation of their growth and habit, is the best guide in the matter. An important condition, both for the health and appearance of the plants, is cleanliness; therefore the foliage should be frequently syringed, or sponged with soapy water if necessary, and the pots scrubbed to prevent the growth of moss or lichen upon them.

Potting plants. The essential requirements for this operation are: clean earthenware pots, a suitable compost of soil, and broken pieces of potsherds or porous tiles, for drainage.

Commencing with the latter, a crock (piece of potsherd) is placed, concave side down, over the hole in the bottom of the pot; around and over this are

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* Now replaced by *Ficus repens*, which answers the purposes even more satisfactorily.

placed more crocks, finishing with smaller ones, the drainage being then about an inch deep; over this should be laid some dry moss, coir fibre, or coarse grass to prevent the soil clogging the drainage. A layer of the potting compost being then filled in, the plant is placed in the centre, the soil filled in around it and pressed firmly. A space of about ½ inch from the top should be left for the purpose of holding water when the plants are watered. It is customary at Peradeniya Gardens to cover the surface of the soil in the pots with a layer of small pieces of brick or sandstone, closely and neatly packed. This has the effect of keeping the staging clean, preventing the soil from being washed out in the course of frequent waterings, while also checking the evaporation of moisture. After the plants are potted, a copious watering is given, and the plants are kept for a few days in a dark room or under heavy shade. A common error on the part of native gardeners is to use pots many sizes too large; these are not only ungainly, but also less suited to the health of the plants. Plants look and thrive best in pots which are in proportion to their size. see p. 81.

The proper time for potting should be determined by the progress of the plants and the condition of the soil and roots, rather than by any fixed seasons. Generally speaking, the best time is when the plants are commencing their more active periods of growth, which usually occur at the commencement of the monsoon rains.

The necessity for re-potting a plant may be ascertained by turning it out of the pot and observing the state of the roots, soil, and drainage. "It is a standing rule," said Sir Joseph Paxton, "with experienced horticulturists that no plant should be allowed a larger pot till the one in which it is growing is filled with fibrous roots," i.e. pot-bound. Frequently, however, before the pot is filled with roots, the soil becomes sodden or impoverished, with the roots in an unhealthy state, and the plant is unable to make normal growth. This condition is especially liable to be induced by the frequent watering necessary in the tropics, and when it occurs the soil should be entirely removed, and replaced with a suitable potting mixture. Plants should never be re-potted when the soil is dry. If in this condition, they should be watered some time before potting is commenced, so that the surplus water will have time to drain away. Soil used for potting should be sufficiently moist to hold together when pressed in the hand.

Drainage of Pot-plants. No point is of greater importance than proper drainage. The cause of sickly plants is to be found, in the majority of cases, in imperfect drainage, in consequence of which the soil becomes sodden and sour, affecting the functions of the roots. Whenever this condition is suspected, the plant should be gently turned out, and the drainage repaired as at first done, renewing the soil also if necessary.

Soil for Potting plants. The ideal compost for most plants should consist of rich loam, leaf-mould, and fine sand, made up in various proportions to suit the plants in hand. A peaty soil is especially suitable for many ferns and plants of the Rhododendron and Azalea family, though these may also thrive in rich loamy soils, which palms and most foliage plants prefer. Old turf from good pasture-land, when well decayed and in a friable condition, forms a good basis for a potting mixture. The turf should be procured long before it is required, and stacked (with the grass-side down), incorporating with it layers of cattle manure and leaf-mould. Where it is difficult to obtain turf or loamy soil, a fairly good substitute may be made up by a mixture of old and rotted coir dust, leaf-mould, and well-rotted cattle manure. In Colombo, for instance, this is practically the only kind of soil procurable for potting plants. See pp. 20, 24.

Worms, eelworms, centipedes, etc. in pots. Vaporite (see page 481) is an excellent remedy for these pests, and should be in the possession of everybody who grows plants in pots. It is a simple but effectual preparation, and may be applied in a solution with water (say, a table-spoonful to a gallon of water), or merely sprinkled dry on the surface of the soil before watering. Lime-water or soot-water, though not so effective as vaporite, may also be employed for the purpose. A good plan is to stop the hole of the pot with clay for a few hours, so that the whole of the soil may become saturated with the solution. See *Insect Pests*, pages 481, 484.

WATERING PLANTS.

Watering is one of the most important operations connected with the cultivation of plants in pots, for a deficient or excessive supply of water at the roots (see *Drainage*, p. 79) is a frequent cause of languid growth or disease. To know just the proper amount of water that is most beneficial to a plant requires judgment, and can only be learnt by observation.

Water should not be given unless required, and then it should be applied in sufficient quantity. A sharp tap on the pot will indicate by the sound whether a plant is dry at the root and in need of water. If the soil is in a very dry state, the plant with the pot should be placed for a time in a bucket of water to become thoroughly soaked. When the leaves droop, it is a sign that the plant is in need of water or is suffering from stagnation at the root. Water should not be allowed to remain in the saucers or vases in which plants are standing, for this will cause a stagnant condition of the soil, besides affording a breeding ground for mosquitoes. A watering-can with a good rose should always be used, especially for young or delicate kinds, but it must not be forgotten that this affords a dishonest gardener a greater opportunity for scamping the work than watering through the plain spout. The best roses are those made of brass with fine regular holes. Only those with the smallest holes should be used for watering seeds in boxes or beds. One of the most important lessons to teach a garden cooly is that watering, if needed at all, must be plentiful, and that a mere wetting of the surface is deceiving. All watering should, if possible, be done late in the afternoon or in the early morning. Always use rain-or pond-water, if procurable, in preference to well-water. Water mixed with a weak solution of liquid-manure (see p. 23) is very beneficial.

Plants vary in their capacity for drawing moisture from the soil, *i.e.*, some have more rapid transpiration than others. Those with a thin epidermis take up relatively a large amount of water; while others of a succulent nature, such as Cactus, Agaves, and Aloes, have a thick cuticle (xerophytic) and take up comparatively very little, and are therefore able to thrive in dry arid regions. Vigorous-growing plants naturally require more water than slow-growing kinds. Deciduous plants, when they have shed their leaves, should be watered but sparingly, as, owing to their transpiration surface being then reduced to a minimum, much moisture at this stage is injurious to them. During wet weather, evaporation from the leaves is reduced; therefore plants take up less water by their roots, while in dry weather the conditions are reversed. Plants give off moisture more rapidly when exposed to wind or sunshine than when growing in the shade, and therefore require more water at the root. When the roots are confined in a small space, there is naturally a great demand on the supply of water available, and plants in this condition require frequent and copious supplies.

Syringing. The operation of syringing is very essential to the health of plants growing under cover, where the natural rain does not reach them. Syringing creates a moist atmosphere, cleanses the leaves and thus assists in promoting their functions as well as in their presenting a cleaner and finer appearance. In dry weather the syringing of plants, which should only be done with perfectly clear water and through a fine syringe-rose, may with advantage be carried out twice or three times a day. During wet and dull weather, however, it should be done sparingly, if at all.

VERANDAH GARDENING.

An essential feature of horticulture in the tropics is what may be called verandah-gardening, which in some cases, especially in towns, may cover the entire gardening scope of a bungalow. Nothing brightens the appearance of a bungalow so much as a verandah furnished with well-

grown and choice plants, and these may be considered almost as indispensable to a verandah as the latter is to a bungalow. As window-gardening is now a prominent feature in many towns in temperate countries, being encouraged by municipalities and sometimes supervised by tasteful women, the attention of municipal authorities in the tropics might well be directed to the encouragement of verandah-gardening in towns.

The successful growth of plants in a verandah depends to some extent on aspect and situation. Many beautiful foliage plants, which become stunted or scorched by the sun on the south side of a bungalow, may thrive luxuriantly in a shady north verandah. Ferns are generally best suited to a shady northern aspect. It is often advisable, however, to change the plants, as may be gauged by their indifferent or unevenly developed growth, from north to south, or *vice versa*. All plants growing in a verandah should be frequently turned round in their position, so as to equalise the effects of light, otherwise their growth will be one-sided. Overcrowding of the plants should always be avoided, for space as well as cleanliness is essential to their well-being. The foliage should be syringed frequently, and all dead, sickly, or superfluous growth removed. The pots or tubs should not be ungainly in size, or of grotesque appearance, and should be raised off the ground and placed on neatly arranged or concealed bricks. See p. 79.

Drawing-room plants. Everybody experiences at one time or another the difficulty of keeping plants in good condition in a room, for, however carefully tended, these sometimes sicken or become discoloured. Frequently the cause is excessive watering (see *Watering of Pot-plants*, p. 80), but it may also be due to insufficient day-light or excessive artificial light. Therefore, the plants should be placed out of doors at night and during the early part of the day, especially during rainy weather. This has the effect of keeping the foliage clean and healthy. Ferns as a rule thrive best in moist shade, as in a north verandah.

Selection of plants for Verandahs. Certain plants are more adapted for growing under cover than others. Thus, in a selection for the low-country, foliage plants, such as Ferns, Begonias, Palms, etc., should predominate; while for higher elevations flowering annuals or perennials, hardy ferns, etc., are best adapted. The following indicate the kinds chiefly suited in either case. For the low-country: Feathery palms, such as *Chrysalidocarpus* (Cane-palm), *Caryota* ("Kitul"), *Ptychosperma, Martinezia, Phoenix* (Date kind), and *Cocos* (Coconut kind); Fan-palms, as *Licuala grandis, Livistona australis, L. rotundifolia, L. chinensis, Thrinax, Latania*, and *Sabal*; also *Anthuriums, Alocasias, Begonias, Marantas, Ferns, Caladiums, Ophiopogon*, etc. For up-country:—*Pelargoniums, Geraniums, Petunias, Begonias, Primulas, Gloxinias, Cinerarias, Chrysanthemums, Fuchsias, Cyclamens, Gesnerias, Streptocarpus, Bouvardias, Adiantum* (Maiden-hair), and other ferns, etc. See page 202.

FRENCH OR INTENSIVE GARDENING.

It is well known that in France and certain other countries, is practised a system of close intensive cultivation of the soil. The term is a broad one, but the general principle is based on getting the most out of the soil in the shortest time possible, procuring crops at the most profitable seasons, and wasting no more space or crop than is unavoidable.

Thus, in economising space, the paths are generally very narrow, and planting distances are regulated by measured boards or by a definite scale. Quick-growing crops are interplanted with those of slower growth, so that the former may be reaped before the latter have attained maturity, and without interfering with the growth of either. By means of hot-beds and cloches, many articles of vegetable and salad are produced throughout the winter and spring, when, being "out of season," they command remunerative prices.

SECTION 2.

CHAPTER XI.

BEAUTIFUL TREES OF THE TROPICS.

SUITABLE FOR LOW OR MEDIUM ELEVATION.

THOSE IN LARGE TYPE ARE OF CHIEF IMPORTANCE.

(1).—*FLOWERING TREES.*

Properly speaking, all trees are *flowering trees*, that is, they normally produce flowers, whether these be showy or inconspicuous; but, for practical purposes, only such as bear conspicuous or showy flowers and are commonly known as *flowering* trees are here included. For trees whose beauty consists chiefly in their foliage or form, see *Ornamental Foliage Trees*. Many of the following species, however, combine to a large extent both beauty of foliage and flowers. Some flowering trees are deciduous, and develop their floral display when devoid of leaves (*e.g.*, Red Cotton Tree or Bombax), while others are in their full glory of foliage and blossom simultaneously, as the Amherstia, Spathodea, etc. Certain flowering trees may be employed for utility as well as for ornament, as for shade along exposed thoroughfares, or in parks, &c. The planting of bright flowering trees around bungalows situated in lonely districts and surrounded by monotonous plantations, would go far to relieve the depressing effect often inseparable from such situations.

Flowering trees for street-planting, etc.—For this purpose a flowering tree should obviously be evergreen, or at least have the habit of developing young foliage soon after the shedding of the old leaves. (See selections, pages 211-218). If the name of the tree employed is such as to lend itself to use as a street name, it might be so adopted; for while thus impressing the charm of the tree, the name itself might be an improvement on some of the street names now in use, *e.g.* "Amherstia-avenue," "Cassia-terrace," "Spathodea-grove." This however may have certain disadvantages. The following are some of the most beautiful flowering trees of the tropics, given in alphabetical order. By coincidence, the first on the list is perhaps the finest flowering tree in the world.

Amherstia nobilis. "Queen" of flowering Trees. *Leguminosae.* Named after Lady Amherst, whose husband was once Governor of Burma.—A medium-sized tree, native of Burma, considered the most beautiful of all flowering trees. Its large, graceful sprays of vermillion and yellow flowers, drooping from every branch and interspersed with the handsome foliage, present an appearance of astonishing elegance and loveliness.

It is in blossom for the greater part of the year, except during long periods of rainy weather, the chief flowering season in Ceylon being from November to April. The tree grows to a height of 50-60 feet, is usually round-topped, with many slender branches and dark-green, pinnate leaves. A remarkable feature is the long, hanging, brownish-pink clusters in which the young leaves appear. This habit is also characteristic, to some extent, of certain other tropical trees, as *Brownea grandiceps* and *Saraca declinata*. In the latter case the young leaves are mottled pale grey or almost white.

The tree thrives in the moist low-country up to 1,600 feet, and requires deep, rich and well-drained soil. It does not seem to flourish near the sea, and is rarely met with about Colombo. It produces seed very scantily anywhere, a pod or two (which are flat, brown, 6-8 in. long, containing 1-3 large flat seeds) occasionally being all that can be obtained. The seeds, moreover, are often infertile. Propagation by layering has, therefore, to be adopted (See *Gootee*, pages 38, 39). Introduced into Ceylon in 1860. See *frontispiece*.

Baikiaea insignis. *Leguminosae.*—A handsome flowering tree, reaching a height of 40 to 50 feet, with large coriaceous, oval leaves, native of West Trop. Africa. Bears large, flaccid, white flowers, opening in evening and fading the following afternoon, chiefly about April—May and August—September. The large flower buds are black and velvety. Introduced at Peradeniya in 1902, and bears seed occasionally.

Bauhinia. *Leguminosae.*—A genus including several small but beautiful flowering trees, as *B. purpurea* with very showy large flowers of a pink shade merging into purple; *B. triandra* or "Mountain Ebony," similar to the latter; *B. tomentosa* (Kaha-petan, *S.*) with yellow flowers; *B. variegata* with large magenta and white flowers; *B. Krugii* of Porto Rico, and *B. monandra* of Burma, and others. The genus takes its name from Bauhin, the twin brother botanists, from the fact that the leaves are joined in twos at the base.

Bolusanthus speciosus. Rhodesian Wistaria; M'pakwa or M'poea. *Leguminosae.*—A beautiful tree of Rhodesia, bearing drooping racemes of deep blue, sweet-scented flowers; it is evergreen and a slow grower, with glossy dark-green leaves. Grows up to 3,000 feet elevation in Rhodesia.

Bombax malabaricum. *Malvaceae.* Red Cotton Tree; "Katu-imbul," *S*; "Parutti," *T*. A very large, handsome, upright, quick-growing, deciduous tree, reaching a height of 120 feet or more, native of Ceylon, India, Burma, &c. It is a striking sight when covered with its large, fleshy, bright red flowers, usually during January and February, when quite leafless. The flowers are edible and, as they drop, form a scarlet carpet on the ground for about 2-3 weeks. The tree forms a large straight trunk which, consisting of soft wood without heartwood, is often used for making native canoes with outriggers. The chief use of the wood in Ceylon is for making tea-boxes, &c. In India, it is said to be suitable for making matches. See page 423.

Brassaia actinophylla. *Araliaceae.*—A small, soft-wooded, sparsely branched tree, with large, handsome, radially-divided leaves, native of Queensland, introduced at Peradeniya in 1873. The remarkable terminal inflorescence consists of several radiating spikes, 2½ to 3½ ft. long, deep crimson in colour. See pages 84, 97.



Brownea macrophylla.

FLOWERS BRIGHT ROSE.

Brownea ariza. *Leguminosae.*—A small spreading tree with pinnate, drooping leaves, native of Trop. America, introduced into Ceylon in 1884. It bears from the ends of the branches large, dense, round clusters of blossom, resembling in form large Rhododendron flowers, being bright scarlet in colour.

B.—coccinea (Scarlet).— A short spreading tree, native of South America and introduced into Ceylon in 1849. It is distinguished from the other Browneas by having the flowers in small scarlet clusters, produced in large numbers along the stem and older branches.

B.—grandiceps (Large-headed). "Rose of Venezuela."—A larger and more handsome species than either of the former, reaching a height of 30 or 40 ft., native of Venezuela, introduced into Ceylon in 1870. A very beautiful tree when in full blossom, the bright red flowers being borne in large dense heads at the ends of the branches. The foliage, too, is very handsome, the young mottled leaves being produced in long, drooping, flaccid bunches, similar to those of Amherstia. S.



Brassaia actinophylla.

INFLORESCENCE CRIMSON.



Brownea grandiceps.

FLOWERS SCARLET.

B.—macrophylla (Large-leaved).—A strong-growing species of Colombia, introduced at Peradeniya in 1894. It is of a less free-flowering habit than the three foregoing species, but the flower heads are larger, of a bright rose shade, with long, protruding, bright-coloured stamens, which distinguish this from the other species. S

B. Crawfordii, a hybrid between the latter two species; bears large, handsome, salmon-pink flowers, each cluster containing 60-70 fl's.

Butea frondosa. *Leguminosae.* Flame of the Forest; Bengal Kino; Dhak; Pulas; Gaskela, *S*; Parasu, *T.*—An erect tree with large, leathery, broad, trifoliate leaves, indigenous to the forests of the dry region of India, Ceylon, and Burma; reaches a height of about 40 feet and bears in the dry months a profusion of beautiful crimson or orange-scarlet flowers. The tree furnishes a resin ("kino"), and a useful fibre from the bark; a lac is produced on the young twigs (see *Lac*, p. 417), and the flowers yield in India yellow and orange dyes.

Cassia Fistula. *Leguminosae.* Indian Laburnum; Pudding-pipe; "Ehela," *S*; "Tirukkontai," *T.*—A small upright tree, common in the forests of the dry region of Ceylon and India. A beautiful object when in blossom, bearing masses of yellow flowers in pendulous racemes, suggesting the Laburnum. The flowers are used as temple offerings, and the astringent bark for tanning and in native medicine. The black cylindrical pods grow to a length of from 20 to 30 inches; the pulp of these is a well-known purgative (see p. 369, 378). Suited chiefly to a semi-dry region, but with good drainage will thrive in moist districts up to 2,000 feet elevation. S.



Cassia grandis. Horse Cassia. Bright pale pink.



Cassia Fistula. Indian laburnum. Flowers yellow.

Cassia grandis (Great). "Horse Cassia." A spreading tree, native of South America, growing to a height of about 40 to 50 feet; bears a

profusion of pale pink inflorescence during the dry months of February and March, when the tree is completely deciduous. It produces in June an abundance of thick, coarse-skinned and slightly curved pods, the pulp of which has an offensive odour. S.

C.—javanica. A medium-sized tree of Malaya, similar to *C. nodosa*, but differs in having the inflorescence among the leaves, and in the sepals being brown or purple, not green.



Cassia moschata. FLOWERS SALMON-PINK.

C.—marginata. (Marginated leaf). "Ratu-wa," *S*; Vakai, *T.*—A small, graceful tree with spreading, drooping branches, common in the dry region of Ceylon, also in South India; very ornamental when bearing its racemes of rose-coloured flowers, usually in July and August.

C.—moschata. Upright tree, 40-50 ft. high, native of Tropical America. Flowers in pendulous racemes, orange to salmon pink, in season from February to March or April. Pods smooth, cylindrical, 14 to 18 in. long, rather like those of *C. Fistula*. S.

C.—multijuga (Many-pinnae).—A slender, brittle, quick-growing tree of Trop. America, introduced into Ceylon in 1851. Remarkably beautiful when in full blossom, during August and September, being practically smothered with very large, erect bunches of bright yellow flowers, suggesting a glorified Calceolaria. The tree luxuriates in the moist climate of Peradeniya, but rarely produces seed here. At Anuradhapura, however, in the drier region, it bore fruit abundantly in the former botanic gardens. It may with difficulty be propagated by cuttings. S.

C.—nodosa (Knotted, referring to the knotted stems). "Pink Cassia".—A moderate-sized upright tree, native of Eastern Bengal and Malaya, very beautiful when bearing in profusion its bright pink and rose-scented flowers, in large sprays, during May and June. The flowers are followed by cylindrical pods, 12 to 15 inches long. The tree is deciduous in the dry weather. S.

Cochlospermum gossypium. *Bixaceae.* "Kinihiriya" or "Ela-imbul." *S*; "Kongu." *T.*—A rather small tree, native of Central India, semi-naturalised in parts of the Southern dry region of Ceylon, and often planted near Buddhist temples. A beautiful tree when in blossom (chiefly in February and March), with its large, bright yellow flowers, which are esteemed as temple offerings. The tree is deciduous in the dry weather; thrives best in moderately dry districts. See p. 206.

Colvillea racemosa. *Leguminosae.* Named in honour of Sir Charles Colville, once Governor of Mauritius.—A medium-sized tree, 40 to 50



CASSIA NODOSA, Ham.

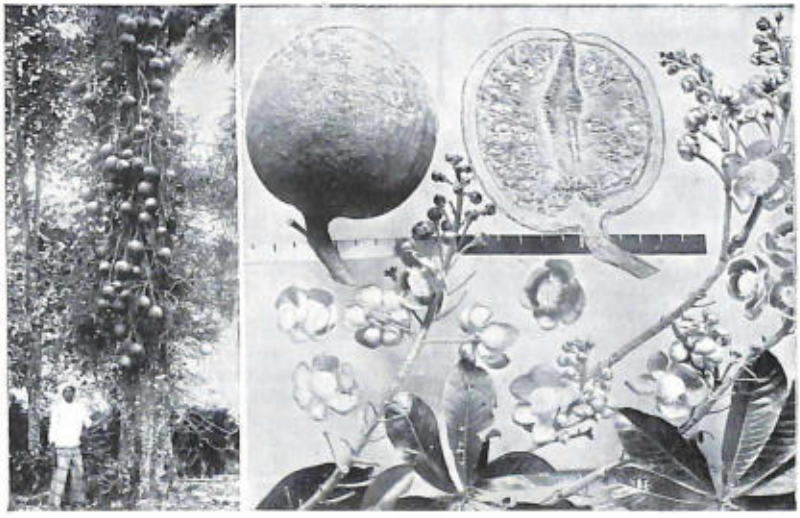


Cassia multijuga.
FLOWERS BRIGHT YELLOW.



Cassia nodosa.
FLOWERS BRIGHT PINK, SCENTED.

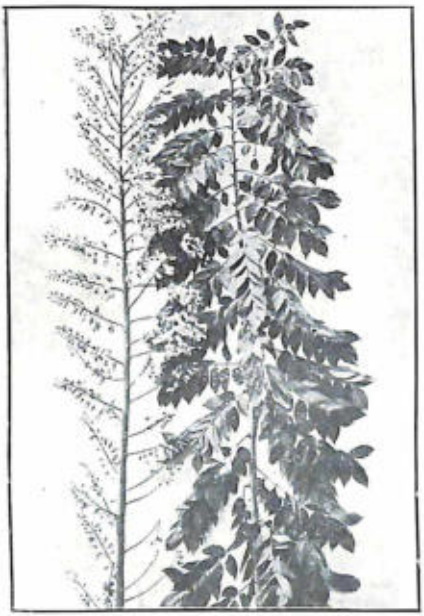
feet high, with handsome pinnate leaves, native of Mauritius and Madagascar. It bears in September large, erect, close racemes of bright scarlet flowers, presenting a very showy appearance. Suited to the moist or moderately dry low-country.



Couroupita guianensis. CANNON-BALL TREE.

Couroupita guianensis. *Myrtaceae.* Cannon-ball Tree.—This, though not beautiful, is a remarkably striking tree when bearing its long woody racemes (4-6 ft. in length) of large curious, pink and white fleshy flowers, crowded along the trunk from the base upwards. The large brown globular fruits, which attain the size of the human head and contain a mass of very sour-smelling pulp, take 8 to 9 months to ripen. The tree is a native of Tropical South America; was introduced at Peradeniya in 1881, where it has flowered and fruited regularly since 1898, when it flowered here for the first time. Suited to the moist low-country. Propagated by seed. §.

Erythrina indica. *Leguminosae.* "Erabadu," *S*; Mullu-murukku, *T.* Thorny Dadap. A medium-sized, quick-growing tree with large trifoliate leaves; deciduous in dry season, unless coppiced. The bright red flowers are borne in tufts at the tips of the branches when the latter are bare of leaves, in the dry season. Sometimes grown as supports for pepper vines, &c. Propagation by cuttings or seeds, stems of considerable size being capable of striking root if planted in moist soil.



Gliricidia maculata.
FLOWERS AND LEAVES.

Gliricidia maculata. *Leguminosae.* "Madre" or "Madre-de-Cacao" of Trop. South America—A small, quick-growing, elegant tree, introduced from the West Indies about 1889. It bears long, arching, feathery, leafy branches, which in the dry weather drop nearly all their leaves and produce along the greater part of their length masses of pinkish purple or pale pink flowers, making the tree a striking object for a few weeks. There is also a variety with pure white flowers. The tree thrives from sea-level to about 3,000 feet or higher. Its rapid growth and long, leafy branches, produced in large quantity, commend it as a shade tree for crops and for green-manuring. Trees at Peradeniya Experiment Station each averaged 141 lbs. green loppings a year, against 90 lbs. for "Dadap." The whole tree is rich in nitrogen, the flowers alone containing up to 3.36 per cent. The dried leaves smell like new-mown hay. About 2,000 of the seeds go to a lb. The tree forms a good support for Vanilla vines, and is best propagated by large cuttings (5-6 ft. long), planted *in situ* at distances of about 12 ft. or more apart, according to requirements. See pages 206, 214, 215.

Jacaranda mimosaefolia. *Bignoniaceae.*—A very elegant tree on account of both leaves and flowers, native of Trop. America and introduced into Ceylon in 1886. It reaches a height of 30 to 40 feet, and bears at various seasons a profusion of bluish purple bell-shaped flowers. The elegant bipinnate Mimosa-like leaves make the seedlings well worth growing as small ornamental foliage plants in pots. *J.—filicifolia* is remarkable for its delicate fern-like foliage, especially in the young state. *J.—micrantha* is a more robust species with larger leaves and leaflets, producing large loose sprays of bright purplish flowers. See p. 89.



Jacaranda mimosaefolia.
FLOWERS BLUISH-PURPLE OR MAUVE.

Kleinhovia hospita. *Sterculiaceae.*—A large, spreading Malayan tree with heart-shaped leaves, introduced into Ceylon about 1820. It bears large terminal panicles of pink or rose-coloured flowers, chiefly during July to August. Thrives in the moist low country.

Lagerstroemia Flos-reginae. *Lythraceae.* Queen's Flower; Pride of India; Murutu, *S.*—A medium-sized spreading tree, native of Ceylon, India, and Malaya. This is undoubtedly one of the most strikingly showy of flowering trees, and from April to July or later bears from the ends of the branches erect panicles of large, beautiful mauve or pink flowers. The older trees are deciduous for a short period during the dry weather. There are two or more varieties, which vary in shades of colour; that with bright pink flowers is especially attractive. §



Lagerstroemia Flos-reginae.
"QUEEN'S FLOWER."
FLOWERS BRIGHT MAUVE OR PINK.



Lagerstroemia tomentosa.
FLOWERS WHITE.

L.—tomentosa. "Leza." A moderate-sized handsome tree, native of hot and moist parts of Burma, introduced at Peradeniya in 1891. It blossoms twice a year, in April and October, bearing large erect panicles of white flowers, produced from the ends of the branches. S.

Millingtonia hortensis. *Bignoniaceae.* Indian Cork-tree.—An erect tree with finely divided leaves, reaching a height of 50 feet or more; bears twice a year, chiefly in November—June, a profusion of long, tubular, pure-white fragrant flowers. A favourite tree in Indian gardens; thrives from sea-level to medium elevations in Ceylon. Often planted in avenues in India. See p. 206.



Lysidice rhodostegia.

Lysidice rhodostegia. *Leguminosae.*—A large handsome tree, with pinnate leaves, native of Southern China, introduced into Ceylon in 1882. It thrives here and bears, usually in January—February, erect loose panicles of rose-purple flowers with pale pink bracts, followed by thin, flat, brown pods, about 5-6 in. long, containing flat brown seeds. The persistent coloured bracts remain for several weeks. S.

Mesua ferrea. *Guttiferae.*—Ceylon Iron-wood; Na-gaha, *S*; Naka, *T*.—A moderate-sized, broad, conical, slow-growing, handsome tree, native of the hot and moist regions of Ceylon, India, and Malaya, often planted near Buddhist temples. It blossoms profusely in the month of April or May, the large white flowers, each with its yellow centre of numerous stamens, being delicately scented. The young leaves, which appear twice a year, are of deep crimson, rendering the tree a striking object. See *Ornamental Foliage Trees*, pages 91, 101. S.

Monodora tenuifolia. *Anonaceae.* Orchid-flower Tree.—A small deciduous tree, flowering profusely in the dry season when devoid of leaves. The 3 enlarged sepals are dull yellow, blotched with brown, suggesting an orchid flower.

Oncoba spinosa. *Bixaceae.*—A small bushy tree of Arabia, with light green, small ovate leaves. Bears during April—May, from the underside of the young branches, large, solitary, white, scented flowers with numerous yellow stamens. Introduced at Peradeniya in 1883. Bears during July—September round, smooth green fruits, which are considered edible. S.

Orchipedia (Portia) grandiflora. *Apocynaceae.*—A small spreading tree, with opposite leaves and biforked branches, native of Java. Bears in Sept.-Oct. a profusion of creamy white flowers, with 5 contorted petals, and a strong starchy odour.

Pachira insignis. *Malvaceae.*—A medium-sized tree of Mexico, with large, palmately-divided leaves, bearing large, fleshy, remarkable flowers, white and bright pink, which, however, soon fade and drop. Introduced at Peradeniya in 1888.S

Peltophorum ferrugineum. *Leguminosae.* Iyavaki, *T*.—A large quick-growing, symmetrical tree, with a spreading top and fine graceful feathery foliage, indigenous to Ceylon and Malaya. It blossoms twice



"FLAMBOYANT." *POINCIANA REGIA*. Boj.



Mesua ferrea. CEYLON IRON-WOOD TREE. (See p. 90).

a year at irregular seasons, some specimens being in blossom while others by their side are in ripe fruit. The flowers are rusty-yellow, sweet-scented, and borne in large erect panicles. The young leaves and shoots are covered with a brown velvety tomentum. "It is a magnificent sight when in full blossom" (Trimen). Suited to dry districts as well as to the moist region, up to 2,000 feet. See p. 92. §

Plumeria acutifolia. *Apocynaceae.* Temple-tree; Pagoda-tree; Frangi-pani; Alariya, *S.*—A low, spreading, succulent tree or large shrub, originally introduced from Trop. America, now naturalised in Ceylon, India, etc. It is a familiar tree in the Eastern tropics, especially throughout the low-country of Ceylon, being often planted near Buddhist temples. Stands the sea breeze well. The tree is almost or quite bare of leaves throughout the dry weather, when it bears large heads of white (with yellow centre) and highly fragrant flowers and occasionally a few bi-forked fruits. Easily propagated by cuttings.

P.—rubra. (Red).—A tree similar to the latter, bearing bright crimson flowers in profusion, also a few fruits occasionally, native of Cent. America, first introduced at Peradeniya in 1900. Very showy, and remains in flower for several months. Large cuttings strike root readily. See p. 92. §.

Poinciana regia. *Leguminosae.* Flamboyante; Flame Tree; Golden Mohur.—A gorgeous tree when in full blossom, bearing immense panicles or long sprays of scarlet or orange flowers; native of Madagascar, introduced into Ceylon before 1841. It is a very striking object in and about Colombo during the months of April and May; grows from 40 to 50 feet in height, with a spreading habit, and has very handsome, fine, feathery, long, bipinnate leaves. Suited to moist as well as dry regions, especially near the sea. There are at least two distinct varieties, that with flowers of a bright orange shade being especially attractive. See p. 93. §



Oncoba spinosa.
See page 90.



Plumeria rubra. CRIMSON TEMPLE-TREE.
See page 91.



Pachira insignis.
See page 91.



Peltophorum ferrugineum.
See page 90.



Poinciana regia.
FLAMBOYANTE; GOLDEN MOHUR.
1, FLOWER; 2, POD; 3, LEAVES.
(See page 91).

a few, flat, bright red pods. Propagated by seed. Thrives best in shady and sheltered situations. See page 83. S.

S.—indica. Diya-ratmal or Diya-ratambala, *S*; "Asoka Tree" of India.—A small, spreading tree, native of Ceylon and South India, bearing on the stems and branches, chiefly in the dry weather, large sessile clusters of scented flowers which change from yellow to orange and red. The young leaves are developed in long, drooping clusters, as in Brownea and Amherstia. Thrives in shady situations, especially near water, in the wet or semi-dry districts, up to 2,000 feet or higher.

Posoqueria longiflora. *Rubiaceae.*—A moderate-sized quick-growing tree, with large, deep-green leaves, native of Trop. America, producing long, tubular, white and scented flowers, borne in pendulous clusters, usually during May and September. Suited to moist districts up to about 2,000 feet.

Pterocarpus echinatus. *Leguminosae.*—A moderate-sized tree, native of the Philippines, introduced into Ceylon in 1882; bears large clusters of pale orange-yellow flowers during April or May, followed by circular, prickly, winged pods. Very ornamental when in blossom. Suited to low elevations.

Saraca declinata. *Leguminosae.*—A small tree, native of Sumatra, introduced into Ceylon in 1870, producing on the stem and older branches very large heads of bright orange-yellow flowers, usually during February and March. Bears



Saraca declinata.

Schizolobium excelsum. *Leguminosae.*—A very large, quick-growing, magnificent tree, with fine, bipinnate long feathery leaves, native of Brazil. Introduced in 1872 at Peradeniya, where it luxuriates, blossoming and fruiting regularly. The bright yellow flowers are borne in very large, erect sprays, during February or March, when the tree is quite bare of leaves. Thrives up to about 2,500 ft. in the moist region.

Solanum macranthum. *Solanaceae.* "Potato-Tree."—A medium-sized, quick-growing and soft-wooded tree of Brazil, reaching a height of 30 to 40 feet, first introduced into Ceylon in 1844. The large purplish-blue and white flowers with conspicuous yellow anthers, resembling the potato flowers, and the large prickly leaves render it a very ornamental tree. Thrives best in sheltered and partially shaded situations, up to about 3,000 feet, or higher if not exposed to strong winds. Propagated by seed or cuttings. This is probably the only species of the Potato order that grows into a tree form. §



Solnaum macranthum.
POTATO TREE.

Spathodea campanulata. "Fountain Tree"; "Tulip Tree." *Bignoniaceae.*—A tall, erect tree from West Trop. Africa, introduced into Ceylon in 1873, now commonly planted about Kandy and elsewhere for shade or ornament. The large, bright orange-scarlet, erect flowers, produced at the tips of the branches throughout the wet season, render the tree strikingly handsome and conspicuous at a distance. The unexpanded flowers contain a quantity of water, hence the common name. Thrives up to 4,000 feet, and is suited to dry districts. The tree is soft-wooded old specimens becoming hollow in the centre and therefore dangerous near buildings or roads. Propagated by seed or cuttings. §.

S.—nilotica. "Kifabakazi" of Africa.—A tree of East Tropical Africa, similar to the preceding species, but with flowers of a brighter orange-red. It blossoms freely when only 3-4 years old, and sets fruit at low elevations. Introduced into Ceylon in 1910.

Stenocarpus sinuatus. *Proteaceae.* "Fire Tree" or "Tulip Tree" of Queensland.—See *Flowering Trees for Up-Country*, pp. 177, 178. §

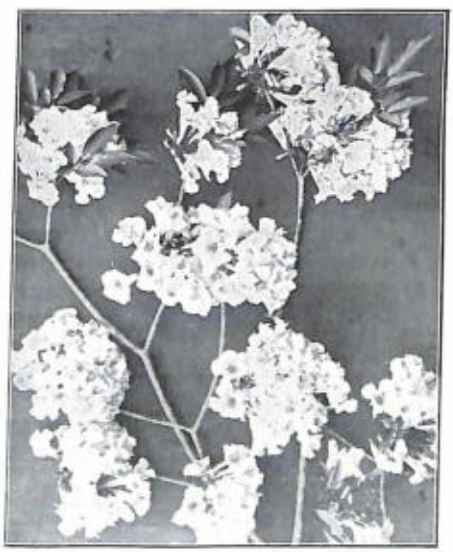
Sterculia colorata. *Sterculiaceae.* Kenawila*; Malaiparutti, *T.*—A moderate-sized tree, 40 to 50 feet high, indigenous to the eastern dry region of Ceylon, but thrives also in moist districts. The brilliant orange-scarlet flowers, appearing in great profusion when the tree is leafless (February to March at Peradeniya) render the tree a conspicuous and handsome object. The Veddas (aboriginals of Ceylon) sing odes to it. (Trimen).

*Vedda name.

S.—Balanghas. ("Nawa" of Ceylon) and other species are, besides being of symmetrical shape, remarkable on account of their showy fruit, the bright orange carpels opening and exposing large jet-black shiny seeds, which adhere to the edges of the latter. See page 463. §

S.—lanceolata. A small or medium-sized tree of Java, S. China, &c., with rather small lanceolate leaves, very handsome when bearing (usually in April-May) in profusion its bright orange scarlet fruit, consisting of a cluster of 5 follicles. The latter spread out horizontally, opening on the under side and displaying the large, shiny, black seeds which remain adhering to the margins of each follicle. Introduced at Peradeniya in 1898.

Stereospermum xylocarpum. *Bignoniaceae.* "Padri-tree" of India.—A large spreading tree, with small pinnate leaves, native of South India, deciduous for a short period in the dry weather. It bears for 2-3 weeks a profusion of white, bell-shaped flowers. Thrives up to 2,000 feet or higher.



Tabebuia rosea.
FLOWERS BRIGHT MAUVE.



Spathodea campanulata.
A YOUNG TREE, SHOWING SCARLET FLOWERS AT TOP.

Tabebuia rosea. *Bignoniaceae.*—A small or medium-sized erect tree of Mexico, palmately 5-leaved, producing after the dry season masses of lovely pale mauve flowers. A beautiful tree when in blossom, which unfortunately is over in about a week. Rarely bears seed at Peradeniya. L. entire in young state.

Tabebuia spectabilis.—A small 5-foliate tree of Venezuela and the West Indies, introduced into Ceylon in 1881. For a short period in March or April, when bare of leaves, the tree is a beautiful sight, being literally covered with masses of bright yellow, bell-shaped flowers, which, as they drop, form a golden carpet on the ground. Thrives at Peradeniya (1,500 feet), but as yet only rarely produces seed here. §

(2).—ORNAMENTAL FOLIAGE TREES.

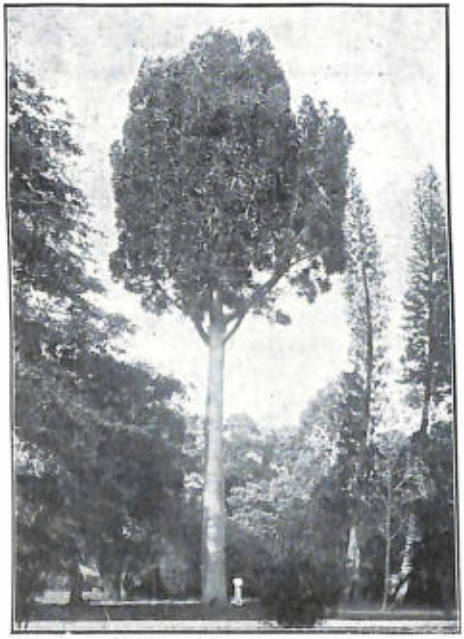
SELECTION SUITABLE FOR LOW OR MEDIUM ELEVATIONS.

Agathis (Dammara) robusta. *Coniferae.* Queensland Kauri Pine.—A tall stately tree with a straight smooth stem, native of Queensland, introduced into Ceylon in 1865. Some very fine specimens may be seen in Peradeniya Gardens, and on Pitakande Estate, Matale, which occasionally bear cones and fertile seeds. Thrives from 1,500-5,000. §

Agathis australis. Kauri Pine of New Zealand. A handsome tree, similar to preceding species, requiring sub-tropical conditions; yields valuable timber and Kauri-gum in its native home, where some 15,000 tons a year of the gum are collected for the extraction of oil. The latter yields a motor spirit and turpentine.



Tabebuia spectabilis. FLOWERS BRIGHT YELLOW.



Agathis robusta. QUEENSLAND KAURI-PINE. Right, *Araucaria Cookii.*

Agrostistachys Hookeri. *Euphorbiaceae.* Maha-beru or Diya-beru, *S.*—A small, sparsely branched tree, with a crown of very large handsome lanceolate, crowded leaves, 18-24 inches long. Endemic but rare in Ceylon; moist low-country. **A. longifolia.** Beru, *S.*—An up-country shrub, with large stiff leathery leaves up to 2 ft. long, which are sometimes used for thatching, being remarkably durable.

Ailantus excelsa. *Simarubaceae.* "Tree-of-Heaven." Similar to *A.—Malabarica* ("Kumbalu," *S*, or Peru-maram, *T.*) of Ceylon, &c. A large, handsome, quick-growing tree, with large, pinnate leaves, 3-4 ft. long, native of India, etc. A striking tree for landscape effect. Wood light, soft, and spongy; yields gum in India. Best suited to medium elevations.

Araucaria Bidwillii. *Coniferae.* Bunya-bunya Pine; "Monkey-puzzle."—A tall tree of Queensland, where it attains a height of 150 to 200 feet, introduced at Peradeniya in 1848. It bears branches down to near the ground; the small leaves are stiff and closely set, ending in a sharp point, hence the popular name. Thrives, but does not bear fruit at Peradeniya.

A.—Cookii.—A very tall, conical tree, with short, slender horizontal branches, native of New Caledonia, introduced at Peradeniya in 1865. Here it has so far reached a height of about 140 feet, but does not produce fertile seed. Commonly grown in the young state as an ornamental pot-plant. §

A.—Cunninghamii. Moreton Bay-or "Hoop"-Pine.—A tall handsome tree of E. Australia and New Guinea, said to attain a height of 200 ft.; introduced into Ceylon in 1848. It is distinguished from *A. Cookii* by its more spreading and horizontal branches, also by the fruit. Not yet fruited at Peradeniya.

Artocarpus Cannoni (=A.—laciniatus). *Urticaceae.*—A medium-sized tree of the Society Islands. The large oblong leaves are of a striking purplish bronze colour, especially in the young state, on account of which small plants are sometimes cultivated for ornamental purposes in hot-houses. Introduced at Peradeniya in 1906.

A.—incisa. *Urticaceae.* Bread-fruit; "Rata-del," *S.*—A very handsome quick-growing tree, with very large, palmately-cut, shining leaves, native of the Pacific Islands. It grows to a height of 50 to 60 feet, and few trees present a more noble appearance. Propagated by suckers, or from seed in the case of seed-producing varieties. See *Trop. Fruits*, p. 253.

A.—nobilis. Wild Breadfruit; "Del," *S.*—A noble spreading tree, with wavy or crinkled, rigid, oval leaves, peculiar to the moist low-country of Ceylon. It is of rather slow growth, but usually attains a height of 50 to 70 feet, sometimes with an enormous trunk. Propagated by seed. See *Tropical Fruits*, pages 253, 254.

Axinandra zeylanica. *Lythraceae.* "Kekiri-wara," *S.*—An ornamental tree, 30 to 40 feet high, with a straight trunk, bearing numerous, slender, drooping branches almost to the base; the handsome lanceolate leaves are 7 to 10 inches long. Peculiar to the moist low-country forests of Ceylon.

Barringtonia speciosa. *Myrtaceae.* "Mudilla" *S.*—A medium-sized handsome spreading tree, with large leathery shining leaves, producing large white flowers, consisting chiefly of a bunch of numerous long white stamens. The large, quadrangular, one-seeded fruit, with its thick fibrous covering, is an excellent example of floating fruits, being commonly found floating in lagoons, rivers, etc. The tree is indigenous to the sea-coast, and is often planted for ornament. See pp. 98, 206.

Brassaia actinophylla. A handsome evergreen tree, 30 to 40 feet high, with large, radially-divided leaves. See *Flowering Trees*, pages 83, 84.

Bertholletia excelsa. Brazil Nut.—See *Tropical Fruits*, p. 223. §

Caesalpinia coriaria. Divi-divi. See pages 212, 461.

Canarium commune. Java Almond. See pages 256, 257.

Casuarina equisetifolia. *Casuarineae.* She-Oak; Beef-wood; Kassa-gaha, *S*; 'Chavaku," *T.*—A lofty, quick-growing tree, with fine cord-like branchlets instead of leaves, 6-8 in. long, native of Northern Australia. It is specially adapted to the sea-coast and dry regions, but thrives also inland up to about 3,000

feet elevation. (See pp. 57, 206, &c.). For fuel, the tree may be cut down at 10 or 12 years of age, but is best left till 20 years old or more. It has been largely planted in South India and Mauritius for fuel and for reclaiming sandy seashores, becoming in both cases quite naturalized. It is of an ornamental character when young, and is grown in temperate countries as a hot-house plant for decorative purposes. Propagated by seed, of which some 20,000 go to an ounce. See pp. 99, 179, 216.

Carapa guianensis. *Meliaceae.* Carapa, or Andiroba Tree.—A quick-growing tree, 60 to 80 feet high, with handsome pinnate leaves composed of 8-10 pairs of shining leaflets, native of Trop. America. Thrives at Peradeniya, and is suited to the low country generally. See *Oils*, p. 395.

Chrysophyllum Cainito. Star-apple. See page 257.



Barringtonia speciosa.
1, FLOWER; 2, UNRIPE FRUIT; 3, SECTION OF FRUIT.

Columbia javanica. *Tiliaceae.* A tall, quick-growing tree, 80. to 100 ft. high, with smooth bark and large oval, tomentose leaves, native of Java; flourishes up to 2,000 feet elevation in the moist region. Blossoms in August and January, the flowers being small and dull yellow.

Copaifera officinalis. *Caesalpinieae.* Copaiba. A very large, spreading or upright tree, with small, unequally pinnate leaves, distinguished by the yellowish grey, smooth bark; native of Cent. America, &c. Introduced into Ceylon in 1880. See p. 412.

Couratari pyriforme. *Lecythidaceae.* A large, upright tree with spreading branches and small, oval, serrate leaves, native of S. America, introduced at Peradeniya in 1888. Deciduous for a short period, usually in October or November.

Cyathocalyx zeylanicus. *Anonaceae.* Kekala or Ipetta, *S.*—A tall, quick-growing tree, with a straight erect stem, long slender graceful branches, and leaves 6 to 10 inches long, native of the moist low-country of Ceylon. Bears ovoid yellow, edible fruit, 2½ to 3 inches long.

Dillenia indica. *Dilleniaceae.* Hondapara or Wampara, *S.*—A handsome, moderate-sized, round-headed, symmetrical tree, native of Ceylon, India and Malaya; characterized by large, oblong, glabrous, serrate leaves, which are 10 to 12 inches long. Flowers very large, pure white, 6 to 7 inches in diameter. See *Tropical Fruits*, p. 260. $

Dimorphandra Mora. *Leguminosae.* "Mora-tree" of British Guiana.—A large handsome tree, noted for its excellent timber and immense fleshy seed, which are produced in November-December, each pod containing only one seed. Introduced at Peradeniya in 1881.

Duabanga moluccana. *Lythraceae.*—A handsome tree, attaining 80-90 feet in height, with very long graceful, drooping, slender and brittle, angular branchlets, bearing large decussate, shining leaves; native of the Moluccas, introduced in 1852 at Peradeniya, where it forms a striking object.

Durio zibethinus. *Malvaceae.* Durian.—A noble tree of pyramidal, symmetrical habit, attaining a height of 80 to 100 feet or more. See *Tropical Fruits*, page 240. §

Enterolobium cyclocarpum. *Leguminosae.*—A tall erect tree with handsome feathery foliage, native of Venezuela, introduced at Peradeniya in 1884. Bears in the dry weather, when it is deciduous, curious circular, twisted pods.

Erythrina Parcelli. *Leguminosae.*—A small, soft-wooded, quick-growing tree with handsome variegated foliage, the leaves being marked by creamy yellow bands running along the main veins. Native of South Sea Islands. Propagated by cuttings. See page 120.



1, *Casuarina montana.*
2, *Casuarina equisetifolia.*
(See page 97.)

Eucalyptus alba. *Myrtaceae.* White Gum.—A tall, slender tree, with smooth, white bark and drooping foliage; native of N. Australia, introduced into Ceylon in 1884. One of the few Eucalypti adapted to low elevations in the tropics; thrives in the semi-dry regions, fruiting freely at Anuradhapura. See p. 206.

Fagraea fragrans. *Loganiaceae.* Tembusu.—A handsome upright, evergreen, small-leaved tree of Malaya, where it is grown for ornament and in avenues, &c. Introduced at Peradeniya in 1891. See page 212.

Ficus benghalensis. *Urticaceae.* Banyan.—A large, spreading, smooth-barked tree with large, leathery, shiny leaves; very effective when bearing its crop of large bright crimson berries, usually in August—September.

F.—Benjamina. "Java Fig" or "Java Willow."—A large, handsome spreading tree, with small ovate leaves and long, graceful, drooping branches, indigenous to Malaya; introduced at Peradeniya in 1861.

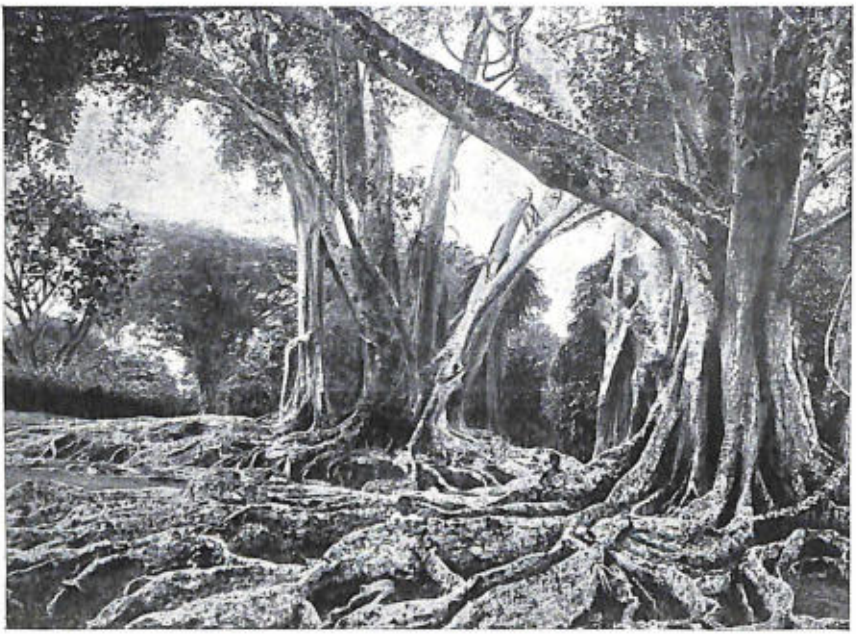
F.—comosa. Considered a variety of the preceding species, which it resembles in general habit, but has larger leaves. Fruits bright yellow.

F.—Cunninghamii. Queensland Fig. A large graceful spreading tree, with long, drooping branches and small oval leaves; very effective for lawns or parks. Similar to *F. Benjamina.*

F.—Canoni. See *Artocarpus Canoni*, p. 97.

F.—elastica. Rambong, or India-rubber Tree.—A very large, handsome, spreading, quick-growing tree, attaining a height of well over 100 feet, with large, oval, leathery, shining leaves, native of Assam, Burma and Malaya; introduced into Ceylon about 1835. A very remarkable tree at Peradeniya on account of its enormous aerial buttressed roots. See page 100, also under *Rubber*, p. 407. §

F.—regia. A tall, erect tree, with straight stem, smooth, white bark and large leaves, bearing a profusion of large fig-like fruits on the trunk and branches; native of Burma, Malaya, etc.



Ficus elastica. INDIA-RUBBER TREE OR RAMBONG.
See pages 99, 407.



Filicium decipiens. FERN-LEAF TREE.

Filicium decipiens. *Burseraceae.* "Pehimbiya," *S.*—A medium-sized or large tree, of rather slow growth, with very handsome fern-like foliage, as the botanical name implies. It is a native of Ceylon and S. India, and produces in March-April quantities of soft vegetative seed, which are of short vitality. Sometimes cultivated as an ornamental pot-plant. $.

Harpullia zanquebarica (=Stadmannia amabilis). *Sapindaceae.*—A medium-sized elegant tree of Trop. Africa, with small pinnate leaves, and 3-valved capsular fruit showing, as it opens, a bright pink interior. Introduced at Peradeniya in 1891.

Kigelia pinnata. *Bignoniaceae.* "Sausage Tree"—A tall or moderate-sized, spreading tree of Tropical Africa, bearing large pinnate leaves and long-stalked panicles of dull purplish tubular flowers. Its remarkable oblong, grey, gourd-like

fruits are suspended by long cord-like stalks, from 3 to 5 ft. in length, dangling in the air for several weeks. Each fruit is about 12 or 16 inches long by 3 to 4 inches or more in diameter. In Nubia, the tree is held sacred by the Negroes and the fruit is used in medicine but not eaten. §

Magnolia sphenocarpa (=M.—*speciosa*). *Magnoliaceae.* Evergreen Magnolia.—A moderate-sized spreading tree, with large shining, tapering leaves, 8 to 16 inches long; native of the Eastern Himalayas. Thrives at medium elevations in Ceylon, having been long established at Peradeniya.

Melia dubia. *Meliaceae.* Lunu-midella, *S*; Malaivempu, T.—A very large, handsome tree of rapid growth, with small bipinnate leaves and smooth bark; native of Ceylon, India, Africa, Australia, &c. Wood light, soft, brownish red, with large pores, much used for ceilings, etc. Fruit a drupe, with a bony stone, containing 2-4 small seeds. See p. 216.

Mesua ferrea. Ceylon Iron-wood. A handsome, well-shaped, closely branched evergreen tree, with small lanceolate leaves. The bright crimson young foliage, which appears twice a year, chiefly in November and April, renders the tree a particularly handsome and conspicuous object. See *Flowering Trees*, pp. 90, 91, 216. §

Myroxylon Balsamum. *Leguminosae.* Balsam Tree.—A large handsome tree of Trop. America, with small pinnate, dark-green leaves. Good for roadsides, fuel and timber. Thrives in moist as well as in rather dry districts. The fruit, consisting of a lance-shaped, one-seeded pod, is produced usually in June and December. Introduced into Ceylon in 1870.

M.—Toluiferum, a similar tree of S. America, &c., introduced at Peradeniya in 1861; yields a fragrant gum-resin known as "Balsam of Tolu."



Kigelia pinnata. SAUSAGE TREE.
(See p. 100)



Pandanus furcatus.
SCREW-PINE.

Ostodes zeylanica. *Euphorbiaceae.* Wal-kekuna or Olupetta, *S.*—A tall handsome tree with smooth bark and large, numerous leaves, the latter being 6 to 12 inches long; indigenous to the moist low-country of Ceylon, up to 1,000 feet. Flowers strongly scented.

Palms. See under *Palms*, p. 163.

Pandanus furcatus. *Pandanaceae.* Screw-pine.—A large, handsome species, native of India, 30 to 40 feet high, with long, prickly leaves, which are arranged on the stem in the form of a screw. $

P.—Leram. Nicobar Islands Bread-fruit.—A striking species of Screw-pine with the stem repeatedly forked, bearing immense, heavy, green fruits, said to be edible; introduced at Peradeniya in 1883. The tree is also remarkable for its large aerial roots, which give it the appearance of being on stilts. $

Pangium edule. *Bixaceae.* Kapayang or Pangi (Malay).—A quick-growing, spreading tree with very large heart-shaped leaves, bearing large, ovoid reddish-brown fruits, about 6 inches long; native of Malaya, introduced into Ceylon in 1891. The fruit and seeds are edible, but the latter contain hydrocyanic acid, which, however, can be removed by washing and cooking, when they are rendered edible.

Parkia Roxburghii. *Leguminosae.*—A remarkably handsome, quick-growing, very large tree, attaining a height of 100 feet or more, with a clear smooth trunk, and beautiful, fine, feathery, large, pinnate leaves; indigenous to Malaya, Burma, etc.; thrives in the moist low-country up to about 2,000 feet; flowers in November to December, followed in February to March by large, hanging clusters of long, brown pods, which contain a quantity of white powdery substance. $

Parmentiera cerifera. *Bignoniaceae.* Candle Tree; "Pandam-gaha," *S.*—A small tree of Trop. America, with small, light-green, twice-trifoliate leaves. It bears very remarkable candle-like yellow, juicy fruits along the stem and branches, in great profusion, twice a year, chiefly during the drier months. These closely resemble the old-fashioned candles of shops, but are of no practical use. They are said to be eaten in the tree's native habitat. See p. 104. $.

Pisonia alba. *Nyctagineae.* Lettuce Tree; Lady-love; Watabanga-kola, *S*; Lechchai-kottai or Chandi, *T.*—A small, evergreen tree, 25-30 ft. high, with very striking pale-yellow foliage, specially adapted to the sea coast. Readily propagated by cuttings. The leaves are sometimes used a vegetable, also in medicine, and cattle are fond of them.

Pithecolobium (Inga) Saman.—*Leguminosae.* Rain-tree; Guango; Saman-tree; "Peni-karal," *S.*—A very large, spreading, quick-growing tree, commonly planted in Ceylon and other tropical countries as a shade tree for roads, for which it is well suited until it becomes too large. It has, however, a shallow, spreading root-system, grows rapidly to an enormous size, especially at low elevations, in moist districts, becoming top-heavy and seldom retaining an upright symmetrical habit. First in-



Pandanus Leram. NICOBAR BREAD-FRUIT.
(See page 102.)

troduced from South America into Ceylon about 1850. The brown, flattish pods, produced chiefly from March to May, are about 6 to 8 inches long and, like those of *Ceratonia*, contain a quantity of sweet sugary pulp, which is relished by cattle. They are exported from South America as a cattle-food. The small pinnate leaves, which form a canopy of shade in the day-time, close up at night: therefore during a period of drought an area of green grass may be seen beneath, while the surrounding ground is parched and brown. This led to the supposition that the tree mysteriously produced rain at night, and hence the name Rain-tree. See pp. 207, 213. §

Podocarpus cupressina. *Coniferae.* "Kawtabua" of Fiji.—A large, elegant, erect tree, with small bipinnate leaves, very handsome, especially in the young state; native of Java, Fiji, &c; introduced at Peradeniya in 1880, and occasionally bears a few seeds here. Bears pollarding well; said to attain 150 ft. or more in height, and affords good timber.

Pometia eximia. *Sapindaceae.* "Gal-mora" or "Bulu-mora," *S.*—A handsome tree with a straight erect trunk and large spreading head, native of the moist low-country of Ceylon, up to about 1,500 ft.; also indigenous to Malaya, erect Grows to 80-100 ft. high. Fruits smooth, ovoid, berry-like, crimson when ripe, chiefly in July-Aug.

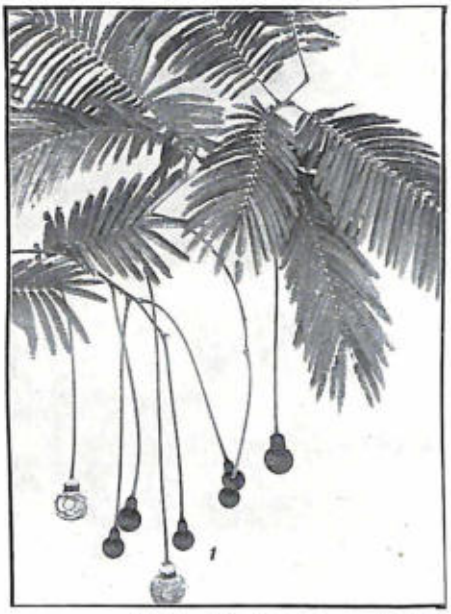
Poinciana regia. Flamboyante. A handsome foliage tree. See p. 91.

Pterocarpus indicus. *Leguminosae.* "Padouk."–A handsome, very large tree of Burma, with a spreading round head, long drooping branches, and rather small pinnate leaves; bears a profusion of yellowish, sweet-scented flowers in March or April, followed by small, circular, winged pods.

Pterocarpus echinatus. See *Flowering Trees*, p. 93.

Pterospermun acerifolium. *Sterculiaceae.* A large tree of Burma, with very large, oval, leathery leaves, snowy white or grey underneath, with prominent veins; long, fleshy, yellowish flowers, scented. Introduced into Ceylon in 1852.

Ravenala madagascariensis. *Scitamineae.* Travellers' Tree.—A remarkable-looking tree (or bush) of Madagascar, introduced at Peradeniya before 1824. It requires a hot, humid climate, and attains a height of 30-40 feet, assuming the form of a gigantic fan. The immense distichous leaves are 12-15 feet in length, the older of which, like those of the Banana tree of the same family, are invariably torn into ribbons by the wind;



Parkia Roxburghii. (See page 102).

ing seed in June. See also p. 94.

Swietenia Mahagoni. *Meliaceae.* Mahogany; Ratakohomba, *S.*—The mahogany tree, noted for its superior wood, is a native of Tropical America and was introduced into Ceylon about 1840; it is a useful shade and ornamental foliage tree, with an upright habit, and small pinnate leaves; is best suited to a rather dry climate, as the north of Ceylon, where it seeds freely during June and July. About 1,900 of the brown, corky seeds = 1lb. Flourishes in various parts of India, is rather a slow-grower, but makes a fine, shapely, durable tree. See pp. 207, 213, 219.

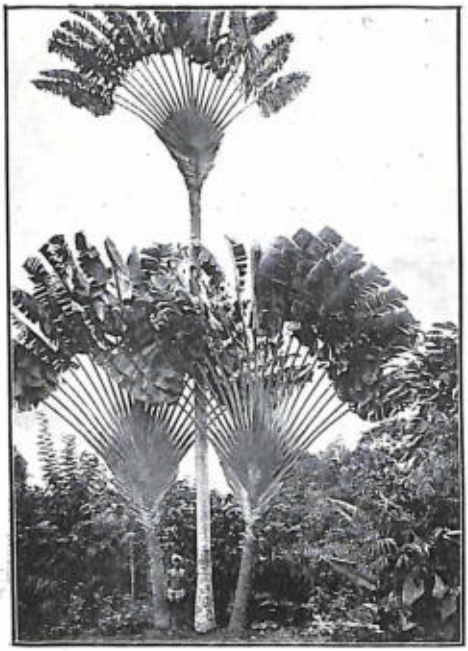
S.—macrophylla. Large-leaved Mahogany.—A handsome tree, with large leaves, but this does not detract from their gracefulness. The large hollow, sheathing leaf-stalks form receptacles in which considerable quantities of secreted water are stored, hence the popular name. Propagated by suckers or seed. The latter is surrounded by a bright blue fibrous covering. See p. 105. *S.*

Sandoricum indicum. *Meliaceae.* Santol (Malay).—A tall, erect, quick-growing tree, with handsome pinnate leaves, native of Malaya, introduced into Ceylon in 1852. See p. 270.

Schizolobium excelsum. *Leguminosae.*—A large, quick-growing tree, with spreading branches and very long, graceful, feathery bipinnate leaves, bearing very large yellow sprays of flowers. Thrives up to about 2,000 ft. and flowers in the dry weather, bear-



Parmentiera cerifera. CANDLE TREE.



Ravenala madagascariensis. TRAVELLERS' TREE.
(See page 103.)

some, upright tree, also of Trop. America, distinguished from the former species by its larger leaves; it is a more rapid grower than the ordinary Mahogany, and is suited to a moist climate, thriving up to about 2,000 feet. Yields excellent reddish brown timber, weighing 35.6 lbs. per cubic foot. The discovery of this species and its introduction to the East were due to an accident, chance seeds being received with others and sown at the Botanic Gardens, Calcutta; the seedlings, on being discovered, were watched and on reaching maturity were found to be a new species, which was named by King as above.

Terminalia belerica. *Combretaceae.* Myrobalan-tree; Bulu, *S*; Ranimaram or Tanti, *T.*—A tall handsome tree, with straight, often buttressed, trunk and long horizontal branches, native of the moist low country of Ceylon, India and Malaya, occasionally planted for use or ornament. See pp. 380, 344.

T.—Catappa. Country- or Indian-almond; Kotamba, *S.*—A medium-sized or large tree with large handsome shining leaves, native of Malaya, but now grown in most tropical countries. It has the disadvantage of shedding its leaves twice a year, usually during February and September, causing a considerable litter on the ground. Before dropping the leaves, however, it is a striking object, the mature leaves becoming bright yellowish red. See *Tropical Fruits*, p. 271.

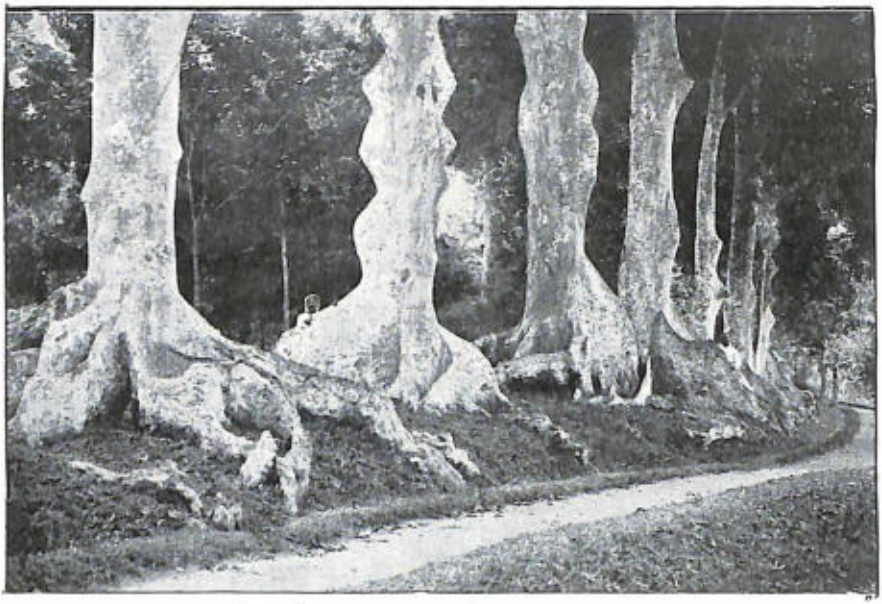
Trevesia moluccana. *Araliaceae.*—A small, sparsely branched tree, with very large, spreading palmate leaves, native of Moluccas. Fruit produced in large round clusters of berries, dark purple when ripe. Introduced at Peradeniya in 1871. §



Trevesia moluccana.

Trichadenia zeylanica. *Bixaceae.* "Tolol" or "Titta-tolol," *S.*—A large tree with handsome foliage, the oblong or oval leaves being 6 to 12 inches long, borne on long slender branches. Peculiar to the moist low-country of Ceylon.

Vateria acuminata. *Dipterocarpeae.* Hal, *S.*—A large handsome upright tree, with spreading branches and a round head. Leaves leathery and oblong, 6 to 10 inches long. Fruit large, pear-shaped. Peculiar to the moist low-country of Ceylon, up to 2,000 feet. Propagated by sowing the large one-seeded fruits. Bark commonly used for retarding fermentation in palm toddy. See pages 412, 444.



Canarium commune. JAVA ALMOND.
(See pages 256, 257).

CHAPTER XII.

SELECTED ORNAMENTAL PLANTS

SUITED TO LOW AND MEDIUM ELEVATIONS.

See also Chapters 15 & 18.

1. *FLOWERING SHRUBS.*
2. *FOLIAGE SHRUBS.*
3. *FLOWERING CLIMBERS.*
4. *FOLIAGE CLIMBERS.*
5. *ORNAMENTAL CREEPERS.*
6. *LIANES OR GIANT CLIMBERS.*
7. *SHOWY ANNUALS AND PERENNIALS.*
8. *BULBOUS OR TUBEROUS PLANTS.*
9. *SELECTED ORNAMENTAL PLANTS INDIGENOUS TO CEYLON.*

[Letters in brackets = usual method of propagation, thus (C) = Cuttings; (S) = Seeds; (Div.) = Division; (Off) = Offsets; (Tu) = Tubers; (Lay) = Layers; (Rhiz.) = Rhizomes; (Su) = suckers. Fl's = flowers; L = leaves. Colour refers to flowers. Figures indicate approximate height in feet.]

(1).—FLOWERING SHRUBS.

Acalypha sanderiana. *Euphorbiaceae.* New Guinea. 5—6. Bright crimson, pendulous tails or catkins. (C). S



Acalypha sanderiana.
FLOWERS BRIGHT CRIMSON.

Acanthus montanus. *Acanthaceae.* Rose-pink. 5—6. Leaves spiny. (C or S).

A.—pubescens. Fl's pink, similar to preceding species.

A.—ilicifolius. Ikili or Katu-ikili, *S.* 3—4; Fl's bright pale pink. L. 4-6 in. long, spiny. In sea-coast swamps. (C or S).

Acokanthera spectabilis. Arrow-poison. *Apocynaceae.* S. Africa. White, scented. 6—8. (C).

Adhatoda cydoniaefolia. *Acanthaceae.* Brazil. White and purple. 5—6. (S or C).

Allamanda Schottii. *Apocynaceae.* Brazil. Yellow. 3—4. (S or C).

A.—violacea. Brazil. Rosy-purple. 5—7. (C).

Alstonia sericea. *Apocynaceae.* Java. White. 3—4. (S or C).

Amomum magnificum. See p. 118.

Aphelandra fascinator. *Acanthaceae.* Colombia. Scarlet. 6—8. (S or C).

A.—tetragona. Colombia. Scarlet. 6—8. (S or C).

Ardisia crenata. *Myrsineae.* China. White. 2—4. Showy scarlet berries. (S).

Aristolochia tricaudata. *Aristolochiaceae.* Mexico. 4-5. Purplish brown, developed into 3 pointed lobes. (C).

Asclepias curassavica. *Asclepiadeae.* W. Indies. Orange-red. 4. (S.) See p. 377.



Clerodendron nutans.

Asystasia chelonioides. *Acanthaceae.* Ceylon and S. India. Reddish purple. 4-6. (S or C). Several other species, with yellow, white, or mauve fl's.

Baccharis rhexioides. *Compositae.* S. America. White. 4. L. 3-nerved. (S or C).

Barleria cristata alba. *Acanthaceae.* India, Malaya, etc. White. 4-5. (C).

B.—cristata rosea. Pink, mauve, or rose. 4-5. (C or S). See p. 72.

B.—Gibsoni. India. Purple. 3-4.

B.—strigosa; pale blue. 3. (C or S).

Bauhinia candida. *Leguminosae.* India, etc. Pure white. 4-6. (S).

B.—Galpini. S. Africa. Brick-red, very showy. 5-6. (S.)

Beloperone nemerosa. *Acanthaceae.* Jamaica. Pink. 4-5. (C or S).

B.—oblongata. Brazil. Rose-pink. 4-5. (C or S).

Bougainvillea formosa. Straggling shrub with long, arching, floriferous, spiny branches. Fl's chiefly in dry season, bright purple; does not require shade. (C.) See pp. 123, 128.

Brunfelsia americana. *Solanaceae.* Trop. America. White or pale yellow, long tubular fl's, scented like Jasmine. 5-7. (C or S.)



Caesalpinia pulcherrima. PEACOCK FLOWER.



Capparis zeylanicum.

B.—calycina. Brazil. Large, purple fl's. 3-5.(=B. lindeniana).
B.—Hopeana (=B.—uniflora and Franciscea bicolor). Brazil. Purplish-blue and white in separate fl's.; sweet-scented. 4-6. (C or S). Beautiful shrub, flowering profusely; slow-growing. See p. 182.
B.—violacea. W. Indies. Deep purple. 4—5.
Byrsonima ligustrifolia. *Malpighiaceae.* S. America. Orange-red. 8—12. (S).
Caesalpinia pulcherrima. Peacock-flower; Barbados' Pride. *Leguminosae.* W. Indies. Orange-red; also a yellow variety. 6-8. (S or C).
Calliandra haematocephala. *Caesalpinieae.* Fl's crimson, in round brush-like heads. 5—7. (S or C).
C.—Tweedii. Brazil. Floriferous, bright pink; 5—6, fine foliage. (S).
Capparis zeylanica. *Capparideae.* Ceylon. White and red; spiny. 6-7. (S). $
Cassia alata. *Leguminosae.* Tropics. Yellow and orange, 5-6. (S).



1, *Cestrum aurantiacum*: FLOWERS YELLOW.
2. *C.—nocturnum*: QUEEN-OF-THE-NIGHT.

C.—auriculata. Ranawara, *S*; Matara Tea. Ceylon and India. Yellow, 6-8. (S). See pages 378, 443.
C.—corymbosa. S. America. Yellow and orange. 4—5. (S).
Cestrum aurantiacum. *Solanaceae.* Guatemala. Orange-yellow. 5—7.(C).
C.—elegans. Purplish-red fl's and berries. 5-7. (S or C). See p. 183. $
C.—nocturnum. "Queen of the night." Hassu-na-Hana. Fl's greenish white, strongly scented at night. Large straggling shrub, 5-8. Peru. (C). $
Chiococca racemosa. *Rubiaceae.* W. Indies. White, turning to cream. 5-6.(S or C).
Clavija ornata. *Myrsineae.* S. America. Bright orange-red. 8—15. Fl's borne on stem. (S).
Clerodendron fragrans. *Verbenaceae.* Java. 3—4. Fl's white, shaded crimson, double, in squat heads, strongly scented. L. large, cordate. Naturalised in Ceylon. (C).
C.—inerme. Ceylon and India. White, tipped with red. 3. (C or S).
C.—infortunatum. Ceylon, India, Malaya, etc. White, 5-10. Fl's scented. (C).
C.—macrosiphon. Zanzibar. White. 3—4, long delicate tubular fl's; long, protruding, pink stamens. (C).
C.—Minahassae. Celebes. Spreading shrub. White, free-flowering. 6-8. (C or S). $.
C.—nutans. Assam, etc. Greenish-white, long, drooping racemes. 5-6. (C or S).$.
C.—odoratum. (Caryopteris wallichianum). White, suffused with purple. (C). $.
C.—paniculatum. Pagoda-flower. Java. 5-6. Large, erect, scarlet panicles. Leaves large, angular. Very showy. (C). $
C.—serratum. Kenhenda, *S.* 5—7. Large blue fl's. (C).
C.—siphonanthus. India. Naturalised in Ceylon. 6—8. Fl's long, white, in large heads on long erect shoots; leaves long, narrow, in whorls of 4.
C.—squamatum. India and China. 6—8. Scarlet. (C). Leaves large, almost round. Naturalised in Ceylon.
Clitoria cajanaefolia. *Leguminosae.* Malaya & Trop. America. Pink. 4-5. (C).
Costus speciosus. *Scitamineae.* Ceylon, India, etc. White, yellow centre. 6-8 (S).
Crossandra undulaefolia. *Acanthaceae.* Ceylon, India, etc. Orange-red or salmon yellow; fl's in dry season. Showy. 2-3. (S or C). See page 141.
Crotalaria laburnifolia. "Yakberiya." *S.* (*Leguminosae*). Pale yellow; 2—4. (S).
Cystacanthus turgidus. *Acanthaceae.* Cochin China. Spotted-purple. 5-6. (C. or S).
Daedalacanthus nervosus. *Acanthaceae.* India. Deep blue. 4—5. (C).
Datura chlorantha. *Solanaceae.* Yellow. 6—8; fl's double. (C or S).



Clerodendron fragrans. *Clerodendron Minahassae.*



Clerodendron paniculatum. PAGODA FLOWER.

D.—fastuosa. Attana, *S.* Ceylon, India, etc. Purple or white. L. large, angular. 2-3. (C or S).

D.—Stramonium. Thorn Apple. White or purple. 2. L. pinnatisect. Naturalised in Ceylon. (S).

D.—(Brugmansia) suaveolens. Trumpet Flower; Rata-attana, *S.* Mexico. White, scented. 10–15. (C or S). Very handsome, floriferous. Naturalised in Ceylon.



Dombeya angulata.

Dombeya angulata. *Sterculiaceae.* Madagascar. Rose, pink, and salmon shades. 8—10. Showy. (C or S). 8

D.—Mastersii. Trop. Africa. Creamy white 5-6. D.—natalensis. S. Africa. White or cream. 4-5. (C).

Duranta Plumieri. *Verbenaceae.* S. America. Purplish blue. 8—12. (C or S).

D.— Plumieri alba. White. 8-12. (C or S).

Ecbolium linneanum. *Acanthaceae.* Ceylon, S. India, etc. Light blue. 4. (C or S).

Eranthemum cinna barinum. *Acanthaceae.* Burma. Terracotta. 5. (C).

E.—pulchellum, = Daedelacanthus nervosus.

Erythrochiton brasiliensis. *Rutaceae.* Brazil. Bright red. 5. (S).

Euphorbia Bojeri. *Euphorbiaceae.* Madagascar. Stems prickly, bronze or purple-red; fl's bright red. (C).

E.—pulcherrima. Poinsettia. Mexico. Brilliant scarlet bracts. 8—10. (C). Also a "double" variety. Very showy.

E.—p—alba. Fl's creamy white.

E.—heterophylla. S. America. Small plant, 2-3; bracts small, green, pink at base. (C).

Franciscea bicolor. See Brunfelsia Hopeana.

Galphimia glauca. *Malpighiaceae.* Mexico. Bright yellow. 4-5. (S).

Gardenia florida. Cape Jasmine. *Rubiaceae.* China and Japan. White. 4-6. (C).

Goethia strictiflora. *Malvaceae.* Brazil. Fl's orange-red, borne on few, erect, unbranching stems. 6-7. (C).

Goldfussia rubescens. *Acanthaceae.* Blue. 3—4. (C).

Gomphia decora. *Ochnaceae.* Brazil. Bright yellow. 4—5. (S or C).

Gomphocarpus fruticosa. *Asclepiadeae.* S. Africa. 4—5. White. Large, peculiar, hollow, green fruits with long fleshy hairs. (S).

Hamelia patens. *Rubiaceae.* S. America and W. Indies. Orange-red. 5—8. (C).

Hedychium angustifolium. *Scitamineae.* Ceylon, Assam, etc. Bright red, large heads. 4—5. (Div). 8

Heeria macrostachya. *Melastomaceae.* Mexico. White, loose sprays; square stems; 4—5. Leaves opposite. (C).

Helicteres Isora. "Liniya," *S. Tiliaceae.* Ceylon, India, etc. Brick-red. 5—6. (C).

Hibiscus mutabilis alba. *Malvaceae.* China. Large white fl's, not floriferous. 5—6. (C or S).

H.—mutabilis rosea. Large pink fl's. 5-6. Single and double varieties of this and preceding species. (C).

H.—rosa-sinensis. Shoe-flower; "Sapatthumal," *S.* Numerous varieties or crosses; large, single and double flowers of different shades, many of them very showy. Propagated by cuttings. Among the best are: *Double*:—"Aurora," large,



Hedychium angustifolium.

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scarlet ; " Salmo," large salmon-pink ; " Avoca," pale yellow ; "Stella," small fl's, salmon-red, slow-growing ; " Eureka," dwarf, pure white, carnation-like ; "Variegata," scarlet streaked with white.

Single :—" Venus," large brilliant crimson with dark-brown rays radiating from centre, leaves deeply cut ; " Aphrodite," large bright pink; "Argosy," rich salmon ; " Etna," bright salmon-pink ; " Albus," creamy white with dark centre ; " Aurea," pure yellow ; " Ophir," bright sulphur-yellow ; " Rosa-schizo," scarlet, a cross partaking of the characters of rosa-sinensis and schizopetalus ; " Delta," brilliant scarlet, broad petals ; " Cooperi," variegated coppery-green foliage.

H.—schizopetalus. Trop. Africa. Long, drooping, orange-red or variegated fl's, petals fringed and reversed ; slender arching branches. 6—8. (C).

H.—syriacus. Erect shrub, bluish purple fl's ; best suited to high elevations. See p. 184.

H.—trionium and H.—africana. See page 134.

Holmskioldia sanguinea. Parasol-flower. *Rubiaceae.* N. India. Orange-red. 6—8. (C or S).

Humboldtia laurifolia. Gal-karanda, *S.* (*Leguminosae*). Ceylon. Large shrub. White and pink fl's, scented. 8-10. Hollow internodes usually inhabited by ants. (S).

Ixora coccinea. *Rubiaceae.* Ceylon, India, &c. Scarlet. 4—5. (C or S).

I.—Fraseri. Hort. Salmon-red. 4.-5. (C). I.—javanica. Java. Orange, 5—6. (C).

I.—lutea. Bright orange-yellow. 2-3. (C. or L.)

I.—macrothyrsa. (=I. Duffii). Sumatra. 4—5. Fl's deep-red, in large clusters, very handsome. (C or layers).

I.—odorata. Madagascar. Fl's long-stalked, in large heads, white and pink. 6-8.(C). §

I.—rosea. Khasia. 4—5. Rose-coloured. (C).

Jacobinia coccinea. *Acanthaceae.* Brazil. Scarlet or cerise. 5—6. (C or S).

J.—aurantiaca. Strong-growing, 5—8. Fl's orange-yellow. (C).

J.—magnifica. Brazil. Bright pink, large racemes. (C).

Jacquinia ruscifolia. *Myrsineae.* Mexico and W. Indies. Bright-orange. 6—10. (S).

Jasminum revolutum. See page 125.

J.—Sambac. " Pichcha," *S* ; Mallia-poo, *T.* India. Straggling semi-climbing shrub; fl's pure white, strongly scented ; leaves glabrous. 5—6. (C). S.



Jasminum pubescens.



Holmskioldia sanguinea.

Jatropha multifida. *Euphorbiaceae.* 5—12. Fl's scarlet. L. palmately cut. (C or S). §
J.—panduraefolia. Cuba. 3—4. Fl's rose-pink. L. fiddle-shaped. (C).
J.—podagrica. Panama. 4—5. Orange-red. L. large, palmate-peltate. Tuberous base. (C or S).
Jussiaea suffruticosa. *Onagraceae.* Ceylon, etc. Yellow. 2—3. (S).
Justicia Betonica. "Sudupuruk," *S. Acanthaceae.* Ceylon, etc. Greenish-white. 3—4. (C or S).
J.—calycotricha. Brazil. Yellow. 2—3. (C or S).
Kopsia fruticosa. *Apocynaceae.* Burma, Java, etc. Pale pink. 6-8. (C or S). §
Lagerstroemia indica. *Lythraceae.* Indian Lilac; Bonnet-flower; Crepe Myrtle. China & India. Large magenta sprays; also white and pink var's. 6-8. (C or S). §



Lagerstroemia indica. INDIAN LILAC.



Ixora odorata.

Lantana nivea. *Verbenaceae.* Trop. America. White; also pink and other shades (C or S). Used for hedges in India, &c.
L.—trifolia. Purple. L. in 3's. L.—aculeata. Common Lantana. Scarlet. 4-6. (C or S). See p. 475.
Malvaviscus arboreus. *Malvaceae.* S. America. Small scarlet fl's. 4—6. (C or S).
Medinilla magnifica. *Melastomaceae.* Philippines. Rosy-pink; large, hanging sprays; leaves large, 7 to 9-nerved. 5—6. (C).
M.—speciosa. Malaya. Crimson. 5—8. M.—Teysmannii. Java. Creamy white. 5—6. (C).
Melastoma malabathricum. "Maha-bowitiya," *S. Melastomaceae.* Ceylon and India. Pink, fairly large fl's. 4—6. (C or S).
Memecylon umbellatum. Korakaha, *S. Melastomaceae.* Ceylon and S. India. 6-8. Fl's small, deep blue, in crowded clusters along the stems, very showy. (S). §.
Montanoa bipinnatifida. Tree-daisy. *Compositae.* Mexico. 8-12. Large white fl's, in great profusion; Dec-Jan. (C). §.
M.—tomentosa. Mexico. 8-12. White flowers, yellow centre, smaller than those of preceding species; leaves tomentose. (C).
Murraya exotica. "Etteriya," *S. Rutaceae.* Eastern Tropics. Small tree with white, scented fl's; small pinnate leaves. (S).

Mussaenda erythrophylla. *Rubiaceae.* Trop. Africa. Naturally a climber or scandent shrub; can be cultivated as a shrub, 5—6. One of 5 sepals much enlarged, hairy, bright scarlet; very showy. Actual fl's small, yellow. (C). $



Kopsia fruticosa.



Lantana nivea, var. mutabilis.



Memecylon umbellatum.
(See p. 114.)

M.—frondosa. Similar to latter species, with enlarged white sepal. (C or S).

M.—luteola. 2—3. Dwarf sp. Fl's small pale yellow; enlarged sepal yellowish white. (C).

Myrtus communis. Myrtle. *Myrtaceae.* S. Europe. 6—8. Small white fl's. (C or S).

M.—tomentosus. See *Rhodomyrtus.*

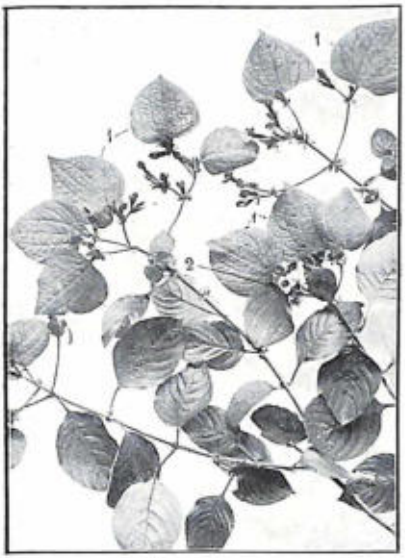
Nerium Oleander. Oleander. *Apocynaceae.* Asia Minor. Large clusters of bright-red fl's. 5—8. (C). A beautiful free-flowering shrub, specially suited to dry, sandy, sunny locality. $

N.—Oleander alba. White fl's. 5—8. Single and double varieties of both species. See pages 115, 208. $

Notonia grandiflora. *Compositae.* India. Yellow. 5—6. (C or S).

Ochna Kirkii. *Ochnaceae.* E. Trop. Africa. Fl's bright yellow, berries bright red. 4—5. (C or S).

Osbeckia aspera. "Bowitiya," *S. Melastomaceae.* Ceylon and India. Bright purplish crimson. 4—5. (S).



Mussaenda erythrophylla.
1, BRIGHTLY COLOURED BRACTS.
2, SMALL, YELLOW FLOWERS.



Montanoa bipinnatifida.
TREE DAISY.

O.—rubicunda. See page 142.

Oxyanthus natalensis. *Rubiaceae.* Natal. White, long, slender tubular fl's, in bunches. 4—5. Squat shrub. (C).

O.—tubiflorus. W. Trop. Africa. White. 6. (C). Shrub, more erect than latter, large oval leaves.

Palicourea gardenioides. Mexico. Creamy white, in bunches. 5—6. (C).

Paulwilhelmia speciosa. *Acanthaceae.* Abyssinia. Blue, showy. 4—5. (C.)

Pavetta indica. "Pawatta," *S.* (*Rubiaceae*) Ceylon and India. Long white fl's, in clusters. 3-5. (C).

P.—lanceolata. S. Africa. White. 4-6. (C).

Pentas carnea. *Rubiaceae.* Trop. Africa. Different var's and shades, pink, mauve, white, &c.; fl's, in bunches. Very pretty; useful for cut fl's. 2-3. (C or S). S

Peristrophe speciosa. *Acanthaceae.* Himalaya. Carmine purple. 4. (C).

Phlogacanthus thyrsiflorus. *Acanthaceae.* India & Java. Purple. 4-6. (C).

Phyllanthus pulcher. Malaya; P.—speciosa. Jamaica. 3-5. Flat green phyllodes (like leaves), bearing small crimson fl's along the margins. See p. 121.



Nerium Oleander. OLEANDER.
1, ROSE-PINK VARIETY; 2, WHITE VARIETY.

Plumbago capensis. *Plumbagineae.* S. Africa. Pale blue. 3-5. (C).
P.—rosea. "Rat-nitul." S. India. Rose scarlet. 2-3. (C or S). Medicinal.
P.—zeylanica. "Ela-nitul," *S.* Ceylon, etc. White. 2-3. (C or S). See p. 387.
Poinsettia, see Euphorbia pulcherrima.
Portlandia grandiflora. *Rubiaceae.* W. Indies. White. 8-12. (C).
Quassia amara. *Simarubaceae.* Guiana. Scarlet. "Surinam Quassia." 6-8. (C or S)
Randia maculata. *Rubiaceae.* Trop. Africa 6-10. Long, tubular fl's, brownish, white. (C or S).
R.—macrantha. Trop Africa. 5-10. Remarkable, long, drooping, tubular, white fl's. (C). S
R.—Mussaenda. S. America. Small, pure white, star-like fl's. 6-8. (C).
Ravenia spectabilis. *Rutaceae.* S. America. Pink. 3-4. (C).
Reinwardtia tetragyna. *Lineae.* Yellow. 2-4. (S or Div).
R.—trigyna. India. Yellow. 3-4.
Rhodomyrtus tomentosa. *Myrtaceae.* Ceylon. Fl's in form of round brush, consisting chiefly of numerous, bright pink stamens. 5-8. (C).



Randia macrantha.



Stifftia chrysantha.

Rondeletia odorata. *Rubiaceae.* Mexico. Salmon-pink; slender branches. 5-6. (C)
R.—speciosa. S. America. Scarlet; erect, rigid branches. 4-5. (C).
Rudgea macrophylla. *Rubiaceae.* Brazil. 4-5. Creamy white, in large heads; leaves large, obovate. (C).
Russelia juncea. *Scrophulariaceae.* Mexico. Scarlet. Grass-like leafless plant. 3-5.(C).
R.—sarmentosa. Trop. America. Leafy shrub; fl's. pink. 4-5. (C).
Salvia coccinea. *Labiatae.* Cent. America. Scarlet. 2-3. (C).
S.—coelestina. Mexico. Lilac-blue. 2. S.—farinacea. Texas. Lavender-blue. 1½. (C). Several shades and varieties, pale to deep purplish blue, &c.
S.—splendens. Brazil. Bright scarlet, very showy. 3-4. (C). Several var's.
Sanchezia longiflora. *Acanthaceae.* S. America. Magenta. 6-8. (C).
Solanum Rondelettii. *Solanaceae.* Deep purplish blue, mottled; 5-6. (C or S).
Sophora violacea. *Leguminosae.* Ceylon. Violet-blue. 2-3. (S).
Stemmadenia bella. *Apocynaceae.* Mexico. Pure white. 4-6. (C).
Steriphoma paradoxa. *Capparidaceae.* Venezuela. Crimson to orange. 4-5. Climbing shrub, long, lanceolate leaves. Very striking. (C or S).

Stifftia chrysantha. *Compositae.* Brazil. Fl's orange to yellow, in large brush-like heads. 10-15. Remarkable shrub or small tree. (S. or layers). S

Strobilanthes coloratus. *Acanthaceae.* E. Himalaya. Purple. 4-5. (C). Many other species. See also pages 142, 185.

Stromanthe sanguinea. *Scitamineae.* Brazil. Crimson 3-4. (Div or S).

Strophanthus dichotomus. *Apocynaceae.* India and Malaya. Purplish white; corolla lobes developed in long cords. 5-6. (C). (=*S. longicaudatus*).

Tabernaemontana coronaria. "Wax-flower." *Apocynaceae.* India and Malaya. Pure white, contorted petals; free-flowering; also a double variety (*flore-pleno*), resembling *Gardenia*. 5-6. (C).

Tecoma stans. *Bignoniaceae.* S. America and W. Indies. Small tree or shrub. Bright yellow. 10-15. (C or S).

T.—velutina. Mexico. Fl's yellow. 8-12. Similar to latter sp., but leaves smaller.

Tephrosia grandiflora. *Leguminosae.* S. Africa. Purplish red. 2-3. (S).

Thespesia macrophylla (=T.—Lampas). *Malvaceae.* Ceylon, Trop. Asia and Africa. Large, bright yellow, with a dark-crimson centre. 5—6. (C or S).



Thunbergia erecta.
(See below).



Yucca gloriosa. ADAM'S NEEDLE.
(See pages 118, 186).

Thevetia nereifolia. *Apocynaceae.* Trop. America. Yellow or orange. Stems milky; leaves narrow, 4—5 in. Fl's few. 10—15. (C).

Thunbergia affinis. *Acanthaceae.* Trop. Africa. Violet-purple, tube white or yellow. 4—5. (C).

T.—(Meyenia) erecta. Trop. Africa. Deep purplish-blue, tube pale yellow. 4—5. (C).

Thyrsacanthus rutilans. *Acanthaceae.* Colombia. Crimson, drooping fl's. 5—6. (C).

Tinnea aethiopica. *Labiatae.* Cent. Africa. Small dark-brown fl's, scented. 4-5. (C).

Tithonia diversifolia. Mexican Sunflower *Compositae.* Mexico. Large, bright yellow fl's. 6—8. (S). Naturalised in Ceylon. See pp. 118, 476. S

Uroskinnera spectabilis. *Scrophulariaceae.* Cent. America. Showy mauve fl's, in close racemes. 4—6. (C). See p. 118.

Veronica madagascariensis. *Compositae.* Violet-purple. 3—5. (C or S).

Warszewiczia (Calycophyllum) coccinea. *Rubiaceae.* Trop. S. America. Large leaves and scarlet bracts; very showy. Introduced at Peradeniya in 1923.



Uroskinnera spectabilis.
FLOWERS MAUVE.



Tithonia diversifolia.
FLOWERS YELLOW.

Woodfordia floribunda. *Lythraceae.* Ceylon, India, etc. Brick-red. 5—6. (C).
Wormia Burbidgei. *Dilleniaceae.* Borneo. Fl's large, bright yellow. 8—10. (C).
Wrightia zeylanica. Sudu-idda, *S. Apocynaceae.* Ceylon. Snow-white. 3—5. (C or S).
Yucca gloriosa. *Liliaceae.* Spanish Needle; Adam's Needle. Fl's in large, erect, white, terminal panicle. L. rigid, sharp-pointed. See pages 117, 186. §

(2).—ORNAMENTAL FOLIAGE SHRUBS.

See also Chapter XIII, pages 148-157.

Abroma fastuosa. *Sterculiaceae.* Trop. Asia. 8-12; large cordate leaves. (C or S.)
Acalypha godseffiana. *Euphorbiaceae.* New Guinea. 3—4; L. white or cream-margined. (C).
A.—hamiltoniana. L. small, semi-filiform, drooping, white-margined; 3-4. (C).
A.—illustris. 6—8. Large leaves, blotched with copper and crimson. (C).
A.—marginata. India. 6—8. Leaves oval, serrate; margin cream or pink. (C).
A.—obovata. Hort. 5—8. Similar to latter. L. generally obovate. (C).
A.—torta. Fiji. 5—6. L. bronze, twisted. (C).
A.—tricolor (A.—wilkesiana). Fiji. 6-10. L. blotched with red and crimson. (C).
A.—triumphans. 6—8. L. large, crimson and green. (C).
A.—Willinckii. 6-8. L. very large, pale green, blotched with yellow. Several other species and varieties.
Alchornea ilicifolia. *Euphorbiaceae.* Australia. 8—10. Holly-like spiny leaves. (C).
Alpinia raffiesiana. *Scitamineae.* 4-5. L. variegated. (Div.)
A.—sanderiana. See *Ornamental Fol. Pot-Plants,* page 148. §
Amomum hemisphaericum. *Scitamineae.* Java. Large, handso e, herbaceous, pinnate leaves, 8-12 ft. long, rising from base; leaflets 1½-2 long, undulated, bronze underneath. (S or Div).
A.—magnificum. Mauritius. 8—10. Similar to latter species, except that the leaves are green on both sides. Fl's in large pink heads, on erect stalks, 2½ to 3 ft. high. §
Aralia filicifolia. *Araliaceae.* Pacific Islands. 6—8. L. large, pinnate and pinnatifid, yellow when young; very showy. (C). See p. 119. §



Amomum magnificum.

A.—Balfourii. Handsome, variegated, pinnated; leaflets oval or round, freely blotched with grey or white. §

A.—Guilfoylei. Pacific. 6—8. Stems erect. Similar to latter, but leaflets smaller and less variegated. (C).

A.—maculata. Polynesia. Stems and leaves purplish with green spots. 8—10. L. large, roundish. (C).

A.—triloba. Leaves 3-lobed. 4—6 ft. (C). See also Panax, closely related to Aralia.

Arundo Donax variegatum. *Gramineae.* S. Europe. Ornamental variegated grass. 6—8. (C or Div).

Bambusa. See *Bamboos and Ornamental Grasses*, page 172.

Beaucharnia (Nolina) recurvata. *Liliaceae.* Mexico. 5—8. Dracaena-like plant, stem swollen at base. (S or Off).

Boehmeria pulchra. *Urticaceae.* 5—6. L. velvety, dentate, dark green. (C).

Carludovica palmata. Panama-hat Plant. *Cyclanthaceae.* Peru. Bushy plant with large handsome palm-like leaves. (Div). See p. 428. S

Chamaeranthemum Beyrichii variegatum. *Acanthaceae.* Brazil. 2—3. Leaves variegated. (C).

Cocoloba, see *Muehlenbeckia.*

Codiaeum (Croton). *Euphorbiaceae.* Malaya, Polynesia, etc. Numerous varieties. 5—7. Highly ornamental shrubs; leaves variously coloured and shaped. (C).

Cordyline (Dracaena) cannaefolia, & other spp. *Liliaceae.* Australia. Very elegant palm-like plants, usually erect and unbranched, many with highly coloured purple, crimson or pink leaves. 6—12. Propagated by stem-or leaf-cuttings, or suckers. Several species and var's, including C.—Duffii. C.—Fraseri, C.—magnifica. C.—terminalis, etc.



1, *Aralia Balfourii*;
2, *A. filicifolia*;
3, *Panax fruticosum.*

Cycas circinalis, "Madu," *S.* Ceylon Sago. *Cycadeae.* Ceylon, India, etc. Handsome, slow-growing plant, bearing a crown of long pinnate leaves. 6—12; the large seeds are made into sago. (S. or Off). See pp. 120. 366, &c. §

C.—pectinata. Burma, &c. 6-10. Scale-leaves cordate, brown, long-toothed. §

C.—revoluta. Japan. Dwarf species with compact, dark green leaves. (Su).

C.—Rumphii. Moluccas. 6—8. Large robust species; male plant not found in Ceylon, therefore fertile seeds not known to be produced here. (Off. or Su.).

C.—siamensis. Cochin China. 4—6. Numerous other species.



Cycas circinalis. CEYLON SAGO

3 peculiar bat-like, obversely triangular leaflets. (S. or C.)

Excaecaria bicolor. *Euphorbiaceae.* Java. 5-7. L. small, ovate, deep crimson beneath. (C).

Gynura bicolor. *Compositae,* Herb. sh. L. ovate with violet hairs. 4-5. (C).

Goldfussia anisophylla. *Acanthaceae.* Himalaya. 3—4. Close bush, small leaves. (C).

Gomphocarpus fruticosus. *Asclepiadeae.* S. Africa. 4-5. Fl's. white.

Graptophyllum hortense. Caricature Plant. *Acanthaceae.* Trop. Asia. 4—5; leaves variegated, blotched creamy-white. (C).

Heliconia angustifolia. *Scitamineae.* Brazil. 5-6. L. large, plantain-like. (Su.)

H.—aurea-striata See p. 153.

H.—brasiliensis. "Lobster-claw." Brazil. 5—6. Remarkable for large, scarlet, distichous fruit-spikes. S

H.—brevispatha. S. America. 4—6. L. long and narrow; fl's white, spathes orange red.

H.—illustrus. Hort. See p. 153.

H.—insignis. 5—8. L. bright bronze, long, narrow, wavy, handsome. (Su).

Cyclanthus cristatus. *Cyclanthaceae.* Colombia. 5—6. Handsome stemless plant with long, entire leaves, divided at junction with petiole. (Su.)

Dioon edule. *Cycadeae.* Mexico. Slow-growing plant with sharp-pointed leaflets. The stout stem affords edible fecula.

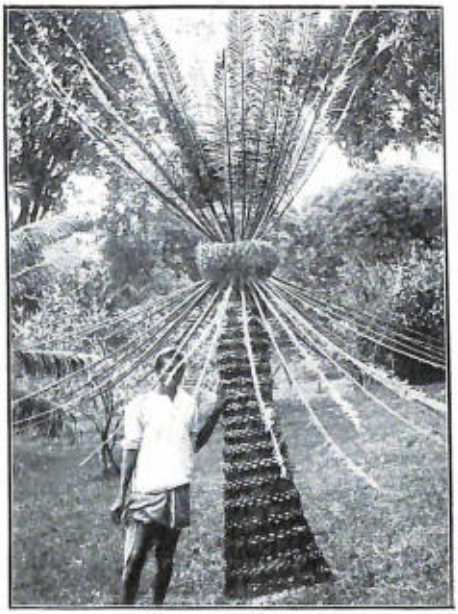
Dracaena reflexa. Trop. Africa. A small, much-branched tree with small green leaves. Also a variegated form. (C. or S.)

Encephalartos Caffra. *Cycadeae.* Slow-growing, Cycas-like plant, with long pinnate, spiny l., native of S. Africa. 5—10. (S or Off). Several other species, including E. Hildebrandtii, E. horridus, E. villosus, &c.

Eranthemum elegans. *Acanthaceae.* Erect sh., 4-6. L. blotched with white, grey, bronze, &c. Several var's. (C).

Erythrina Parcelli. *Leguminosae.* 8-15 or more. L. with creamy white bands. (C).

E.—Vespertilio. W. Australia. Small tree or sh., with

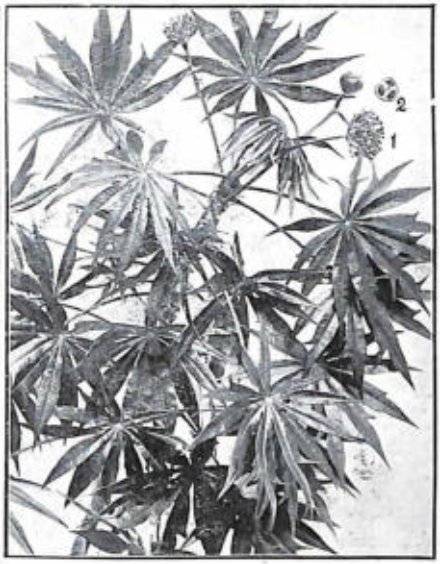


Cycas pectinata.

H.—metallica. Colombia. 4—5; Leaves bronze, drooping. (Su.).
H.—pulverulenta. S. America. 4—6; L. with white powdery substance beneath.
H.—spectabilis. 4—6. L. bright bronze. (Div. or S).
Honckenya ficifolia. *Tiliaceae.* 3—5. Deep copper-coloured leaves. (S or C).
Jatropha multifida. Coral-tree. *Euphorbiaceae.* 5—15. Handsome palmately-divided leaves. (S or C). See p. 113. S.
Justicia grandiflora. *Acanthaceae.* 4—5. Handsome foliage plant. (C).
Leea amabilis. *Ampelideae.* Borneo. 4—6. Handsome pinnate leaves with white or pinkish-grey mid-rib and nerves. (C or S).
L.—coccinea. Burma. Similar to preceding species.
Macrozamia Fraseri. *Cycadeae.* W. Australia. 5—7. Large handsome, closely pinnate leaves; pinnae narrow and sharp-pointed. S or Su).
M.—Moorei. Queensland. Similar to latter species. (S). S.

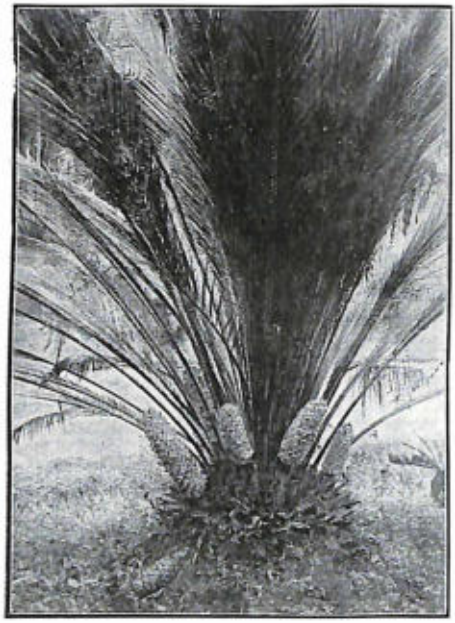


Heliconia brasiliensis.



Jatropha multifida.

M.—plumosa. and several other species.
Miconia flammea. *Melastomaceae.* Trop. S. America. 4—5. Handsome plant with large rugose leaves. (C). M.—pulverulentum (=M.—hookeriana). Peru. Large shrub or small tree, 15—20; large, handsome, ovate leaves, satiny purple beneath, with prominent nerves; fl's in large, creamy-white, erect panicles.(C).
Muehlenbeckia Cocoloba) platyclada. *Polygonaceae.* Solomon Islands. 5-7. Straggling, leafless climbing shrub, with flattened, green, leaf-like branches. (C).
Myriocarpa longipes. *Urticaceae.* Costa Rica and Mexico. 8-10; leaves large, oval, hispid. Fl's in long pendulous green cords.
Nandina domestica. *Berberideae.* China and Japan. 4-6; leaves small, bipinnate, tinted bronze; erect, numerous stems. (Su or S). See p. 122, 184, 465. S.
Palms. See under *Palms*, pages 162-170.
Panax fruticosum. *Araliaceae.* Trop. Asia. 4—6. Quick-growing; handsome, feathery bipinnate leaves. (C). See *Aralia*, closely realated to *Panax.*
Pardanus sanderiana. Hort. *Pandanaceae.* 4—10; long, arching, handsome leaves, striped creamy-yellow and green. (Off or Su).
P.—variegatus. Java. Long narrow spiny l., variegated white and green. (Off).
Phyllanthus myrtifolius. "Ceylon Myrtle." *Euphorbiaceae.* 5—6. Small, myrtle-like leaves; slow-growing, makes an excellent hedge or edging. (S).



Macrozamia Moorei.

Tococa latifolia. *Melastomaceae.* Brazil. Large shrub or small tree, 15-20. Very large, handsome oval leaves, with satiny sheen and 3 prominent nerves. See p. 123. S

Vernonia macrophylla. *Compositae.* Brazil. 6—8. Large oval leaves. (S).

Zamia latifolia and other species. *Cycadeae.* Mexico, S. Africa, &c. Small palm-like plants with stiff, spiny, pinnate leaves. (Su).

(3)—ORNAMENTAL FLOWERING CLIMBERS.

(*See also* pages 128, 133, 208).

Acridocarpus natalitius. *Malpighiaceae.* Natal. Bright yellow. L. leathery, ovate. (C).

Adenocalymna nitidum. *Bignoniaceae.* Brazil. Yellow. L. trifoliate, tendrilled. (C).

Allamanda cathartica. Willow-leaved Allamanda. *Apocynaceae.* Trop. America. Bright yellow; quick-growing and free-flowering. (C).

P.—nivosus. See page 154.

Pisonia alba. Lettuce Tree. 10—20. Pale yellow foliage. See p. 102.

Ravenala madagascariensis. Travellers' Tree. See *Orn. Fol. Trees*, p. 103.

Sanchezia nobilis. *Acanthaceae.* Ecquador. 5—6; long lanceolate leaves with white bands (C).

S.—glaucophylla. Similar to latter species, but variegation less pronounced.

Sesbania aegyptiaca. *Leguminosae.* Tropics. 6—8. Fine bipinnate leaves. (S or C).

Sophora tomentosa. "Mudu-murunga," *S.* (*Leguminosae*). Ceylon, etc. Whole plant woolly-grey. (S or C).

Tangeria paradoxa. *Cycadeae.* Natal. Small plant with short stout trunk and fern-like foliage. Distinct from other Cycads.

Strelitzia augusta. Large Banana-like plant, with distichous leaves and numerous slender stems. 15—20 ft. (Su or S).

Thunbergia Kirkii. *Acanthaceae.* Trop. Africa. 3—4. Small, lanceolate, pinnate leaves; blue fl's: a close-growing shrub. (C).



Nandina domestica.



Tococa latifolia.
(See p. 122.)

A.—Hendersoni. Brazil. Yellow. Similar to, but more robust than, preceding species, with large bell-shaped fl's. A.—nobilis. Yellow, large fl's. Several other species and var's.

Antigonon insigne. *Polygonaceae.* Colombia. Bright rose-pink; large double fl's. (C).

A.—leptopus. "Corallita." Mexico. Bright pink. Beautiful plant, suitable for arbours, pergolas, etc. (S or C). $

A.—leptopus albiflora. A white-flowered variety of the latter. C).

Araujа grandiflora. *Apocynaceae.* Brazil. White, tubular, scented fl's. (C).

Aristolochia elegans. *Aristolochiaceae.* Brazil. Fl's saucer-shaped mottled dark-purple and creamy yellow; very elegant. (S). See p. 125. $

A.—gigas (var. Sturtevantii). Giant Fly-Catcher; Pelican-or Goose-flower. Guatemala. Fl's very large with long tail (20 to 24 in.), greenish-white and brown; strong offensive odour, which attracts numerous flies, upon which the plant depends for pollination. (C). See p. 124.

A.—hians. Venezuela. Spotted purple and green; fl's 2-lobed. (S).

A.—labiosa. Brazil. Fl's purplish brown & green, with large, peculiar, broad lip. (C).$

A.—ridicula. Brazil. Fl's greenish-brown, developed into 2 horn-like projections tipped with rigid knobbed hairs; self-sterile (Petch). (C or S). See p. 125. $

A.—saccata. Himalaya. Purplish-red. Large, ovate, hairy leaves. (C).

Asparagus falcatus. "Hatawariya," *S. Liliaceae.* Ceylon. Fl's creamy white, in large panicles, sweet-scented; spiny. Cladodes 3-4 in. long and 1-tenth inch broad. (S or Tu).

Banisteria fulgens. *Malpighiaceae.* W. Indies. Yellow. (C). See p. 78.

B.—laurifolia (=Stigmaphyllon periplocaefolium). Bright yellow. (C)

Beaumontia grandiflora. Nepal Trumpet Flower. *Apocynaceae.* India. Large white, trumpet-shaped fl's. Strong grower. (C).

Bignonia magnifica. *Bignoniaceae.* Colombia. Magenta; vigorous grower, very showy; frequent bloomer. Leaves of this and other species of the genus usually binate, with forked and hooked tendrils. (C).

B.—Unguis-cati. Trop. America. Bright yellow; fl's in great profusion after dry season; very handsome. Creeping by clawed tendrils; slender stems. (S or Su).

B.—venusta. "Tanga-poo," *T*; Golden Shower. Brazil. Fl's bright orange, tubular, 2-3 in. long, in pendulous clusters. Blossoms in dry season in great profusion; remarkably beautiful. (C).

Bougainvillea glabra. *Nyctagineae.* Brazil. Bright purple bracts; very showy. Spiny stems, strong grower; likes sunny place. (C or S). See also pages 108, 128, 188.

B.—glabra var. sanderiana. Dwarf, free-flowering variety of latter species. (C).

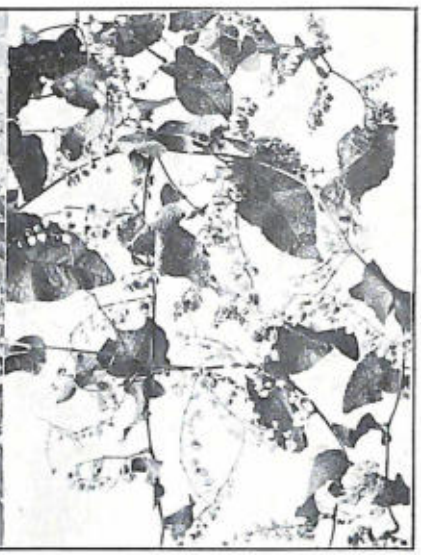
B.—spectabilis var. laterita. Brazil. Brick-red. Straggling shrub, very handsome when in flower. Several hybrids with fl's of different shades. (Lay.).

Callichlamys riparia. *Bignoniaceae.* Woody climber with beautiful yellow fl's, like those of Allamanda.

Camoensia maxima. *Leguminosae.* Trop. Africa. Fl's 8-9 in. long, largest of *Papilionaceae*; white, fringed with yellow, scented. Strong grower. (C or S). See p. 126.$



Porana volubilis.



Antigonon leptopus.

Cereus triangularis. Night-flowering Cactus. *Cactaceae.* W. Indies. Epiphytic creeper with large, tubular, white fl's. Stems 3-angled. (C).



Aristolochia gigas.

Chonemorpha macrophylla, see *Ceylon Plants,* p. 140.

Clerodendron Thompsonae. (=C.—Balfouri). *Verbenaceae.* Trop. Africa. White fl's with scarlet projecting stigmas. Lovely plant; slender, moderate grower. (C).

Clitoria ternatea. Katarodu-wel, *S. Leguminosae.* Large, blue, pretty fl's; not a free bloomer. Also "double" deep-blue and white varieties.

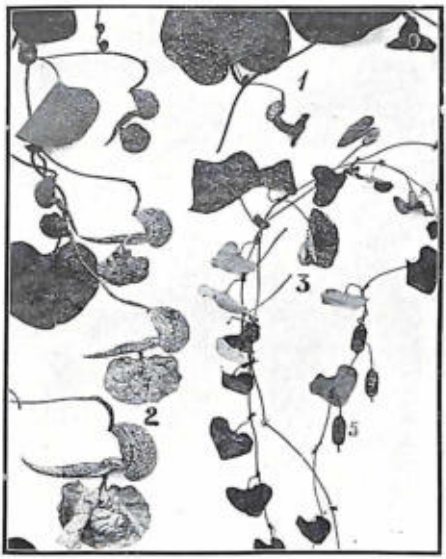
Congea tomentosa. *Verbenaceae.* Burma. Bears large loose sprays, from September to February, composed of mauve-pink velvety bracts, in 4's, resembling petals, lasting several months. Beautiful plant. See p. 126. (C). S

Dipladenia amabilis. Hort. *Apocynaceae.* Rosy-crimson, very showy. (C). Several other species, including D.—flava. Colombia. Yellow; and D.—splendens; Brazil. Rose-pink.

Gloriosa rothschildiana. *Liliaceae.* Crimson and yellow, large fl's. Beautiful herbaceous twiner. (Tu). p. 127. S

G.—superba. "Niyangala," *S.* Ceylon. Trop. Asia and Africa. Scarlet and yellow, very showy. (Tu). See p. 385.

G.—virescens. Trop. Africa. Greenish-red. (Tu).

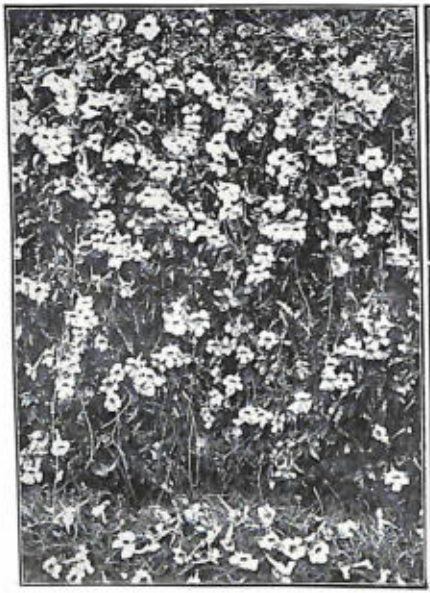


FLY-CATCHING PLANTS.
1, *Aristolochia ridicula*; 2, *A.—labiosa*, showing large lip; 3, *A.—elegans*; 5, fruit pods of latter.



Bignonia venusta.
TANGA-POO OR GOLDEN SHOWER.

Hoya carnosa. Wax-flower. *Asclepiadeae*. Queensland. Pinkish wax-like fl's, produced in bunches. Thrives best on tree-trunks at medium elevations. (C).
Ipomoea carnea. *Convolvulaceae*. Trop. America. Pale pink. Straggling, climbing shrub, large fl's; likes a sunny situation and sea-coast. (C).
I.—Briggsi. W. Indies. Bright crimson; floriferous, very showy. (C).
I.—Learii. Trop. America. Fl's large, bright purplish-blue. Leaves tri-lobed. Beautiful plant, quick-grower useful for forming a screen rapidly, but dies down once a year. (C).
I.—palmata. Trop. Africa. Purple. Small palmately divided leaves. (S or C).
I.—Quamoclit. Tropics. Small scarlet fl's, fine pinnate leaves. Annual. (S).
I.—tuberosa. Spanish Arbour-vine. W. Indies. Yellow. Handsome, vigorous climber. (S or Tu). I.—Bona-nox, see p. 141.
Jacquemontia violacea. *Convolvulaceae*. Mexico. Small perennial; fl's bright blue, small, bell-shaped; free bloomer. L. small, oblong-cordate. (C).
Jasminum flexile. *Oleaceae*. Ceylon. White, scented; trifoliate. (C).
J.—pubescens. India, Burma, &c. Pure white, very fragrant. (C). See p. 112.
J.—revolutum. "Saban-pichcha," *S*. S. India. Yellow fl's; climbing shrub. (C).
J.—Sambac. Arabian Jasmine; Pichcha; Geta-pichcha, *S*; Mallia-poo, *T*. Ceylon, S. India. White fl's, strongly scented. Semi-climbing shrub. L. glabrous (C).
Lonicera hildebrandiana. *Caprifoliaceae*. Burma. Yellow. Largest-flowered Honeysuckle. (C).
Macrosphyra longistyla. *Rubiaceae*. W. Trop. Africa. Creamy white; very long style; stigma covered with sticky yellow fluid; strong odour. (C).
Manettia bicolor. *Rubiaceae*. Brazil. Small twiner. Fl's scarlet and yellow. (C).
Naravelia zeylanica. *Ranunculaceae*. Ceylon, India, etc. Dingy white. Thrives best on tree-trunks. (C).
Nyctocalos Thomsoni. *Bignoniaceae*. Assam. White. Beautiful plant. (C).
Odontadenia speciosa. *Apocynaceae*. S. America. Salmon-yellow. Fl's fragrant and showy. Propagated by layering, seldom by cuttings. Does not seed in Ceylon. See pages 127, 142. S.
Oxera pulchella. *Verbenaceae*. New Caledonia. Greenish-white; showy. (C).
Passiflora coerulea. *Passifloraceae* Brazil. Bluish-purple. L. 3—5 lobed. (C).



Bignonia Unguis-cati.
(See page 123).



Camoensia maxima.
(See page 123.)

P.—**holosericea.** S. America. Purplish-blue. L. entire, lanceolate. (C).

P.—**Jenmani.** Guiana. Creamy-yellow. Leaves 7-lobed. (C).

P.—**laurifolia.** Trop. America. Purple and violet. L. oval. See p. 130.

P.—**racemosa.** Brazil. Scarlet. L. glaucous beneath. (C).

P.—**violacea.** Purple-lilac. Beautiful species. (C).

P.—**vitifolia.** Panama. Beautiful, scarlet, large fl's. L. 3- lobed. (C).

Pereskia Bleo. *Cactaceae.* Mexico. Large spiny el., pink fl's. (C).

Pergularia odoratissima. Tonkin Creeper. *Asclepiadeae.* China and Sumatra. Greenish yellow, fragrant. Fruit large, winged. (S or C).

Petrea volubilis. *Verbenaceae.* Trop. America. Mauve and blue racemes. A beautiful plant; flowers several times a year. See p. 128.

Porana paniculata. Horse-tail Creeper. "Corallila." *Convolvulaceae.* India, Java, &c. Greenish white, long sprays. Large climber. (C).

P.—**volubilis.** "Bridal Bouquet." Malaya. Creamy white, large panicles. Very handsome when in full flower. (C). See p. 124. §



Congea tomentosa.



Gloriosa rothschildiana.
(See page 124.)

Quisqualis indica. "Rangoon Creeper." *Combretaceae.* S. India & Malaya. A semi-climbing shrub. Fl's pale pink to deep crimson, in drooping clusters. (C). See p. 130. S

Raphistemma pulchellum. *Asclepiadeae.* Assam & Burma. Fl's waxy white, in numerous clusters. L. large, heart-shaped. (C). S

Rhodochiton volubile. *Scrophulariaceae.* Mexico. Bright-red. 8-10 ft. (C).

Rose. "Marechal Niel" and others. See page 194.

Roupellia grata. Cream-fruit. *Apocynaceae.* Trop. Africa. White, suffused with dark crimson; close bunches; scented. Strong grower. (S or C).

Schubertia.—See Arauja.

Senecio hederaefolia. *Compositae.* S. Africa. Yellow. Herbaceous plant with Ivy-like leaves. Sometimes known as "German Ivy." (C or S).

Solandra macrantha. *Solanaceae.* Creamy-yellow. (C). See page 189. S.

Solanum pensile. *Solanaceae.* Brazil. Dark-blue.(C).

S.—Wendlandii. Giant potato-climber. *Solanaceae.* Costa Rica. Bluish-purple, large panicles. Vigorous grower, petioles and leaves prickly; very showy. (C). See p. 129. S

Stephanotis floribunda. *Asclepiadeae.* Madagascar. Waxy, white, tubular fl's, strongly scented. Very popular for bouquets, etc. Thrives best in tubs.

Stigmaphyllon ciliatum. *Malpighiaceae.* Brazil. Yellow. See Banisteria.

S.—periplocaefolium (= Banisteria laurifolia). India. Bright yellow. (C).

Strophanthus hispidus. *Apocynaceae.* Trop. Africa. Corolla lobes developed into long tails. (C or S).

Thunbergia grandiflora. *Acanthaceae.* Malaya. Bluish-mauve, large fl's; quick-growing, immense climber. (S., C. or Tu). See page 130. Also a white-fl'd form, which is less robust.

Tristellateia australis. *Malpighiaceae.* Malaya, etc. Yellow, erect racemes; elegant and free bloomer. (C).



Odontadenia speciosa.



Petrea volubilis. (See page 126).

Wagatea spicata. *Leguminosae.* India. Fl's in scarlet spikes. Vigorous grower, very thorny ; leaves pinnate. (C or S).

(4).—ORNAMENTAL-LEAVED CLIMBERS.

Argyreia speciosa. Elephant-climber. *Convolvulaceae.* Bengal, Java, &c. Vigorous grower ; leaves large, cordate, silvery white beneath. Fl's purple.

Aristolochia leuconeura. *Aristolochiaceae.* Colombia. Leaves large, white-veined. (C or S).

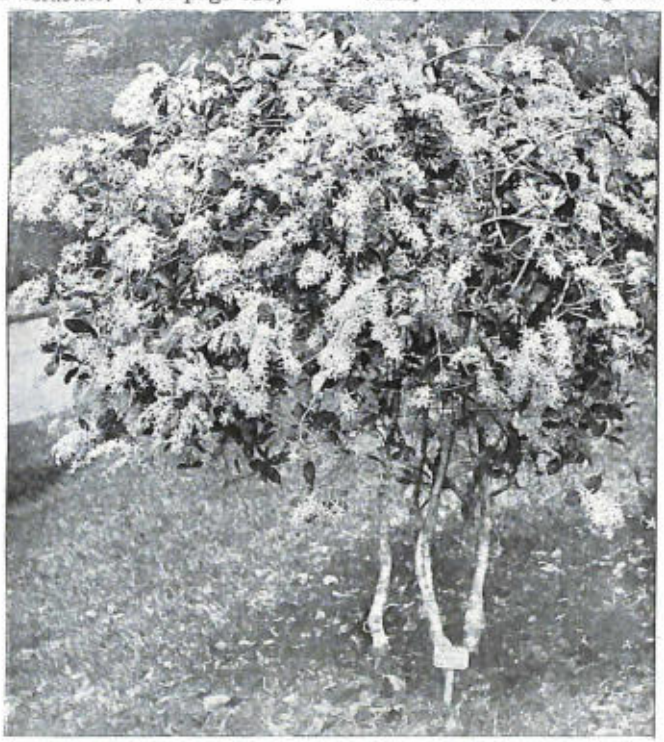
A.—trilobata. W. Indies. Leaves 3-lobed. (C).

Asparagus plumosus. *Liliaceae.* S.Africa. "Asparagus Fern." Handsome fern-like foliage. (S or Tu).

A.—Sprengeri. Natal. Needle-like flat "leaves" (cladodes), about 1 in. long, 3-4 in each whorl. (S).

Bauhinia diphylla. *Leguminosae.* Malaya. L. small, 2-lobed ; a straggling, climbing shrub. (C).

Bignonia argyreo-violascens. Hort. *Bignoniaceae.* L. prettily marked with white veins, violet in a young state. (Su).



Petrea volubilis trained as a bush.
One of the most beautiful plants of the tropics. See page 126.

Buddleia madagascariensis. *Loganiaceae.* Madagascar. L. silky-white beneath. (C.)
Cardiospermum Corindum. *Sapindaceae.* Ceylon. Annual with delicate bi-ternate (*i.e* twice trifoliate) leaves and small white fl's, in clusters.
Cissus (Vitis) discolor. *Ampelideae.* Java. Young leaves beautifully tinted, violet and purple. Requires shade. (C).
Dioscorea argyrea. *Dioscoraceae.* Colombia. Large variegated leaves. (Tu.)



Raphistemma pulchella.

D.— multicolor. Similar to preceding species.
Echites rubro-venosa. *Apocynaceae.* Brazil. L. with pink veins. (C).
Geitonoplesium cymosum. *Liliaceae.* Queensland. Leaves strap-shaped, distichous; fl's in small white clusters. (S or Su).
Ipomoea sinuata. *Convolvulaceae.* Trop. America. L. deeply cut. (S or C).
Marcgravia paradoxa. See *Creepers*, p. 131.



Solanum Wendlandii. GIANT POTATO-CREEPER.



Quisqualis indica.
"RANGOON CREEPER."



Thunbergia grandiflora.
FLOWERS PALE BLUE OR MAUVE.

Mimosa argentea. *Leguminosae.* Small pinnate leaves. Silvery white midrib. (C or S).

Muehlenbeckia (Cocoloba) platyclada. See *Orn. Fol. Shrubs,* p. 121.

Nepenthes distillatoria. Pitcher Plant. *Nepenthaceae.* Ceylon. Leaf-tips formed into "pitchers." Moist shady situation.(C or Su). See p. 141.

Passiflora laurifolia. *Passifloraceae.* Trop. America. Leaves lanceolate excellent plant for forming screens. (C). See pp. 78, 126.

P—trifasciata. Brazil. L. variegated, purplish beneath, trilobed. (C).

Paullinia thalictrifolia. *Sapindaceae.* Brazil. A small plant with fine fern-like foliage. (C).

Pothos. See *Creepers,* p.131.

Smilax argyraea. *Liliaceae.* Bolivia Leaves large, oval, spotted white; prickly stems. (Su or S).

S—officinale. Colombia. Large, shiny, ovate leaves; (Su). See p. 375.

Vitis incisa. *Ampelideae.* Texas. Leaves much cut. (C).

V.—voinerriana. Tonkin. Large, thick, trifoliate, hairy leaves. (C.)



Strophanthus hispidus.



Ficus repens. IVY-LIKE CREEPER.

(5).—ORNAMENTAL CREEPERS.

SUITABLE FOR TREE-TRUNKS, WALLS, ETC.

Epipremnum mirabile. Tonga-creeper. *Aroideae.* Malaya, Fiji, etc. Large epiphytic creeper, with very large pinnatifid handsome leaves. (C).

Ficus pumila. *Urticaceae.* China and Japan. Small-leaved, ivy-like creeper. (C).

F.—repens, = F.—stipulata. China and Japan. Similar to preceding species. S

Impatiens repens. "Gal-demata," *S. Geraniaceae.* Ceylon. Whole plant purplish crimson; fl's bright yellow. Excellent for rockeries. (C).

Marcgravia paradoxa. *Rubiaceae.* Large, handsome, 2-ranked l.; stems adhere to walls, &c., like ivy. (C).

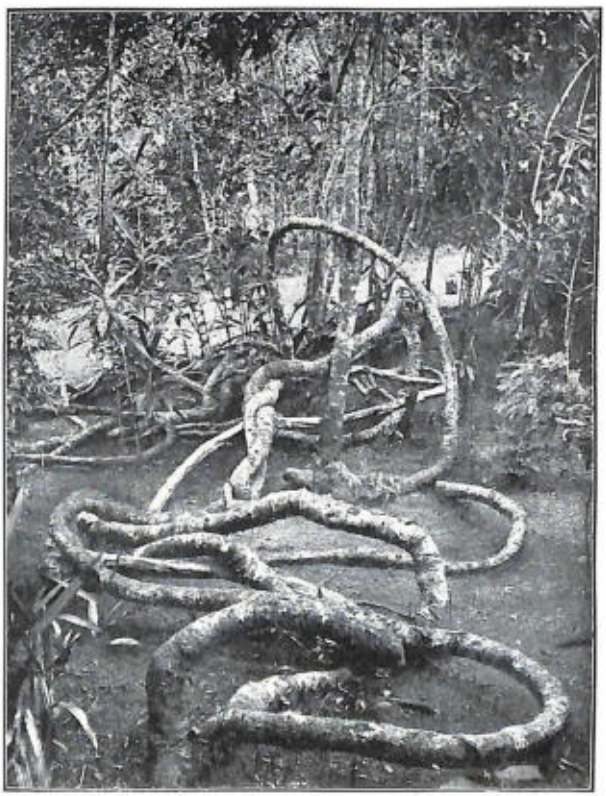
Monstera deliciosa. *Aroideae.* Mexico. A noble vigorous creeper; huge leathery, perforated and pinnatifid leaves. (C). See page 266. S.

Philodendron andreanum. Hort. *Aroideae.* Very large, handsome, satiny leaves. (C). See p. 149.

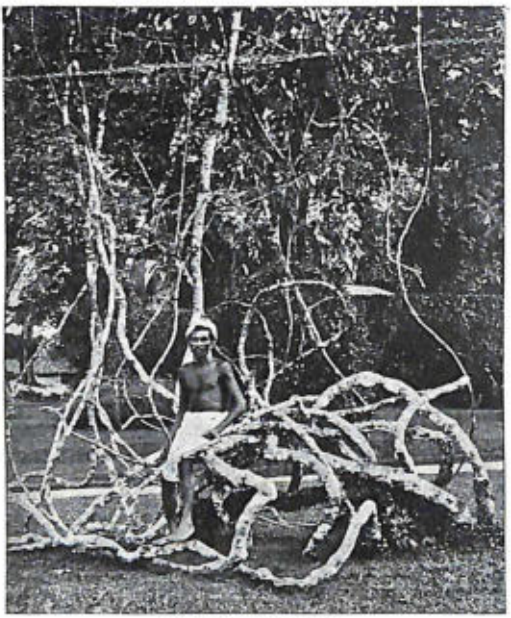
P.—erubescens. Venezuela. Leaves coppery beneath. (C).

P.—squamiferum. Leaves and petioles with glandular pinkish hairs. (C).

I



Anodendron paniculatum.



Salacia reticulata.

Pothos argenteus. *Aroideae.* Borneo. Leaves ovate, silvery-grey. (C).

P.—aureus. "Colombo Agent." Solomon Islands. Enormous epiphytic creeper. L. large, oval, blotched with yellow. Thrives in moist shade. (C).

Rhahpidophora decursiva. Dadakehel, *S. Aroideae.* Ceylon, India, Java. Large handsome creeper, on stems of large trees, in moist shady locality. Very large, almost pinnate, dark-green leaves. (C). See View in Fernery. Peradeniya Gardens, page 159.

R.—pertusa. Malaya, etc. L. perforated, smaller than in preceding species. (C).

Scindapsus argyraea. *Aroideae.* Philippines. L. coriaceous, with grey spots.

(6.)—LIANES OR GIANT CLIMBERS.

A feature of tropical vegetation is the prevalence of enormous climbers or creepers, commonly known as lianas or lianes. Though not suited to a garden of ordinary size, many are very remarkable on account of their immense woody stems, which wind snake-like round trees to a great length, or spread in contorted masses over the ground until they find a support. Most climbers twine in a definite direction, either from left to right, or *vice versa*; very few twine in both directions alternately. Among the more striking lianes are:

Anamirta paniculata (=*Cocculus indicus*). "Titta-wel," *S.* (*Menispermaceae*). Large woody twiner, furrowed bark, seeds bitter and poisonous.

Anodendron paniculatum. "Dul" or "Aswel," *S.* (*Apocynaceae*). A very large twiner; bears pods 4-6 inches long, black when ripe, containing small flat seeds, each attached to a long, white, silky coma. §

Bauhinia anguina. Snake-climber. (*Leguminosae*). A remarkable wide-spreading climber, with flattened serpentine stems, strongly curved in alternate directions between the nodes; climbing by hooked tendrils. Leaves binate.

B.—Vahlii. "Maloo" of India. A huge climber, with very large, tough, roundish leaves, each up to 12 in. or more in diameter, sometimes used for plates.

Caesalpinia Nuga. "Diya-wawuletiya," *S.* (*Leguminosae*). A large woody climber with yellowish grey bark; fl's yellow.

Celastrus paniculatus. "Duhudu," *S.* (*Celastraceae*). Bright yellow fruits. See p. 378.

Calamus.—See *Rattans*, page 433.

Cocculus macrocarpus. Large woody climber, with large, oval leaves. See p. 461.

Derris scandens. Kala-wel, *S*; Tekil, *T.* (*Leguminosae*). A strong woody climber with smooth bark. Fl's pure white in large masses; ornamental.

Distictis lactiflora. (*Bignoniaceae*). A large woody climber of South America.

Entada scandens. Elephant-creeper; "Pus-wel" *S.* (*Leguminosae*). An immense woody cl., often with stems twisted like a corkscrew; bears large flat pods, 3½-4½ feet long and 3-4 in. broad, containing very large, hard, brown, flat seeds.

E.—polystachya. Trop. America. Enormous climber; small pinnate leaves.

Salacia reticulata. Himbutu-wel, *S.* (*Celastraceae*). Large, woody climber. Pulp of fruit edible. Decoction of root given in diabetes. §

Securidaca volubilis. *Polygalaceae.* A wide spreading climber of Trop. S. America. Fl's small, bright purple, in large panicles.
Toddalia aculeata. "Kudu-miris," *S*; "Kandai," *T.* (*Rutaceae*). A woody climber with closely packed, large round prickles.
Willughbeia zeylanica. "Kiri-wel," *S.* (*Apocynaceae*). A large woody creeper, climbing by means of long whip-like leafless shoots. Bears handsome bright pink, large, round, smooth fruit. Stems milky, yielding sticky gum used for smearing on bamboos to catch paddy insect-pests. See p. 478.

(7).—SHOWY ANNUALS AND PERENNIALS.

Suitable for Flower-beds and Borders at Low and Medium elevations.
Ann=annual; P=perennial; Hp=herbaceous perennial; Sh=shrub.
Achimenes, different varieties. See *Bulbous or Tuberous Plants*, page 136.
Ageratum, several varieties. Ann. 1—1½. Fl's blue. (C or S).
Alternanthera, green and bronze var's. *Amarantaceae.* Hp. ½—1. Useful for edging and pattern work. (C).



Gynandropsis speciosa.
(See page 134).



Turnera ulmifolia.
(See page 135).

Amarantus tricolor. Several var's. Ann. 2—4. Terminal crown of showy coloured leaves, crimson, yellow, &c. (S).
Ananas sativus variegata. Variegated Pineapple. P. 1½—2. Variegated leaves. (Su).
Angelonia salicariaefolia. *Scrophulariaceae.* Hp. 2. Fl's bluish-purple, scented. (C).
A.—salicariaefolia alba. 2. Fl's white, scented; stands drought well. (C). See p. 134. S.
Arundo Donax variegatus. P. 6—8. Handsome variegated grass; is most effective when grown in light sandy soil, without manure and shade. (Div).
Aster, China. Numerous var's. Ann. ½—1. Shades of pink, purple, white, etc. (S).
A.—eminens. Hp. 1½—2. Fl's pale blue or mauve. (Div.)
Balsam, numerous var's. Ann. ½—1. Different shades, very showy. (S).
Bartonia aurea. *Loasaceae.* Ann. 1½. Handsome yellow fl's. (S).
Begonia semperflorens. 1—1½ Showy, pale pink, &c. "Fairy Queen" (with coppery, shining leaves), several other fibrous-rooted or bedding var's. (C or S).

B.—Bismarckii. 2—4. Bright vermillion, free-flowering. (C).
Browallia grandiflora. *Scrophulariaceae.* Ann. ½—1. Fl's dark blue. (S).
Caladium Humboldtii. Hp. ½—1. Small leaves, variegated white and green; excellent for edging, designs, etc. Numerous other species and var's. (Tu). See page 136.
Calendula officinalis. *Compositae.* Ann. 1—1½. Fl's orange-yellow. (S).
Candytuft (*Iberis*). "White spiral." *Cruciferae.* Ann. 1. Fl's pure white, in large heads; also purple and other var's. (S).
Canna, numerous var's. Hp. (Tu and Div). 2—4. Various shades, orange, yellow, crimson and pink. Some var's with purple or bronze foliage. (Tu or Div). See *Bulbous and Tuberous Plants*, page 137.
Celosia cristata. "Cock's Comb." *Amarantaceae.* Ann. ½—1. Fl's in large heads, crimson, scarlet, etc. (S). C. plumosa.—Fl's in plumes, not crested.
Chrysanthemum, Chinese. Sevanthi-poo, *T*; Kapuru-mal, *S.* Hp. 1—2. Fl's double, white, brown, yellow, &c., annual and perennial; numerous var's, 1½—3. Various colours. (S or C).
Cleome heptaphylla. *Capparideae.* Ann. 3-4; L. digitate, 7 leaflets. Fl's white. (S).
Coleus, numerous garden var's. *Labiateae.* P. Leaves beautifully marked and coloured. (C).
C.—rehneltianus. Hp. ½—1. Leaves small, cordate, dark-brown edged with green. Fl's purplish blue. (C or S).
C.—thyrsoidea. Bright blue fl's; small leaves.
Coreopsis grandiflora. *Compositae.* Ann. 1. Fl's yellow with brown centre. (S).
C.—tinctoria. Ann. 1. Fl's crimson, etc. (S).
Cosmos bipinnatus. *Compositae.* Ann. 2-3. Fl's pink or white; l. finely cut; very effective. (S)
C.—sulphureus. Ann. 2—3. Fl's orange-yellow. (S).



1, *Pentas carnea*; 2, *Angelonia salicariaefolia alba.*

Dahlia, "Cactus," "Double" and "Single" var's. Hp. 2—4. Purple, scarlet, yellow, etc. (Tu). See *Bulbous and Tuberous Plants*, page 191.
Dianthus chinensis. Indian Pink. *Caryophyllaceae.* Single and double var's. Ann. 1. Fl's fringed, white, pink, scarlet, &c., very showy. (S).
Euphorbia pulcherrima. Poinsettia. Sh. 5—8. Large, brilliant scarlet fl's (bracts). Suitable for grouping. Cut back after flowering. (C).
Exacum macranthum. *Gentianaceae.* Bindara, *S.* Ann. 1-1½. Large, beautiful purplish-blue fl's. (S). See pages 141, 198. S
Gerbera Jamesoni. Barberton Daisy; several var's. *Compositae.* Transvaal. P. 1. Large star-like fl's., different colours, very showy. Fl's partly close at night. Plants prefer rich humous soil and sunny place. (S or Div).
Gomphrena globosa. Globe Amaranth; Bachelor's Button. *Amarantaceae.* Ann., 1 ft. Free flowering; fl's purple, in round heads. (S).
Gynandropsis speciosa. *Capparideae.* Mexico. Ann. 2—3. Handsome pink fl's. (S). S
G.—speciosa var. alba. A variety with white flowers.
Helianthus annuus. Sunflower several var's. *Compositae.* Ann. 5—6. Very large yellow fl's, up to 10 or 12 in. across, dark-brown centre. "Dwarf" single sorts, 3-4, more ornamental, also useful for cut-flowers. (S).
Hibiscus Trionium var. Annual prickly shrub, with large fl's, bright crimson and other shades. (S). H.—africana. Ann. 3—5. Yellow.

Hippeastrum. Several var's. P. 1—1½. Fl's large, scarlet, white, etc. Very showy. (Bulbs). See page 138.
Hollyhock (Althea rosea). *Malvaceae.* Aun. 4—5; rose, crimson, white, &c.; very showy. "Single" var's best suited to tropics, thriving at all elevations. (S or C).
Honckenya ficifolia. Trop. Africa. Ann. Shb. 3—5. L. bronze; fl's coppery red (S or C). See *Fibre Plants*, page. 430.
Impatiens Sultani. Sultan's Flower. *Geraniaceae.* P. 1—1½. Showy scarlet or pink. (C or S).
Isotoma longiflora. Ann. 1½—2. Fl's pure white, long and tubular. See p. 386.
Marigold, African (Tagetes erecta). *Compositae.* Ann. 1½—2. Lemon yellow. (S).
M.—French. (Tagetes patula). Ann. 1—1½. Orange crimson, etc. (S).
Nasturtium. See *Tropaeolum.*
Nicotiana, numerous var's. Ann. 2—3. White, pink, etc. Very showy. (S).
Pentas carnea. Several var's. *Rubiaceae.* 2—3. White, pink, mauve, &c. (C). §
Petunia, numerous var's. *Solanaceae.* Ann. or P. 1½—2. Large, showy, white, purple, or pink fl's. "Single" var's best for beds, &c. See pp. 200, 204. (S or C).
Phlox Drummondii. Several var's. *Polemoniaceae.* Ann. 1. Beautiful free-flowering plants; different colours, and forms, as "Star," "Fringed," &c. (S).
P.—suffruticosa. Perennial Phlox. P. 1½—2. Different var's and shades. (Div).
Phrynium (Maranta) variegatum. *Scitamineae.* Variegated Arrowroot. P. 2. Handsome, variegated, large leaves. (Tu or Div).
Pimpinella monoica. "Lady's Lace." See page 201.
Plumbago capensis. *Plumbaginaceae.* Shb. 3-5. Fl's beautiful delicate blue. (C).
Poinsettia. See *Euphorbia pulcherrima.*
Portulaca, several, var's. *Portulaceae.* Ann. ¼. Brilliant shades of pink, yellow, &c. (S).
Rivina humilis. *Phytolaccaceae.* Ann. or P. Shb. 3. Bears racemes of small bright red berries. (S).
Ruellia acutangula. *Acanthaceae.* P. 1—2. Bright rose-pink. (S or C).
R.—formosa. P. 2. Fl's large, bright pink. (S).
R.—macrantha. P. 2. Large fl's, rose-pink.
R.—tuberosa. P. (S or C). 1½. Fl's purplish blue. (S or C).
Salvia farinacea. *Labiatae.* P. 1½. Fl's lavender blue. (C or S).
S.—splendens, var. "Scarlet Queen." P. or Sh, 2—3. Fl's bright scarlet. Several other species and var's; various shades. (S or C). See also p. 116.
Sedum sexangulare. *Crassulaceae.* Stonecrop. P. ¼. Fl's yellow; suitable for edging or rockery. (C).
Sinningia speciosa. Wild Gloxinia. *Gesneraceae.* Hp. 2—3 ft. (Tu or Div). Fl's large, mauve, or bluish-purple, bell-shaped. Likes shade and rich soil. See pp. 138, 139.
Siphocampylus Humboldtii. *Campanulaceae.* P. 1. Fl's scarlet. (C).
Telanthera sp. P. 1-2. Dark-purple velvety leaves, green when dried. (C).
Torenia Bailloni. *Scrophulariaceae.* Ann. ½. Fl's yellow. (S).
T.—Fournieri. Ann. ½. Fl's violet and pale blue; very pretty in a mass. (S). § Also a creamy-white fl'd variety.
Tropaeolum, dwarf and climbing var's. *Gesneraceae.* Ann. Fl's orange and yellow; very showy. Prefers sunny situation. (S or C).
Turnera elegans. *Turneraceae.* P. 1½—2. Fl's creamy white with dark centre, closing at noon; free bloomer. (C or S).
T.—ulmifolia. W. Indies, 2—3. Fl's large, yellow. Naturalised in Ceylon; common near sea-coast. (S or C). See p. 208. §



Torenia Fournieri.

Uroskinnera spectabilis. Sh. 3—4. Fl's mauve, in bunches, very showy. (C): S
Verbena bonariensis. Vervain. *Verbenaceae.* 1—1½. Bright purple; leaves much cut. Naturalised at Hakgala, Ceylon. Different garden var's, scarlet, mauve, white, etc. Very showy. (C or S).
Vinca rosea alba. P. Madagascar Periwinkle. *Apocynaceae.* Pure white. (S or C).
V.—oculata rubra. P. 2. White with pink centre. (S or C).
V.—rosea. Rose-pink. 2. (S). Naturalised along sea coast in Ceylon.
Zinnia linearis. *Compositae.* Ann. 1. Orange-yellow. (S). Mexico.
Z.—"Fireball" and other var's. Ann. 1½—2. Free-flowering, scarlet, pink, mauve, and yellow shades. (S).

(8)—SELECTED BULBOUS OR TUBEROUS PLANTS.

SUITABLE FOR POTS OR BORDERS, UP TO ABOUT 4,000 FT.

SEE ALSO SELECTION FOR UP-COUNTRY, PAGE 192.

(Propagated by bulbs, tubers, or division, and in some cases also by seed)

Achimenes grandiflora. Several other species or var's. *Gesneraceae.* Mexico. Small tuberous, showy flowering plants, suitable for pots or borders, ½-1ft. Mauve, white, purple, and pale-blue shades.
Alocasia. See *Foliage Pot Plants*, page 148.
Amaryllis, "Mrs. Garfield." *Amaryllideae.* 1½—2. Fl's large, white, with numerous pink lines; very handsome. White band along centre of leaf. See *Hippeastrum.*
A.—reticulatum. Brazil. Scarlet. ½—1. L. with pale band in centre.
Amorphophallus campanulatus. Kidaran, *S.* (*Aroideae*). S. India and Ceylon. Fl's very large, purplish brown, about 1—1½ ft., foetid. Tuber, large, warted.
A.—Titanum. Sumatra. Flower 5 ft. high by 3 ft. across, dark purple, strongly foetid. L. 10 ft. high.
Arisaema speciosa. "Wal-kidaran," *S.* (*Aroideae*). S. India and Ceylon. Greenish purple, 2. Leaflets 5—7 palmate.
Belamcanda (Pardanthus) chinensis. Leopard Lily. *Irideae.* China. Orange, spotted brown. 1½.



Hippeastrum var. GARFIELD LILY. (See also Amaryllis).

Caladium. (*Aroideae*). A family of small tuberous plants with large, ornamental, hastate-peltate leaves, mostly of S. American origin, including many beautiful hybrids or varieties. They require rich soil, well decomposed manure, and abundance of moisture, and thrive best in moderate shade, though many of the hardier varieties are also adapted for growing in open borders or beds. They are propagated by suckers or by division of the roots or tubers (corms). The leaves die down once a year, in the dry season, after which the tubers should be kept in a fairly dry state. They may be left undisturbed in the ground, or taken up and stored in earth or sand in a shed, until the next season for planting. The following are some of the best varieties:
Caladium argyrites. (=C. Humboldtii). Small green and white variegated leaves, compact; suitable for edgings, ribbon borders, etc; leaves excellent for bouquets.



Hyline gardneriana.
IN MAIN-DRIVE, PERADENIYA GARDENS.

Caladium bicolor. Leaves bright pink, with green border, 1 ft., showy and distinct. Suitable for edges and borders.

C.—"Baron Rothschild." Dark crimson, spotted with rich pink, large leaves.

C.—"Candidum." White, with bright green veins; excellent for borders and grouping.

C.—"Ashstead Beauty." Dark-rose, flecked pink and white, large leaves.

C.—"Duchess of Fife." White, netted with green and carmine.

C.—"His Majesty." Creamy white, with green markings.

C.—"Pintado." Pinkish red, with green margin.

C.—"Ladas." Crimson with scarlet shading; small variety.

C.—"Peach Blossom." Transparent pearly white, blotched with pink and green.

C.—"Mrs. L. R. Russel." Bright carmine-red, margined green and pink.

C.—"R. Hoffman." Rose-pink passing to white, bordered with green.

C.—"Silver Fleece." Almost pure white.

C.—"Thomas Tomlinson." Dark-red with pure white border, distinct.

Callipsyche aurantiaca. *Amaryllideae.* S. America. Orange. 2.

C.—eucrosioides. Mexico. Scarlet, 2½.

Canna. (*Scitamineae*). A most showy class of flowering plants, with large handsome, green, dark-purple, or bronze leaves, readily propagated by tubers (rhizomes), easily cultivated, and rapidly yielding a bright display of flowers. Deep cultivation, liberal manuring, abundant moisture, and replanting once in six months are essential to success. Planting may be done at almost any season, double shoots being placed about 18 or 20 in. apart. No shade is required, unless that of a temporary nature at time of planting if the weather is hot and dry. There are numerous varieties, obtained by hybridising, crossing and re-crossing, and these come under two more or less distinct forms or classes, viz: *Orchid-flowered* Cannas, in which the flower segments are large and broad but rather flaccid; and *Gladiolus-flowered*, with the segments smaller but firmer, and the flower heads larger than in the former. The latter are generally more floriferous and lasting. Both these include varieties with green, bronze or purple leaves. The following are limited selections of both classes:

Orchid-flowered Cannas: "Austria," lemon yellow: "Italia," yellow ground, crimson centre; "Britannia," orange-yellow; "Kronos," orange and yellow; "H. Wendland," scarlet edged with yellow; "Roma," orange and yellow; "Phoebe," yellow ground, orange centre.

Gladiolus-flowered: "Circe," salmon pink; "King George," cerise; "Bedouin," bright salmon; "Janus," yellow with numerous small brown spots; "Madame Crozy," scarlet, edged with yellow; "Windsor," deep crimson, large fl's and heads; "Hungaria," bright pink, free flowering, distinct; "California," bright orange, free flowering, distinct; "R. Wallis," bright canary-yellow; "Alpha," salmon-pink, faintly edged with yellow, large loose heads; "Vice Reine," bright salmon-pink; "Jeanne d'Arc," pale cream, faintly netted with pink; "Louis Jittman," orange salmon, broad segments; "Mont Blanc," pale

cream, turning almost pure white; "Uncle Sam," deep crimson, broad segments, large heads; "Eureka," large, deep orange.

Bronze or purple-leaved: "Africa," fl's orange-red; "Plato," fl's deep red, leaves dark purple; "Rhoea," fl's orange-red; "Nero," fl's large, bright orange-crimson, leaves large, dark bronze, broad-pointed and striated, very handsome; "La France," fl's scarlet with yellow throat; "Wyoming," similar to "Nero."

Chirita Moonii. *Gesneraceae.* Ceylon. Mauve-violet. 2. Very showy.

Crinum asiaticum. "Tolabo." *Amaryllideae.* Trop. Asia. White; scented. 2.

C.—augustum. Mauritius. Pink and white, 2-3. C.—defixum. India, White, 2.

C.—erubescens. Trop. America. White and purple. 2.

C.—Moorei. S. Africa. Pale rose. 1½. C.—Powelli. Pale pink; 3-4.

C.—speciosissimum. Pure white, 2-3. C.—zeylanicum. Ceylon. White; 2.

Dahlia, see p. 191. Very showy, especially "Cactus" type, with large, loose fl's,—scarlet, yellow, white, &c.

Dracontium (Godwinia) gigas. *Aroideae.* Nicaragua. Brownish-red. 3-4. L. 6-8; blade very large, deeply bipinnatifid; petiole stout, erect. A remarkable plant. §



Dracontium gigas.

1, leaf-stalk; 2, floral spathe; 3, single leaf, growing from tuber in pot.

Drimiopsis Kirkii. *Liliaceae.* Zanzibar. Pale greenish fl's. L. with brown spots.

Eucharis grandiflora. Eucharist Lily. *Amaryllidcae.* Colombia. Pure-white; 1-1½. E.—Sanderi. Colombia. White. 1.

Eurycles amboinensis. Malaya, etc. *Amaryllideae.* White. 1-2. L. almost round.

E.—Cunninghami. Australia. White, 1.

Gesnera cardinalis. *Gesneraceae.* Brazil. Scarlet, 1½ ft.

G.—Hookeri. Colombia. Scarlet, 1½-2.

G.—magnifica. Brazil. Purple, 1-1½.

Gloriosa rothschildiana. *Liliaceae.* Herbaceous, climber. Large, showy, crimson fl's.

G.—superba. Niyangala, *S.* Trop. Asia. Scarlet and yellow; beautiful, herbaceous twiner.

Gloxinia maculata. See *Sinningia speciosa*, page 135.

Godwinia, see *Dracontium.*

Griffinia hyacinthina. *Amaryllideae.* Very showy, large, bright amethyst-blue fl's; 2.

Haemanthus Lindeni. *Amaryllideae.* Congo. Rosy scarlet, 1½.

H.—multiflorus (=H. Kalbreyeri). Trop. Africa. Scarlet fl's. 1. § Numerous other species.

Hippeastrum (Amaryllis) equestre. *Amaryllideae.* Flowers large, bright red. Numerous hybrids and var's, various shades of red to almost pure white.

H.—"Mrs. Garfield." A distinct and exceptionally fine var. See *Amaryllis.*

Hyline gardneriana. *Amaryllideae.* Trop. America. Pure white; blossoms after dry weather. 1-1½. See illustration, p. 137.

Hymenocallis ovata. *Amaryllideae.* West Indies. 1. Long-pedicelled, pure white, delicate fl's, borne in cluster on a stout stalk.

H.—amoena, H.—tenuiflora, both of S. America; pure white. Several other species.

Isoloma (Tydaea) amabile. *Gesneraceae.* 1-2. Colombia. Dark-rose or crimson.

I.—hirsutum. W. Indies. Scarlet, orange-vermilion. 1—2.

Kaempferia roscoeana. *Scitamineae.* Ceylon, India, etc. Bright pink, showy; 1 ft.

K.—rotunda. Ceylon, India, and Malaya. Red and white; 1 ft.

K.—speciosa. S. America. Violet-purple, 1.



Haemanthus Kalbreyeri.

Lowia grandiflora *Scitamineae.* Malaya. White, 2.

L.—longiflora. Perak. White and purple; 2.

Marica borshiana. See p. 156.

Pancratium gloriosa. *Amaryllideae.* Trop. Amer. Pure white, 2.

P.—zeylanicum. "Wal-lunu," *S.* Ceylon. Delicate, pure white; ½-1.

Polianthes tuberosa. Tuberose. *Amaryllideae.* Mexico. Flowers very fragrant, creamy white. 2-3.

Sinningia (Gloxinia) speciosa. Wild Gloxinia. *Gesneraceae.* Brazil. 2-3. See page 135. S

Sprekelia formosissima. *Amaryllideae.* Guatemala. Perianth deep crimson, bent to one side (declinate). 1 ft.

Tacca laevis. *Taccaceae.* Trop. Asia and Africa. 1½ ft. Peculiar brownish purple flowers, with long thread-like projections from base of flower. S

Tulbaghia violacea. *Liliaceae.* S. Africa. Purplish-violet. 1 ft.

Tydaea. See Isoloma.

Zephyranthes Andersoni. *Amaryllideae.* Peru. Bright yellow, Crocus-like. ½-1.

Z.—carinata. "Rose Amaryllis." ½-1. Large, bright pink fl's, very showy. Mexico and W. Indies. See p. 140.

Z.—citrina. Trop. America. Bright yellow. ½-1.

Z.—tubispatha. West Indies. White. ½-1.

(9).—SELECTED ORNAMENTAL PLANTS INDIGENOUS TO CEYLON.

(L. c. = Low country; I.e. = Intermediate elevations; U.c. = Up-country; Sh. = shrub; Cr. = creeper; Cl. = climber; Ep = epiphyte; H. p. = herbaceous perennial; T. = tree).

Abutilon asiaticum. "Anoda." *Malvaceae.* (L.c.). Sh., 2—4; fl's yellow.

Acanthus ilicifolius. *Acanthaceae.* Swamps near sea shore. Sh, 2—4; fl's bright purple-blue; holly-like leaves.

Aeschynanthus zeylanica. *Gesneraceae.* (U. c.) Sh.-cr., 2—2½; fl's orange-yellow.

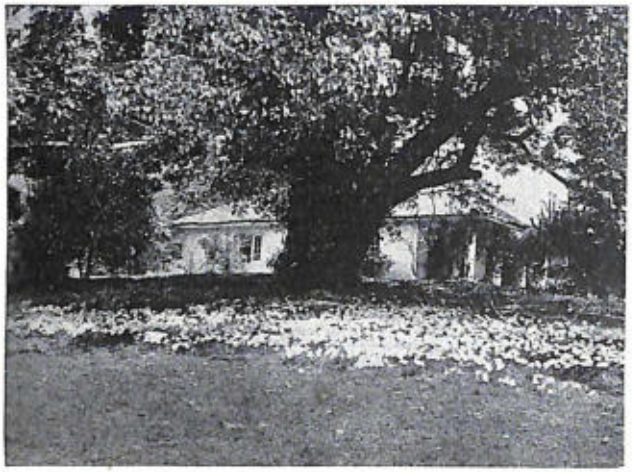
Alocasia macrorrhiza variegata. *Aroideae.* (L.c.) Hp. 4—5; very large, variegated, hastate leaves, large portions of which are pure white.



Sinningia (Gloxinia) speciosa.

Alpinia nutans, var. sericea. Rankiriya. *Scitamineae.* (L.c.). Hp. 5—6. Large leaves, 5-7; fl's pinkish white.

Alyxia zeylanica. *Apocynaceae.* (L. c.). Sh., 3—5; fl's pale yellow.



Zephyranthes carinata. ROSE AMARYLLIS.
(See page 139).

Amorphopallus campanulatus. "Kidaran." (L. c.). *Aroideae.* See p. 136.

Aneilema giganteum. *Commelinaceae.* (L. c.). Hp. 3; fl's pale blue.

Anoectochilus regalis. "Wanaraja." (Moist region; I. c.). *Orchideae.* Hp. Ground orchid; beautifully marked leaves. Moist shady jungle. See p. 147.

Ardisia missionis. *Myrsineae.* (L. c.) Sh., 6—8; fl's in clusters, pale pink.

Barleria involucrata. *Acanthaceae.* (U c.) Sh., 3—4, fl's brilliant purple-blue.

B.—mysorensis. "Katu-nelu," *S.* (Dry region). Sh, 3; fl's bright violet-blue.

B.—Prionitis. "Katu-karandu." (Dry region). Sh, 2-3; fl's pale orange-yellow.

Berberis aristata. *Berberideae.* (U. c.) Sh., 5—6; fl's bright yellow.

Burmannia disticha. "Ma-diya-jawala." *Burmanniaceae.* (L. c.) Hp. 1—1½, fl's bright yellow.

Calophanes Nagchana. *Acanthaceae.* (Dry region). Sh., 3; fl's pale blue.

Capparis zeylanica. *Capparideae.* (Dry region). Sh., 6—8. Beautiful pink and white fl's.

Cassia auriculata. Matara Tea; "Ranawara." (L. c.). *Leguminosae.* Sh., 4—6; fl's bright yellow.

C.—occidentalis. "Peni-tora." (U.c.). Sh., 3-4; fl's bright orange yellow.

Cardiospermum Corindum. See p. 129.

Chirita Moonii. *Gesneraceae.* (L. c.). Sh. 2—3; Large mauve-violet fl's; found on rocks. Very showy.

Chonemorpha macrophylla. "Bulu-walanguna," *S. Apocynaceae.* Large woody twiner, with large leaves. Fl's large, creamy-white, scented. S

Clematis smilacifolia. "Narawel." *Ranunculaceae.* (L. c.), Cl. Small, white fl's. Leaves ovate, 7-nerved.



Chonemorpha macrophylla.

Clerodendron serratum. "Ken-henda." (L.c.). *Verbenaceae.* Sh., 4-8; fl's bright blue. A handsome shrub; also indigenous to India, Malaya, &c.

Clitoria ternatea. "Nil-katarodu," (L. c.). Ann. cr., 8-10; fl's bright blue.

Coleus barbatus. "Wal-kapura-walliya. (L.c., rocky ground). 1½-2. Fl's rich purple, in whorls. C. inflatus. (U.c., moist jungle). 2-4. L. large, oval; fl's pinkish-violet, Aug.-Jan. Endemic.

Costus speciosus. "Tebu." (L. c.). Hp., 5-6; fl's white and yellow.

Crossandra undulaefolia. *Acanthaceae.* Dry region. (L. c.). Sh., 2; fl's bright salmon yellow, very showy.
Crotalaria Walkeri. *Leguminosae.* (U.c.). Sh., 4—6; fl's striated yellow.
Curculigo recurvata. "Waga-pol." *Amaryllideae.* (L.c.). H.p. 2-3; stemless plant with large palm-like leaves.
Cyanotis obtusa. *Commelinaceae.* (L.c.). H.p. 1; fl's violet-blue.
Cycas circinalis. "Madu." *Cycadeae.* (L. c.). T., 10—15; palm-like feathery leaves. S
Cynoglossum micranthum. *Boragineae.* (U.c.). Hp., 2—3; fl's deep blue.
Cyphostigma pulchellum. *Scitamineae.* (L.c.). Hp, ½—1; fl's bright pale pink.
Datura fastuosa. Attana. *Solanaceae.* (U.c.). Ann., 2—3; fl's large, white.
Daedalacanthus montanus. *Acanthaceae.* (I.c.). Sh., 2—3; fl's pale violet-blue.
Dianella ensifolia. *Liliaceae.* (I.c.). Hp. 3—5; fl's pale-blue, followed by pretty blue berries.
Didymocarpus zeylanicus. *Gesneraceae.* (U.c.). Hp. ½; white and purple.
Dopatrium lobelioides. *Scrophulariaceae.* Aquatic, 9—15; bright purplish blue.
Exacum macranthum. *Gentianaceae.* (U.c. open patanas). Annual, 1—2; fl's large, deep purplish blue. A beautiful plant. See pp. 134, 199.
Filicium decipiens. Pehimbiya. *Burseraceae.* (L.c.). T. Ornamental as small plant on account of the handsome fern-like leaves.
Gloriosa superba. "Niyangala." *Liliaceae.* (L. c.). H. cl. 4—6; large, handsome, orange and scarlet fl's.
Glossocarya scandens. *Verbenaceae.* (Dry region). (W. cl.). Fl's white; a beautiful climber or bush.
Gymnostachyum zeylanicum. *Acanthaceae.* (L.c.). Hp. ½. Leaves variegated with creamy white veins.
Hedyotis Lawsoniae. *Rubiaceae.* (U.c.). Sh., 5—7; fl's white.
Hibiscus angulosus. var. grandiflorus. *Malvaceae.* (U.c.). Hp., 5—6; fl's large, bright yellow with brown centre.
Humboldtia laurifolia. "Gal-karanda." *Leguminosae.* (L.c.). Sh. or T., 12—15; fl's pinkish white, slightly scented.
Hypericum mysorense. *Hypericaceae.* (U.c.). Sh., 5—8; fl's bright yellow.
Impatiens acaulis. *Geraniaceae.* (U.c). Hp., 1; fl's bright rosy pink.
I.—elongata. (U.c.) Hp. 2; whole plant tinged with red, fl's bright rose pink.
I.—flaccida. Kudalu-mal. (L.c). Ann., 2; fl's bright mauve and pink. Also a pure white variety.
I.—Hookeriana. (U.c.). Hp., 3—5; fl's large, white, streaked with red.
I.—leptopoda. (U.c.). Ann., 2—3; fl's pale pink, in season all the year.
I.—repens. Gal-demata. (L.c.). Cr.; fl's bright yellow; stems purplish crimson.
I.—Walkeri. (U.c.). H., 2—3; fl's pale scarlet, sometimes yellow.
Ipomoea Bona-nox. "Alanga." Moon-flower. *Convolvulaceae.* W. cl.; large white fl's, opening at dusk. See p. 125. I.—palmata. Woody cl. Leaves palmately cut; fl's dull violet-purple. I.—vitifolia, see p. 208.
Ixora coccinea. (L.c.). *Rubiaceae.* Sh., 4—6; fl's scarlet, very showy.
I.—jucunda. (L.c.). Sh., 10—12; fl's bright coral red.
Jussiaea suffruticosa. *Onagraceae.* (L.c.). Hp. 4—6; fl's yellow.
Justicia Betonica. "Sudu-puruk." *Acanthaceae.* (L.c.). Sh., 4; pale-violet.
Kendrickia Walkeri. *Melastomaceae.* (U.c.). Ep. sh. Fl's bright rose; very showy.
Klugia notoniana. "Dyanilla." *Gesneraceae.* (U.c.). Ann., 1; fl's deep blue.
Lawsonia alba. Tree Mignonette. *Lythraceae.* (Dry region). Sh., 5—6; fl's creamy white, scented. See *Dyes*, p. 438.
Leonotis nepetaefolia. Maha-yak-wanassa, *S*; Kasi-tumpai, *T. Labiatae*; (L.c.). Herb. sh., 4—5 ft., quadrangular stems. Orange-scarlet fl's. Handsome.
Limnophyllum racemosa. *Scrophulariaceae.* (L.c.). Aquatic, 6—10; pale violet and yellow fl's, 3—5 nerved.
Melastoma malabathricum. "Maha-bowitiya." (L.c.). Sh., 10—12; fl's violet mauve.
Memecylon umbellatum. "Kora-kaha." (L.c.). Sh., 7—8; fl's bright blue, in bunches all along the branches; very striking. See page 114.
Mundulea suberosa. "Wal-burutu." *Leguminosae.* (Dry region). Sh. or T., 10—15; fl's bright pinkish violet.
Nepenthes distillatoria. Pitcher Plant; "Wanderu-wel." *Nepenthaceae.* (L.c.) Cl., 5—8; elongation of leaf-tips formed into pitchers.
Ophiopogon intermedius. *Haemodoraceae.* (L.c.) Hp., 1; grass-like leaves; fl's dingy white or pale mauve. Moist shady places.

Osbeckia buxifolia. *Melastomaceae.* (U.c.). Sh., 4—6; fl's rich mauve.
O.—rubicunda. "Bowitiya." (U.c.). Sh., 4—6; fl's brilliant purplish crimson, with large yellow anthers. A beautiful shrub, always in flower; common on banks or in poor rocky soil.
Oxystelma esculentum. Kulappalai, *T. Asclepiadaceae.* (Dry region). H. cr. Semi-aquatic; fl's cup-shaped, veined with pink.
Pavetta indica. *Rubiaceae.* (U.c.). Sh., 4—6; fl's white, in bunches, profuse.
Phyllanthus myrtifolius. Ceylon Myrtle. *Euphorbiaceae.* (L.c.). Sh., 4—6; small myrtle-like leaves; fl's very small, dark purplish red.
Plumbago zeylanica. "Ela-nitul." *Plumbagineae.* (L.c.). Sh., 2—3; fl's white.
Rhaphidophora decursiva. "Dada-kehel." *Aroideae.* (L.c.). Cr., 40—50; very large, deeply cut leaves. On large trees in moist shade, up to 5,000 ft.
Rhododendron arboreum. "Ma-ratmal," *S. Ericaceae.* (U.c.). T., 10—15 or more. Large showy fl's; in season May-August. See pp. 177, 185, &c.
Rivea ornata. "Muchuddai," *T. Convolvulaceae.* (Dry region). Cl. on rocks. Fl's Dec-Mar., pure white to yellow, sweet-scented.
Sansevieria zeylanica. "Niyanda." *Haemodoraceae.* (L.c. and dry region). Hp., 3-4 or more; sword-shaped variegated succulent leaves. See p. 418, 431, 432.S
Sonerilla Gardneri. *Melastomaceae.* Endemic (U.c.). Hp. 1—1½ ft. Leaves 5—7 nerved; fl's large, pink; rare.
S.—hirsutala. (U.c.). 2 ft. or more; free flowering; fl's large, pale pink or almost white. Endemic.
Sophora tomentosa. "Mudu-murunga." *Leguminosae.* (L.c.). Sh., 8—10; foliage grey tomentose. S.—violacea. (L.c.). Sh., 3—4; fl's violet.



Odontadenia speciosa.
(See page 125.)

Stachytarpheta mutabilis. "Balunakuta." *Verbenaceae.* Hp., 3—4; fl's pink, on a long, scaly stalk, only a few opening at once, proceeding from base to apex.
Strobilanthes helicoides. *Acanthaceae.* (U.c.). 3—5; fl's violet with white tube; very showy.
S.—asperrimus. (U.c.). Sh. Fl's pale purple, tinged with pink. Resembles Hop.
S.—Hookeri. (U.c.) Sh., 2-4; fl's pure white, with purple veins.
S.—pulcherrimus. (U.c.). Sh., 3—6; fl's bright pink and violet. A beautiful plant.
Tephrosia maxima. *Leguminosae.* (Dry region). Hp. 1—2. fl's bright pale-pink.
Thespesia macrophylla (=T. Lampas). *Malvaceae.* (Dry region). Sh., 6—8; fl's bright yellow, with a dark crimson centre. "Apparently very rare" (Trimen).
Torenia asiatica. "Kotala-wel." *Scrophulariaceae.* (U.c.). Cr. Fl's dark purple, tube pale yellow.
Vacciniu m Leschenaultii. "Boralu." *Vacciniaceae.* (U.c.). Sh. or T. 8—12; fl's bright pink; season Feb., Mar., and Sept.

Woodfordia floribunda. "Malitta." *Lythraceae.* (L.). Sh., 6—8; fl's orange red.
Wrightia zeylanica. "Sudu-idda." *Apocynaceae.* (L.c.). Sh., 3—6; fl's waxy, pure white.

CHAPTER XIII.

ORCHIDS, POT-PLANTS, AND FERNS

SUITED TO LOW & MEDIUM ELEVATIONS

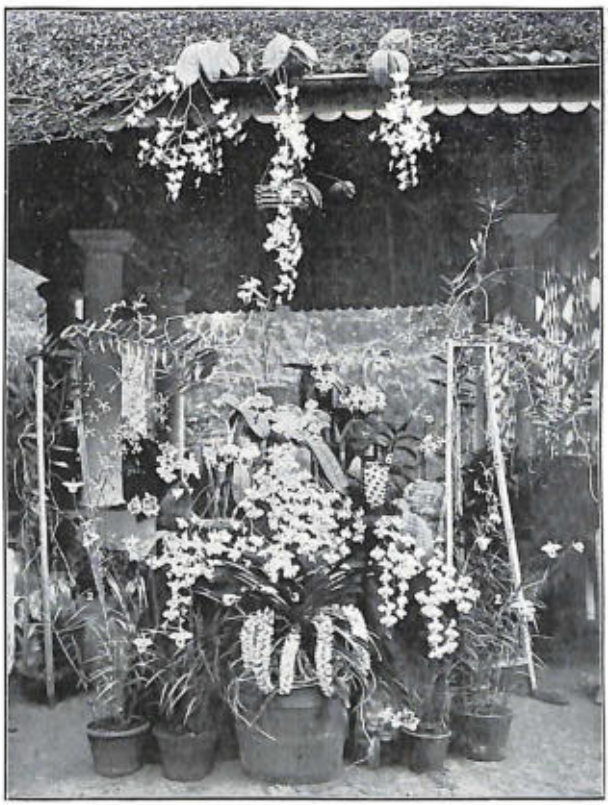
(1)—*ORCHIDS.* (2)—*SELECTED CEYLON ORCHIDS.*

(3)—*FOLIAGE POT-PLANTS.* (4)—*FLOWERING POT-PLANTS.*

(5)—*FERNS FOR POTS, FERNERIES, ETC.*

Orchids may be divided into two main classes, (1) *terrestrial* or ground orchids, and (2) *epiphytes*,—that is, plants which are found growing naturally upon trees but not deriving nourishment from their host, *i.e.* not parasitic. The great majority of tropical orchids belong to the latter class, while most of the temperate forms are terrestrial. *Saprophytic* orchids, which live on dead matter, are rare.

In order to grow orchids successfully, a knowledge of the conditions of the climate, etc., under which they grow in their natural state is helpful, if not indispensable. Those belonging to a dry region often fail when removed to a wet climate, and *vice*



COLLECTION OF ORCHIDS IN FLOWER.

1 and 5, *Phalaenopsis schilleriana*; 2, *Cattleya sanderiana*; 3, *Rhyncostylis retusa*; 4, *Renanthera* (*Arachnanthe*) *Maingayi*; 6, *Dendrobium thyrsiflorum*.

versa; thus Cattleyas and other South American species, which are accustomed to a long dry period, soon deteriorate in the moist climate of the south west part of Ceylon, especially if not protected during long rainy seasons. Nevertheless, orchids, like other plants, are often adaptable to altered conditions. Epiphytic species generally thrive better on trees than in pots, but the former conditions cannot always be provided, and for various reasons pot-culture is usually the most convenient to adopt. Many orchids thrive best when fully exposed to the sun, provided sufficient moisture is available at the roots ; others, however, grow and flower best under light shade.

Potting Orchids.—Special kinds of pots with several drainage holes and perforated sides are made for growing orchids in. When these are not procurable, very useful substitutes may be found in well-seasoned joints of large bamboos, these being cut so as to leave one of the divisions intact, the section being then perforated at the bottom and sides. Another useful type of bamboo pot for orchids is afforded by a longitudinal section of the joint, with one side cut away slantingly ; thin copper wire is strung through the margins to hold the plant and potting material in position, a layer of coir fibre or beaten coconut husk being placed between the material and the wires. For epiphytes, a potting mixture consisting of old bark, broken crocks or pieces of porous brick and some sphagnum moss (*Sphagnum zeylanicum*) is essential. Peat and sphagnum in equal proportions form a safe compost for nearly all orchids, but the former is not procurable in Ceylon and the latter is difficult to obtain, being only found in a limited area on Horton Plains. Bracken or other fern roots are a useful component in orchid mixtures, and are generally easily obtained. Coir fibre, which should be well-leached, is a very serviceable material much employed at Peradeniya for growing orchids of all kinds, and is indispensable for fixing them on boards, stems of trees, etc. For terrestrial or ground orchids, a compost of loam, well-decomposed cow manure, bones, broken pieces of old bark and knobs of charcoal is recommended.



Coelogyne asperata.

Propagation of Orchids.—Orchids are usually propagated or increased by means of cuttings or divisions of the root-stock or pseudo-bulbs, being seldom raised from seed except by expert growers. They are characterised by the presence of a microscopic fungus (*mycorhiza*) mycelium growing on their young roots and taking the place of root hairs (absent in orchids), whose function it performs by supplying the plant with moisture and food materials through the medium of its hyphae. When orchids are propagated vegetatively, they generally carry with them sufficient of the fungus for their need, but in raising them from seed it is necessary that the germinating medium be infected with the appropriate fungus. It has been found that in the absence of the latter, orchid seeds seldom germinate, or that, if they do, the seedlings will not thrive. Therefore the seed should be sown on soil obtained from or permeated with that in which the parent plant grows. In scientific horticulture, pure cultures of these fungi are now made, and when orchid seeds are brought into contact with them in germination, their "forcing" effect is remarkable.

The following are among the most showy orchids cultivated at the Royal Botanic Gardens, Peradeniya (elevation 1,540 ft., rainfall about 80 inches). Many others are found growing naturally on trees here, more particularly on old, rough-barked trees with forked branches, such as Mango, Jak, Sapu, &c. Smooth-barked or dense-foliaged trees are usually unsuitable for orchids of any kind.

[Ep. = epiphyte; Terr. = terrestrial].

Aerides odoratum. India and China. (Ep). Fl's scented, white, blotched magenta.
Angraecum sesquipedale. Madagascar. (Ep.). Fl's very large, ivory-white, long-spurred.
A.—modestum, = A.— sanderianum. Long sprays of pure white fl's.
Cattleya bowringiana. Cent. America. (Ep.). Fl's bluish-purple and magenta.
C.—citrina. Mexico. Citron-yellow.
C.—eldorado. Cent. America. White, purple, and orange shades.
C.—gaskelliana. Venezuela. (Ep.). Fl's scented, white and amethyst purple.
C.—gigas. Colombia. (Ep.). Fl's very large, rose, crimson, purple, and yellow.
C.—labiata. Brazil. (Ep.). Crimson, lilac, &c.
C.—Mossiae. Venezuela. (Ep.). Fl's large, crimson and rose.
C.—Skinneri. Guatemala. (Ep.). Fl's rose-purple.
C.—Trianae. Colombia. (Ep.). Fl's purple-crimson, very showy.
Chysis bractescens. Peru. (Ep.). Fl's large, creamy-white; stout fleshy stems.
Coelogyne asperata. Borneo. (Terr.). Fl's in long drooping racemes, creamy-white, streaked brown, strongly scented. Long pseudo-bulbs, 6-7 in. L. 1½-2ft.
C.—dayana. Borneo. (Terr.) Long pseudo-bulbs, 4—6 in. L. 2—2½ ft. Fl's creamy yellow.
Cymbidium Lowianum. Burma. (Ep.). Fl's large, yellowish green with a crimson blotch.
Dendrobium brymerianum. (Ep.). Lip developed into long fringe.
D.—Calceolaria. Very large robust species. Fl's large, pale yellow, throat brownish crimson.
D.—dalhousieanum. Burma. Stems 3—5 ft. Fl's large, tawny-yellow and rose.
D.—densiflorum. India. Fl's pendulous, amber-yellow and orange.
D.—Farmeri. India and Burma. Yellow, tinted with pink.
D.—fimbriatum. Burma. Fl's pendulous, rich orange-yellow.
D.—Macarthiae." Wesakmal." Ceylon. Stems slender, 2—2½ ft. Fl's rose-pink. Difficult of cultivation. Requires hot and moist climate, as in Ratnapura District, Ceylon.
D.—nobile. India and Burma. Fl's large, showy, white, tipped with rose-purple. Several beautiful varieties.
D.—pulchellum, see D. Dalhousieanum.
D.—regium. Large purplish-blue flowers.
D.—superbum. Philippines, 2-2½ ft. Pink, tinged rose.



Grammatophyllum speciosum. GIANT ORCHID.

D.—thyrsiflorum. Burma. Stems 18—30 in. high. Fl's in large drooping clusters, white and yellow.
D.—wardianum. Assam. Stems 1 to 2 ft. Fl's white, purple and yellow.
Epidendrum radicans. Mexico. (Ep.). Stems long, scandent; fl's terminal, bright orange-scarlet.
Grammatophyllum speciosum. "Giant Orchid." Malaya. (Ep.). Stems 6—10 ft., fl's large, ochre-yellow, blotched with brown; racemes stout, erect, 5—7 ft. §

Laelia purpurata. Brazil. (Ep.). Fl's large and showy, rose-white and crimson-purple.

Laelia-Cattleya Decia. Large, showy; fl's scented.

Lycaste Skinneri. Guatemala. (Terr.). White and crimson.

Oncidium luridum. West Indies. (Ep.). L. leathery, 1—2 ft. long; fl's yellow, blotched with brown.

O.—Papilio. Butterfly Orchid. (Ep.), W. Indies. Fl's large, butterfly-shaped.

Peristeria elata. Holy Ghost Orchid. Panama. (Terr). L. 2—3½ ft., fl's scented, waxy-white, globose; centre resembles a dove.



Aracnanthe Maingayi.
"SCORPION ORCHID."

Phaius (Thunia) Bensoniae. Moulmein. (Terr). 2 ft. high, fl's large, amethyst-purple.

P.—Blumei. Java. (Terr). Fl's buff-yellow, mottled with red.

Phalaenopsis amabilis. Malaya. (Ep.). L. broadly oval, 6—12 in. long; fl's large, white, spotted with red.

P.—schilleriana. Philippines. (Ep.). L. 10—18 in. long, blotched with grey. Fl's large, rose-purple.

Renanthera coccinea. Burma and Cochin-China. (Ep.). Stems 6—10 ft., creeping. Fl's in long, loose racemes, pink ground, spotted with crimson; very showy. (C).

R.—imschootiana. Burma. (Ep.). Height 6—24. Fl's bright crimson or pink ground.

R.—(Aracnanthe) Maingayi. Burma. Large, robust creeper; fl's large, pale green, blotched with brown.

Rhyncostylis retusa. Fox-tail Orchid. India, Ceylon, etc. (Ep.). Fl's white, spotted with amethyst-purple; very showy. See page 148.

Saccolabium guttatum, see Rhyncostylis retusa.

S.—curvifolium. Salmon-red, small fl's. 1 ft. Ceylon, 3—5,000 ft.

Sophronitis grandiflora. Orange-red. Brazil.

Spathoglottis plicata. (Terr.). Borneo, &c. Pink and white var's. Flower spikes 2–3 ft. S.—aurea. Malaya. Fl's yellow. Several varieties and other species.

Stanhopea grandiflora. Ecuador. (Ep.). Fl's large, fragrant, yellow, shaded with orange and crimson.

S.—tigrina. Mexico. (Ep.). Fl's large, scented, crimson, spotted with yellow.

Vanda coerulea. North India and Assam. (Ep.). Stems 1—3 ft. Fl's in large sprays, light blue. A beautiful species.

V.—hookeriana. Malaya. (Ep.). Stem and leaves cylindrical; fl's purple-magenta and orange-yellow.

V.—Roxburghii. Ceylon and Burma. (Ep.). Fl's pale buff or grey, with chocolate spots and blue lip, scented; also a variety with pink lip, rare. See page 148.

V.—spathulata. Ceylon and South India. (Ep.). Stems several feet long; Fl's large, bright yellow. See page 148.

V.—teres. India, Burma, etc. (Ep.). Stems and leaves cylindrical, 2—7 ft. high. Fl's rose-magenta and orange-yellow.

V.—tricolor. Java. Fl's yellow, spotted brown, scented.

(2).—SELECTED CEYLON INDIGENOUS ORCHIDS

ARRANGED ACCORDING TO REGION WHERE CHIEFLY FOUND.

(*A*).—*MOIST LOW COUNTRY* (up to about 2,500 ft.).

Acanthophippium bicolor. (Terr). Fl's bright yellow, tipped with purplish red.

Aerides lineare (Saccolabium paniculatum). (Ep.). Fl's white, tinged pale-pink.

Cymbidium bicolor. (Ep.). Fl's cream-coloured, stained with reddish purple.

Dendrobium crumenatum. "Sudu-pareiyamal." "Dove-" or "Pigeon-Orchid." (Ep.). Often on coconut stems. Fl's small, pure white.

D.—Macarthiae. "Wesak-mal," *S.* (Ep.). Fl's violet-pink, rarely white. Moist forests below 2,000 ft., rare. Endemic.

D.—macrostachyum. (Ep.) Fl's pale green or yellow, tinged with pink. Up to about 4,000 ft.

Eulophia macrostachya. (Terr.). Fl's purplish green, lip yellow.

E.—sanguinea. (Terr.). Fl's dull purplish-red, lip pinkish green.

E.—virens. (Terr.) See *Dry Region Orchids*, p. 148.

Phajus luridus. (Terr). Fl's yellow, striped longitudinally with red, lip yellow. Endemic, rare.

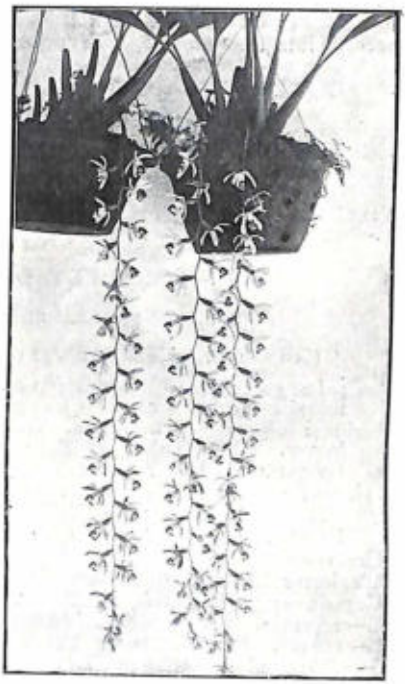
Pholidota imbricata. (Ep.). Fl's white, with a pinkish or yellow tinge, in long, drooping racemes. S

Saccolabium ochraceum. (Ep.). Fl's yellow, with red transverse lines.

S.—wightianum. (Ep). Fl's pale yellow, tinged with red.

Sarcochilus pulchellus. (Ep.) Fl's pure white, lip tinged with orange.

Tainia bicornis (Terr). Fl's pale olive-green, stained with purple.



Pholidota imbricata.

(*B*).—*INTERMEDIATE ZONE*

(About 2,000 to 3,500 ft.).

Aerides cylindricum. (Ep.) Fl's creamy white. Fol. like *Luisia*. (1,000—4,000 ft.).

Anoectochilus regalis. (Terr.). "Wana-raja," *S.* Beautiful velvety brownish leaves, with yellow veins Fl's inconspicuous. In moist shady forests, among leaves.

Arundina bambusifolia. Similar to A.—minor, but larger; stems 5—7 ft.

Cirrhopetalum grandiflorum. (Ep). See p. 148.

Cottonia macrostachya. (Ep). Fl's yellowish-green, veined with pink, resembling an insect. Rare.

Geodorum dilatatum. (Terr.). Fl's white, lip suffused with yellow and pink.

Habenaria pterocarpa. (Terr). Fl's white, with the spur green. Endemic.

Zeuxine regia. (Terr.) "Iru-raja;" "Sudhu-raja." Narrow pointed leaves, with longitudinal white band in centre. Moist forests.

(*C*).—*MONTANE ZONE* (About 4,000 to 6,000 ft.

Arundina minor. (Terr). Fl's pale pink, lip yellow.
Bulbophyllum elegans. (Ep). Fl's dull purple, tinged with green, lip orange.
Calanthe purpurea. (Terr). Fl's pale purplish-pink.
C.—veratrifolia. (Terr). Fl's pure white, lip pale-pink or dull-yellow.
Chrysoglossum maculatum. (Ep). Fl's pale green with reddish blotches, lip white.
Cirrhopetalum grandiflorum. (Ep). Fl's yellow, veined and spotted with red; lip purple. Rare.
Cleisostoma tenerum. (Ep). Fl's yellow, lip white, with pink wings.
Coelogyne odoratissima. (Ep.) Fl's white, with a yellow stain on lip, scented.
Cymbidium ensifolium. (Ep). Fl's dull yellow, lined with pink; sweet-scented.
Dendrobium aureum. (Ep). "Primrose orchid." Fl's pale yellow, sweet-scented.
Eria bicolor. (Ep.). "Lily of the Valley Orchid." Fl's pure white, on purplish red stalks.
Ipsea (Pachystoma) speciosa. (Terr). Daffodil Orchid; "Naga-marapu-ala," *S.* Fl's large, bright yellow. L. narrow or linear, 6—10 in. long. Open patanas; endemic.
Phajus bicolor, =P.—Wallichii. (Terr.) Fl's purplish orange, or pale orange-yellow; leaves large, broad.
Saccolabium roseum. (Ep). Fl's pale purple.

(*D*).—*DRY* (*OR INTERMEDIATELY DRY*) *REGION.*

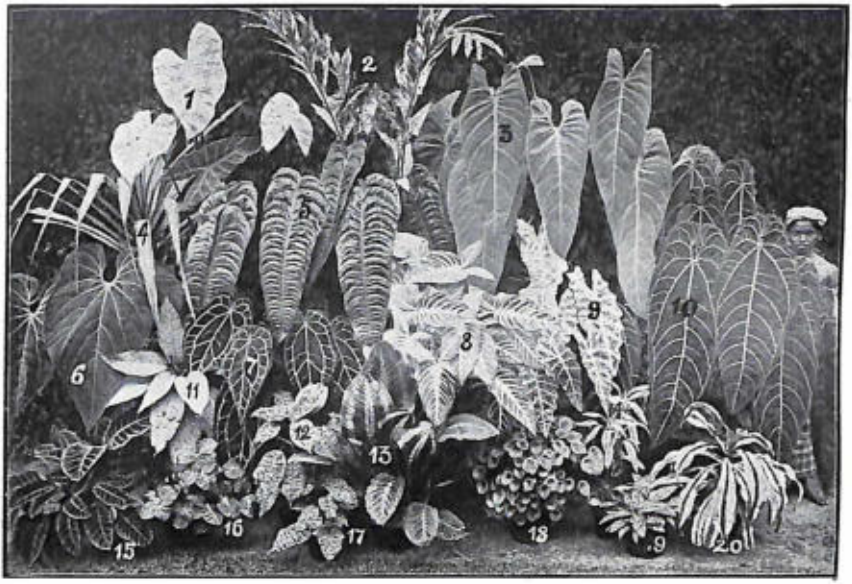
Eulophia virens. (Terr). Fl's yellowish green, lip white, with crimson lines.
Habenaria plantagenia. (Terr). "Pigeon Orchid." Fl's large, pure white.
Rhyncostylis retusa (Saccolabium guttatum). (Ep). "Fox-tail Orchid." Fl's in brush-like, pendulous racemes; white, dotted with violet-pink. Very handsome.
Vanda Roxburghii. (Ep). Fl's pale buff or grey, streaked with brown lines. Scented.
V.—spathulata. (Ep). Fl's bright yellow, in long erect racemes. Showy.

(3).—ORNAMENTAL FOLIAGE POT-PLANTS.

SUITED ALSO FOR SHADED BORDERS, UP TO ABOUT 3,000 FT.

(See also *Ornamental Foliage* and *Flowering Shrubs*, pages 107-122).

Acalypha godseffiana. *Euphorbiaceae.* New Guinea. 2—3. L. oval, coppery; margins creamy white. (C).
Aechmea fulgens. *Bromeliaceae.* Guiana. 1. Stemless plant with stiff, sheathing leaves. (Off). Other species: A.—mexicana; Mexico. 2. A.—skinneri; Guatemala. 1½. A.—Weilbachii; Brazil. 1½. (Off).
Aglaonema costatum. *Aroideae.* Perak. ½; fleshy, variegated or blotched leaves (C). Other species: A.—Haenkii; Philippines. 2. (C). A.—marantifolium; Malaya, 2; (C). A.—pictum; Malaya. 1—2. (C). A.—versicolor. 1½-2. (C).
Aloe, see *Succulent Plants.*
Alloplectus Lynchii. *Gesneraceae.* Colombia. 1½. L. bronze, purple beneath. (C).
Alocasia argyrea. *Aroideae.* 2. L. peltate, with grey bands. (Tu. or Off).
A.—argentea. Leaves lobed, silvery grey, 1—1½.
A.—cuprea. Borneo. 1—2. L. peltate, coppery green. (Tu. or Off)
A.—Johnstoni (see *Cyrtosperma*). A.—Lindeni. Papua. 1—1½. Yellow leaf-stalks and veins. (Tu. or Off.). A.—gigantea = A. = longiloba.
A.—longiloba. Malaya. L. very large, deeply cut, narrow lobes. Stem 6—8. (Off).
A.—Lindeni. 1—1½. L. broadly arrow-shaped; midrib pale yellow.
A.—macrorrhiza variegata. Ceylon, etc., 4—5. L. very large, cordate, green, with large portions pure white. (Off. or su). A.—princeps. Malaya. 2. (Su).
A.—Sanderi. Philippines. 2. L. peltate, scalloped-edges, broad white margins and nerves. (Su). See p. 149. §
A.—thibautiana. Borneo. 3—4. Silvery white nerves.
A.—violacea. 2. L. metallic blue. (Div. or C).
A.—zebrina. Manila. 3. L. sagittate; petiole with dark-green bands. (Div. or C). Numerous other species and varieties.
Alpinia sanderiana. *Scitamineae.* Hort. Leaves streaked and banded with white; very handsome. (Su). See p. 149. §



COLLECTION OF ORNAMENTAL FOLIAGE PLANTS.

1, *Nephthytis picturata*; 2, *Alpinia sanderiana*; 3, *Philodendron andreanum*; 4, *Pandanus sanderiana*; 5, *Anthurium Vietchii*; 6, *Anthurium macrolobum*; 7, *Anthurium crystallinum*; 8, *Phyllotaenium Lindeni*; 9, *Alocasia Sanderi*; 10, *Anthurium warocqueanum*; 11, *Schismatoglottis decora*; 12, *Dracaena goldieana*; 13, *Calathea Veitchii*; 14, *Dracaena sanderiana*; 15. *Maranta zebrina*; 16, *Dichorisandra undata*; 17, *Cryptanthus undulatus zebrinus*; 18, *Peperomia Saundersii*, 19, *Aglaonema costatum*; 20, *Dracaena Victoriae*.

Anoectochilus regalis. "Wana-raja," *S. Orchideae.* Ceylon. ½. Velvety bronze leaves, with golden veins. (Tu or C). Several other species. See *Orchids*, page 147.

Ananas sativus variegatus. Variegated Pineapple. *Bromeliaceae.* 1½. L. variegated pinkish-white. (Su).

Anthurium andreanum. *Aroideae.* Colombia. 3—5. Large, handsome, satiny, leaves. (C or Off).

A.—bogotense. Colombia. 2. L. curiously 3—lobed. (Off).

A.—crassinervium. Panama. 3—4. L. radical, obovate, upright. (Off).

A.—cristallinum. Peru. 2–3. L. large, satiny, prominent silvery veins. (Off). S.

A.—digitatum. Peru. 2—3. Leaves palmately divided. (C or Off).

A.—Fitzeri. L. large, 4—5, similar to A.—warocqueanum. (Off).

A.—Harrisii. Brazil; and A.—longifolium. L. strap-shaped, 1½—2.

A.—pandulifolium. Brazil. L. 5-8 ft. long by 6-8 in. broad; very rare. (Off). S.

A.—radiatum. Mexico. 3. L. radially digitate. (Off or C).

A.—Veitchii. Colombia. L. 2½-3 long, furrowed transversely. (Off). Distinct. S.

A.—warocqueanum. Colombia. L. 3—4 long, satiny green. (S or Off). S.

Aralia Balfouri. Hort. *Araliaceae.* 4—6. L. roundish, wavy, variegated. (C). See p. 119. S.

A.—elegantissima. Polynesia. 2—3. L. very finely cut, palmate-digitate; delicate plant, usually propagated by grafting on a more robust species.

A.—filicifolia. 5—7. Handsome, deeply cut leaves, yellow when young. See p. 118.

A.—triloba. 2—3. L. trilobed. (C).

A.—Veitchii. New Caledonia. 2-3. Finely cut palmate l, like A. elegantissima.

Arundinaria suberecta. *Gramineae.* 2. Small bamboo-like plant with elegant drooping foliage. (Div).

Asarum geophyllum. *Aristolochiaceae.* China. ½. L. round, variegated. (Div).

Asparagus myriocladus. *Liliaceae.* Natal. L. (cladodes) in small, numerous, brush-like whorls. 1—1½. (Su).

A.—plumosus and other species, see *Orn. Fol. Cl.*, p. 128.

Begonia albo-picta. *Begoniaceae.* Brazil. 1½. L. spotted white. (C).

B.—gogoensis. Sumatra. 1. L. peltate. B.—grandis. 1—2. L. satiny, with pale spots. (C).

B.—Haageana. Brazil; 3. B.—Heraclifolia. Mexico; 3. L. bronzy purple. (C).

B.—purpurea. 2. L. satiny, deep bronzy purple. (C).

B.—rex. Numerous varieties; 1. L. variously and beautifully marked. (C).

B.—sceptrum. Brazil. 3—4. (C). L. spotted grey.



Anthurium crystallinum.
(See p. 149).

B.—tomentosa. Brazil. 1½—2. L. greyish tomentose. (C). Numerous other species and var's. See pp. 133, 186, 202.

Bertolonia marmorata. *Melastomaceae.* Brazil. ½—1. Beautiful, shade-loving, delicate plants; young leaves purplish crimson with a satiny sheen. (C).

B.—superba. Madagascar. 1. (C). L. 5—nerved, beautifully marked, like above.

Billbergia rosea *Bromeliaceae.* Trop. America. 2—3. Erect, rigid, convolute leaves, banded and blotched with grey and bronze; fl's rose-pink on long spike.

B.—sanderiana. Brazil; 1½. B.—speciosa. Brazil; 1½. (S or Off). B.—thyrsoidea, see p. 156.

Bowenia spectabilis. *Cycadeae.* Queensland. 2—3. Large, bipinnatisect, fern-like leaves. (Su or S).

Caladium. See *Bulbous and Tuberous Plants*, p. 136.

Calathea arrecta. *Scitamineae.* Ecuador. 3. L. erect, tinted bronze. (Div).

C.—grandiflora. Brazil. 2. Large round leaves. (Div).

C.—Leitzii. Brazil. 1½. Erect habit. L. small, with dark grey bands. (Div)

C.—lindeniana. Peru. 2—3. L. beautifully marked on both sides. (Div).

C.—sanderiana. Brazil. 1. L. with transverse parallel pink lines. (Div).

C.—makoyana Trop. America. ½. L. with oval or round dark blotches.

C.—medeo-picta. Brazil. 1½. L. with white, feathery, central stripes. (Div.).

C.—tigrina. L. with distinct alternate bands of light and dark-green. Similar to but distinct from C.—zebrina.

C.—Veitchii. Bolivia. 2—3. L. large, oblong, with 3 longitudinal bands of dark green above, and corresponding broad purple bands beneath.

C.—veitchiana. Brazil. 1. L. broadly oval or round, variegated; purple beneath.

C.—zebrina. (=Maranta zebrina). Zebra Plant. Brazil. 2—3. L. velvety, with parallel bands of light and dark-green; similar to C.—tigrina, but with darker green and less distinct bands. See p. 149. S.



Anthurium pandulifolium. See p. 149.

Caraguata andreana. *Bromeliaceae.* Colombia. 2. Stiff convolute leaves, prettily marked. (Su).

C.—musaica. Colombia. 1. (Su). C.—Zahnii. Chirqui. L. prettily marked.

Carludovica palmata. Panama-hat Plant. *Cyclanthaceae.* S. America. 5—6. Stemless plant with palm-like leaves. See p. 425. S.

C.—Plumerii. S. America. 6—7. Similar to preceding species. (Su or S).

Centradenia rosea. *Melastomaceae.* Mexico. Pinkish purple leaves. (C or Div.).

Chamaeranthemum argenteum. *Acanthaceae.* New Britain. 1½—2. L. variegated. (C).

C.—pictum. Brazil. 1½. L. with purplish margin and silvery centre. (C).

Glinogyne australis. Malaya. 3—4. (Div).

Conocephalus suaveolens. *Urticaceae.* Malaya. 4—6. (C).

Cordyline australis. *Liliaceae.* New Zealand, &c. 6—8. Showy palm-like plant, with crown of crimson, purple, or green leaves. (C or S).

C.—indivisa. New Zealand. 6—8. C.—terminalis. Several var's and other species. (C or S).

Costus afer. *Scitamineae.* Sierra Leone. 3—4. Fl's white. Leafy stems, forming a loop towards apex. Juice used for coagulating rubber latex in Africa.

C.—elegans. Costa Rica. 2. L. large, oval or obovate, velvety, with dark bands. (Su).

C.—musaicus. Trop. America. 1½—2. L. narrow, margined with grey.

C.—pictus. Mexico. 4—5. L. satiny green, galucous beneath.

Cryptanthus Beuckeri. *Bromeliaceae.* Brazil. ½. L. rigid, in rosette, prettily marked. (S).

C.—undulatus var. zebrinus. Brazil. ½. L. with transverse bands of brown.

C.—zonatus. Brazil. ½. Similar to preceding species.

Curculigo recurvata. *Amaryllideae.* Trop. Asia. 3—4. Stemless plant; long palm-like, furrowed, arching, leaves. (Div or Su).

C.—recurvata variegata. A variegated form of above.

Curmeria. See *Homalomena.*

Cycas circinalis. "Madu" *S.* (*Cycadeae*). Ceylon and India. 4—12. Palm-like plant with large pinnate leaves. See p. 119.

C.—revoluta. China and Japan. 3—4. Dwarf elegant species. (Off or S).

Cyclanthus cristatus. *Cyclanthaceae.* Colombia. 6—7. Stemless plant; large, stalked leaves, blade divided at base into two. (Su).

Cyperus alternifolius. "Umbrella Plant." *Cyperaceae.* Australia. 3—4. Ornamental sedge; radiating feathery leaves. (Div.). Also a variegated form.

C.—elegans. 1—1½. Similar to preceding species, but smaller.

C.—Papyrus. Papyrus Grass; Paper-reed. Egypt, Palestine, etc. 6—10. Tall handsome aquatic sedge, with large brush-like tops at end of tall leaf-stalks. (Div). See pp. 172, 430. S

Cyrtosperma Johnstonii. *Aroideae.* Solomon Islands. 4—6. Large, arrow-shaped reddish leaves; petioles mottled, spiny. (Su).

Dichorisandra mosaica. *Commelinaceae.* Peru. ½. L. variegated, mosaic-like. (C)
D.—thyrsiflora. Brazil. (C). See p. 156.
D.—undata. Peru. ½. L. oval, undulated, striped grey along 8 nerves. (C).
D.—vittata. Hort. ½. L. purplish green, with grey stripes. (C).
Dieffenbachia Bowmanni. Dumb-cane. *Aroideae.* Brazil. 2—5. Handsome, quick-growing, fleshy herbaceous plants; variegated and blotched with grey or creamy-white. Readily propagated by cuttings. Poisonous. See p. 385.



Dieffenbachia Bowmanni. DUMB-CANE.

D.—eburnea. Brazil. D.—Jenmani Brit. Guiana. D.—Leopoldii. S. America.
D.—magnifica. Venezuela. D.—Memoria-Cortii; Hort. D.—picta; Brazil.
D.—warocqueanum. Petioles pure white; blade with few white spots; distinct. Several other species and var's.
Dorstenia argentata. *Urticaceae.* Brazil. 1. L. with central silvery band. (Div).
Dracaena godseffiana. *Liliaceae.* W. Trop. Africa. 3—4. Branching, woody shrub, with small variegated leaves. (C or S).
D.—goldieana. W. Trop. Africa. 2—5. L. broadly oval, curiously marked with dark spots and patches. (C). See p. 149. S.
D.—sanderiana. W. Trop. Africa. 1—1½. Erect. Narrow green leaves with creamy white margins. (C). See p. 149. S.
D.—Victoriae. W. Trop. Africa. 2—4. L. long narrow, creamy white, with green stripe in centre. (C. of stem or S). See p. 149. S.
Dracontium (Godwinia). See *Bulbous and Tuberous Plants*, p. 138.
Elatostema lineolatum majus. *Urticaceae.* Ceylon. 1. Herb, leaves much cut.
Episcia cupreata. *Gesneraceae.* Nicaragua. 1½. Bronze-coloured leaves. (C).
E.—(Centrosolenia) tessellata. Peru. 1½. L. oval, bronze, hairy, strongly bullate, purplish crimson beneath. (C).
Eranthemum artropurpureum. *Acanthaceae.* Polynesia. 4—6. Shrub, variegated bronze or purple 1.; 4—6. Several species and var's, viz: E.—eldorado, E.—tricolor, E.—versicolor, &c.
Fittonia argyroneura. *Acanthaceae.* Peru. ½. L. oval, white net-veined. (C).
F.—gigantea. Ecuador. 1½. L. oval, reddish, with pink net-veins. (C).
F.—Verschaffeltii. Brazil. ½. Similar to preceding species.
Gymnostachyum zeylanicum. *Acanthaceae.* Ceylon. ½. L. oval, pinkish veins. (C).

Heliconia aureo-striata. (=H. Bihai). *Scitamineae.* New Britain, &c. 4-6. Large, handsome, broad leaves, striated with yellowish, parallel, transverse lines. (Su).
H.—illustris. Hort. 4—6. L. coppery, striated with bright pink lines. (Su).
H.—insigne. 5—6. Leaves bright bronze, long, narrow and wavy. (Su).
Hoffmannia discolor. *Rubiaceae.* Mexico. ½. L. satiny bronze. (C).
H.—(Higginsia) Ghiesbreghtii. Mexico. 1½—2. L. obovate, satiny brown, nerves deeply sunk, forming deep cross ridges (rugose), crimson beneath, mid-rib grey.
H.—(Higginsia) refulgens. S. America; 1—2. L. deep bronze. (C).
Homalomena picturata. *Aroideae.* Colombia. 1. L. variegated. (Su).
H.—pubescens. Trop. America. 4. L. large, handsome, peltate, tomentose beneath. (Su).
H.—rubescens. India. 2. Ornamental variegated leaves.
H.—Wallisii. Colombia. 1. L. large, thick, variegated grey and green.
Jacaranda filicifolia and J.—mimosaefolia. Ornamental fern-like foliage in young state. (C or S). See *Beautiful Flowering Trees*, pp. 88 & 89.
Kaempferia Gilberti. *Scitamineae.* Burma. ½. L. with white bands. (Div).
Kalanchoe flammea. Life-plant. *Crassulaceae.* Somaliland. 1—1½. L. succulent, deeply cut; fl's in large, bright red panicles. (C).
Karatas cruenta. *Bromeliaceae.* Brazil. 1. Sheathing leaves, growing in form of bird's nest, tipped bright pink. (Su or S). Several other species, including: K.—Innocentii striata. K.—spectabilis. 1—1½. Fl's in squat head, in centre.
Ledenbergia roseo-aena. *Phytolaccaceae.* Cent. America. 1—2. L. coppery green, purple underneath. (C).
Leea amabilis var. splendens. *Ampelideae.* 3—4. Handsome, pinnate, bronzy green leaves, creamy-white or pink along midrib. (C).
Ludovia crenifolia. *Cyclanthaceae.* Brazil. 3—4. Palm-like stemless plant; leaves scalloped. See p. 174. (Su).
Macrozamia Fraseri. *Cycadeae.* Australia. 3—5. Graceful fern-like plant. (Off. or S).
M.—Moorei.—Australia. 4—6. Similar to preceding species.
*Maranta. *Scitamineae.* Chiefly Trop. America. Stemless plants with large, beautifully marked leaves, similar to Calathea, which see.
M.—imperialis. 2—3. M.—insignis. 1. M.—Lubbersii. 2—3. L. mottled grey.
M.—makoyana. ½. Small oval leaves with brown patches. M.—Massangeanum. ½; oval leaves, with brown oval spots. M.—picta; M.—politia. 1. M.—sangoreana. Hort. 1½. M.—tigrina and M.—zebrina, see *Calathea.*
Massangea, see *Caraguata.*
Nephthytis picturata. *Aroideae.* Congo. 1½. L. large, handsomely marked with pale green and dark satiny bands. (Su).
Ophiopogon intermedius. *Haemodoraceae.* Ceylon, India, etc. 1. Grass-like narrow leaves; fl's dingy white or pale mauve; requires shaded situation.
O.—japonicus. Japan. ½. O.—j.-variegata; leaves variegated.
Oxalis bupleurifolia. *Geraniaceae.* Brazil. 1—1½. Petioles flattened like leaves. (C).
Palisota Elizabethae. *Commelinaceae.* Congo. 1. Long radical leaves with broad silvery band along centre.
Panax crispum. *Araliaceae.* Brazil. 2—3. L. much cut.
P.—elegans. Australia. 2—3. L. bipinnate. (C).
P.—multifidum. 1—1½. L. much cut, resembling parsley. (C).
P.—Victoriae. 2—3. L. pinnate; leaflets deeply dentate, with white margins. (C)
Pandanus sanderiana. Variegated Screw-pine. *Pandanaceae.* 3—8. Handsome foliage. L. pale yellow, with broad streaks of green.
P.—Vetichii. Polynesia. 2—3. Like P.—Sanderi, but not so robust.
Pandanophyllum (Mapania) Wendlandii. *Cyperaceae.* 2—3. Grass-like plant.
Panicum plicatum. *Gramineae.* Trop. Asia, &c. 3—4. Grass with long, broad, plicate leaves. (Div).
Peliosanthes Teta. *Haemodoraceae.* India. 1. Plicate radical leaves. (Div. or S).
Pellionia deveauana. *Urticaceae.* Cochin China. Small, trailing, fleshy plant with scaly stems; leaves blotched grey and green. (C). P.—pulchra. Similar to latter species.

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*Leaves of Maranta and Calathea close towards the centre of the plant on approach of night.

Peperomia argyreia. *Piperaceae.* S. America. 12 in. Succulent, variegated, oval or round, peltate leaves. (Div. or C). Other species: P.—Fraseri; S. America. P.—magnifica; Hort. 2—3. P.—Saundersii; Brazil. 1. L. with grey bands.

Phalaris arundinacea variegata. *Gramineae.* ½—1. Fine variegated leaves. See page 172.

Philodendron andreanum. *Aroideae.* Colombia. Climber. Large, beautiful satiny, pointed leaves, 3–4. (C).

P.—gloriosum. Colombia. 2–3. Large, handsome, broadly cordate, leaves with pinkish white nerves. (C). S.

P.—Mamei. Ecuador. 2—3. L. very large, broadly cordate, blotched and mottled with grey. (C).

P.—Selloum. Brazil. 2—3. L. bipinnatifid. A handsome species. (C.)

P.—squamiferum. Brazil. L. 5-lobed, satiny green, shaded with dark green; petioles with reddish bristles.

Phrynium variegatum. Variegated Arrowroot. *Scitamineae.* 2. L. handsomely variegated. (Div or tu).

Phyllanthus nivosus. *Euphorbiaceae.* Polynesia. 2—5. Slow-growing; small leaves, mottled with pinkish white. (C).

Phyllotaenium (Xanthosoma) Lindeni. *Aroideae.* Colombia. 1—1½. Large handsome sagittate leaves, with broad white bands. (Su).



Philodendron gloriosum.



Schizocasia (Alocasia) Portei.

Pilea muscosa. (=P.—microphylla). Artillery Plant (referring to the opening of the inflorescence). *Urticaceae.* Trop. Amer., naturalised in Ceylon. Dwarf, evergreen, moss-like plant; good for edgings. (C).

Pothos. See *Ornamental Climbers*, page 132.

Rhoeo discolor. *Commelinaceae.* Cent. America. 1-2. Fleshy plant; leaves bronzy purple, underside bright purple. (C).

Ruellia colorata. *Acanthaceae.* Moluccas. ½. Creeping, purplish-bronze. (C). See p. 68.

Sansevieria cylindrica. *Haemodoraceae.* Trop. Africa. 3–4. L. stout, cylindrical, erect. (Su or leaf-C).

S.—guineensis. Trop. Africa 3—4. L. fleshy, erect, sword-shaped, with grey, wavy, cross bands.

S.—Laurentii. Similar to latter, except in leaves, which are white-margined.

S.—zeylanica. Ceylon, India, etc. 3–4. L. semi-cylindrical or flat. See *Fibres*, pages 431, 432.

Schismatoglottis decora. *Aroideae.* Borneo. ½. L. lanceloate, variegated. (Div).

S.—neoguineensis. New Guinea. 1. L. large, oval, blotched with grey. (Div).
S.—picta. Java. 1. L. dark-green, 2 grey bands. (Div).
S.—siamensis. Siam. 1. L. lanceolate, spotted grey. (Div).
Schizocasia (Alocasia) Portei. *Aroideae.* New Guinea. Stem 5—8. L. very large, deeply bipinnatifid, sagittate. (Su.). See p. 154.
Stangeria paradoxa. *Cycadeae.* Natal. 3. Handsome fern-like plant. (Off).
Stenandrium Lindeni. *Acanthaceae.* Brazil. 1. Handsome variegated leaves. (C).
Steudnera colocasiaefolia. *Aroideae.* Martaban. 2. L. oval, peltate. (Su).
S.—discolor. India. 2. L. peltate, with dark, oblong, radiating blotches above, purple beneath. (Su).
Strobilanthes dyerianus. *Acanthaceae.* Burma. 2-3. Young leaves satiny crimson and purple ; requires shade. (C.)
Syngonium podophyllum albo-lineatum. *Aroideae.* ½. L. pinnate, variegated. (C).
Tillandsia pulchella. *Bromeliaceae.* Brazil. 1. Epiphyte ; ornamental-coloured leaves. Fl's bright pink. (Su).
T.—splendens(=T.—zebrina). Guiana. 1. L. with transverse violet bands. (Su).
Tradescantia fuscata. *Commelinaceae.* Brazil. ½. L. covered with reddish hairs.
T.—zebrina, see Zebrina pendula.
T.—reginae. Hort. 1. L. mottled white, with violet centre. (C).
Xanthosoma Lindeni. See *Phyllotaenium.* Several other species.
Zamioculcas Loddigesii. *Aroideae.* Trop. Africa. L. pinnate, ¾ long. (Div).
Zebrina pendula. *Commelinaceae.* Mexico. A small herbaceous creeper with ornamental foliage. L. with grey and purple bands, purple beneath.
Zeuxine regia. "Iru-raja." *Orchideae.* ½. L. velvety, greenish purple, white line along centre. (C or Tu). See p. 147.
Zingiber Darceyi. "Variegated Ginger." *Scitamineae.* 2. L. variegated. (Tu).

(4).—FLOWERING POT-PLANTS.

SUITABLE FOR SHADED SITUATIONS UP TO 3,000 OR 4,000 FT.

(See also pages 190, 196, 204.).

Acalypha sanderiana. *Euphorbiaceae.* Papua. 4—5. Flowers in long crimson, drooping tails (catkins). (C). See p. 107.

Achimenes. See *Bulbous and Tuberous Plants,* p.136.
Aechmea fulgens. *Bromeliaceae.* Guiana. 2½. Rich crimson and pink. (Off).
A.—paniculigera. W. Indies. 1—2. Rose-coloured. (Off).
A.—spectabilis. Guatemala. 2½. (Off).
Aeschynanthus Hildebrandii. *Gesneraceae.* Burma. Small epiphytic semi-creeper ; scarlet fl's tipped with black. (C).
Amydrium humile. *Aroideae.* Borneo. ½. White. (Div).
Anthurium "Archduke Joseph." Hort. *Aroideae.* 2. Bright rose. (Off or S).
A.—carneum. Hort. Light rose colour.
A.—chelsiense. Hort. 1½. Crimson.
A.—desmetianum. Deep crimson-scarlet.
A.—ferrierense. Hort. Spathe bright red. A.—scherzerianum. Guatemala. Several varieties and hybrids. 1—2. Spathe large, scarlet or crimson, etc ; spadix spiral. (Off or S).
Aphelandra nitens. *Acanthaceae.* Colombia. 1½. Leaves shining, dark-green, fl's scarlet. (C).



1, *Billbergia thyrsoidea*; 2, *B.—rosea.*

Billbergia thyrsoidea. *Bromeliaceae.* Brazil. 1—1½. Stemless plant. Fl's scarlet and violet, on erect head. L. broad at base, narrowed upwards from middle. S.

Centropogon lucyanus. Hort. *Campanulaceae.* 1½. Crimson, tubular fl's. (C).



Saintpaulia ionantha.
" AFRICAN VIOLET."

Clerodendron macrosiphon. *Verbenaceae.* Zanzibar. 2—3. Fl's white, fugacious. (C).

Cochliostema jacobianum. *Commelinaceae.* Ecuador. 1½. Fl's in large, loose, clusters, blue and pink. Very showy. (Div.).

Costus igneus. *Scitamineae.* Brazil. 1—2. Fl's bright orange; leaves purple beneath. (Div or Su).

Cyanotis barbata. *Commelinaceae.* Nepaul. ½. Fl's blue. (Div or C).

C.—kewensis. Travancore. ½. Fl's pink. (Div or C).

Dalechampia roezliana. *Euphorbiaceae.* Mexico 2-3. Rose-coloured bracts. (C).

Dichorisandra thyrsiflora. *Commelinaceae.* Brazil. 3. Beautiful bright blue fl's. (C).

Euadenia eminens. *Capparideae.* W. Trop. Africa. 1½. Large, pale yellow fl's. (C).

Griffinia hyacinthina. *Amaryllideae.* Brazil. 1. Large, beautiful, amethyst-blue fl's.(Div.)

Impatiens flaccida, var. *Geraniaceae.* Ceylon. 1. Pure white. (C or S).

I.—Holstii. 1. Fl's salmon-pink. I.—mirabilis. Malaya. 2—3. Yellow. (C).

I.—repens. " Gal-demata," *S.* Ceylon. Stems creeping, whole plant crimson. Fl's bright yellow. Suited to rockeries. (C).

I.—Sultani. Zanzibar. 1. Scarlet fl's. (C or S).

Isoloma. See p. 138. Numerous species and var's. scarlet, orange, &c., often spotted. Trop. S. America.

Karatas Innocentii. *Bromeliaceae.* Brazil. 1. Bright orange-red. (Off).

K.—spectabilis. Brazil. 1. Red and violet-blue. (Off).

Marica borchiana. *Irideae.* Trop. America. Fl's lilac-blue, yellow, and brown; offensive odour. (S or Su).

Musa coccinea. " Flowering Banana." *Scitamineae.* China. 4—5. whole inflorescence bright red. (Su).

Nematanthus longipes. *Gesneraceae.* Brazil. 2. Scarlet. (C).

Pitcairnea alta. *Bromeliaceae.* W. Indies 3. Crimson; loose sprays. (Div or S).

P.—coerulea. Chili; 3; blue. P.—corallina. Colombia. 2; crimson. (Div or Su).

Saintpaulia ionantha. " African Violet." *Gesneraceae.* Central Africa. ½. Purplish-blue fl's; leaves hairy, circular or cordate, fleshy. (Leaf-C or Div).

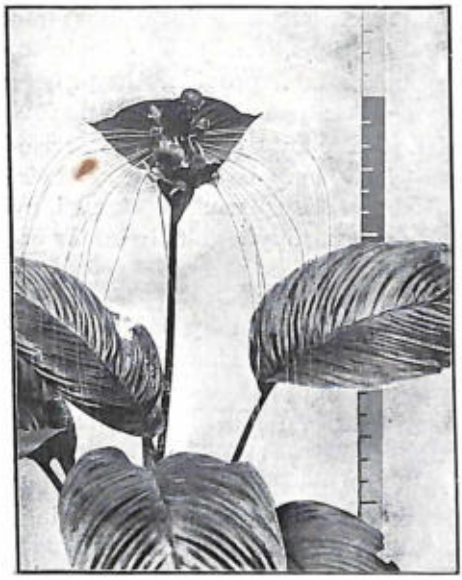
Scutellaria mociniana. *Labiatae.* Mexico. 1½. Scarlet. (S or Div).

S.—violacea. Ceylon, etc. 1. Violet-purple. (S or Div).

Sinningia Helleri. *Gesneraceae.* Congo. 1½. Creamy white. L. variegated. (C or Div).



Spathiphyllum Patinii.



Tacca laevis.

Siphocampylus elegans. *Campanulaceae.* Colombia. 2. Bright red. (C).

S.—tovariensis. Venezuela. 2. Scarlet. (C).

Spathiphyllum candidum. *Aroideae.* Colombia. 1½. White, scented. (Div.)

S.—cannaefolium. Trop. America. 2. Spathes large, white, scented. (Su).

S.—Patinii. Colombia. 1—2. Spathe and spadix pure white; scented.

Spironema fragrans. *Commelinaceae.* Mexico. 1. White, spiral stamens. (S or Div).

Strelitzia Reginae. "Bird of Paradise Flower." *Scitamineae.* S. Africa. 3—4, large leaves. Fl's bright orange and purple. (Su).

Tacca laevis. *Taccaceae.* Trop. Asia. 2. Fl's brownish purple, with large bracts and long thread-like filaments. (Div).

Tillandsia Lindeni. *Bromeliaceae.* Peru. 1½. Violet and rose bracts. (Div or Su).

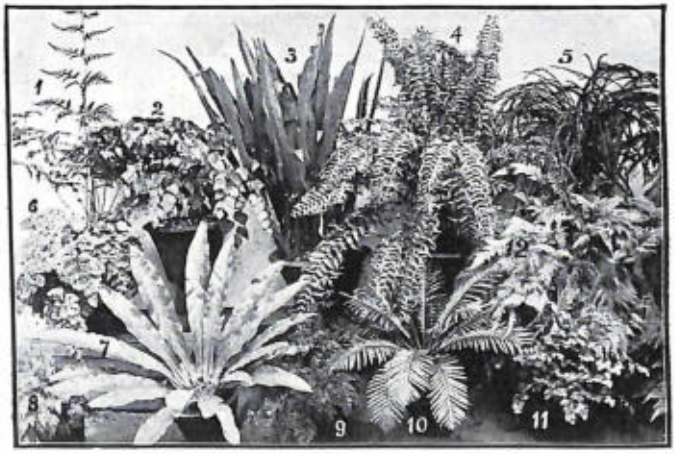
T.—nitida. Jamaica. 2. Blue bracts; leaves convolute. (Div or Su).

T.—pulchra. Trop. America. 1. Pink. (Div or Su).

T.—(Vriesia) recurvifolia. 1½. Blue fl's, rosy-purple bracts.

(5)—FERNS.

Ferns comprise an extensive family of plants, and are deservedly popular on account of the beauty and gracefulness of their foliage. Mixed



GROUP OF FERNS.

Microlepia platyphylla; 2, *Adiantum peruvianum*; 3, *Polypodium punctatum*; 4, *Nephrolepis Duffii*; 6, *Adiantum Farleyense*; 7, *Asplenium nidus-avis*; 8, *Selaginella amara*; 9, *Selaginella Vogeli*; 10, *Lomaria gibba*; 11, *Adiantum Fergusoni*.

with other plants in the embellishment of verandahs and plant-houses, they are always effective, while in floral decorations their cut fronds lend a special charm. Ferns, with few exceptions, are not difficult to cultivate ; they may be grown in pots, boxes, etc., provided the proper conditions of soil, moisture and temperature are afforded. By observing the conditions under which the plants grow and flourish in their natural state, an accurate idea may be formed of their requirements ; it will thus be seen that they usually luxuriate on humous, fibrous soil and limestone rock, occupying shady banks or gullies, as by the side of streams or water courses.



Gleichenia linearis.

Therefore, it may be accepted as a general rule that their principal requirements are shade, moist atmosphere, shelter from strong wind, and good drainage at the roots. Though generally regarded as shade-loving plants, a striking exception is found in the "Gold-fern" (*Gymnogramme chrysophylla*), which thrives to perfection at sea-level in the full glare of the tropical sun, attaining a large size when grown in tubs along paths or drives. While many species, notably tree-ferns and the finer-leaved Adiantums ("Maiden hair"), thrive best at the higher elevations or under sub-tropical conditions, others are naturally adapted to low elevations. A few thrive in swamps, e.g. *Acrostichum aureum*, which grows naturally on the margins of lagoons.

Potting mixtures for ferns should consist mainly of fibrous loam and leaf-mould in equal proportions, to which should be added a small proportion of lime or old mortar containing lime, and a similar quantity of fine river-sand ; broken pieces of porous brick mixed with the soil are also a useful ingredient and have the effect of maintaining proper aeration of the latter. A small portion of old manure should be added to the compost, but it must be in a thoroughly decomposed state. Thorough drainage being essential, the pots should be filled to about one-fifth of their depth with crocks. Many of the more delicate ferns, such as Adiantums (maiden-hair ferns), resent much water being applied

to the foliage; therefore, in watering, the fronds should not be unnecessarily wetted. Ferns are generally easily multiplied by division of the roots, or by sowing the brown powder-like spores usually found on the under side of the fronds. See under *Propagation*, page 36. Some species may be propagated by bulbils produced on the upper side of the fronds, *e.g.* *Asplenium bulbiferum*. Others, being usually infertile, *e.g.* the "Farleyense," a handsome sub-cristate variety discovered n Barbados in 1865, have to be propagated almost entirely by root-division.

The following are some of the most ornamental ferns suitable for cultivation in the tropics.



VIEW IN FERNERY, PERADENIYA GARDENS. Fine specimen of *Rhaphidophora decursiva* to the right.

FERNS SUITED TO LOW-ELEVATIONS.

THOSE MARKED * ARE INDIGENOUS TO CEYLON.

*Acrostichum aureum. Karang or Kérékoku, *S*; sea-coast, brackish water.
Adiantum concinnum.—Maiden-hair.
A.—cuneatum. Trop. America.
A.—Fergusoni. Ceylon.
*A.—hispidulum. India, Malaya, etc.
A.—Pacotti. Chili.
A.—peruvianum. Peru.
A.—trapeziforme. W. Indies.
A.—Weigandii. Hort.
Anemia Phyllitidis. W. Indies.
Asplenium falcatum. India, Malaya, etc.
*A.—lunulatum. ,, ,,
*A.—nidus-avis. Bird's nest Fern.
*A.—sylvaticum. India, Ceylon, etc.
A.—tenerum. ,, ,,
A.—tenerum var. A.—Farleyense.
*Blechnum occidentale. W. Indies.
*Cheilanthus tenuifolia.
Davallia fijiensis.
*D.—pulchra. India, China, etc.
D.—tenuifolia. ,, ,,
Dicksonia flaccida. New Hebrides.
Didymochlaena lunulata.
*Gleichenia linearis. "Kekilla," *S*.
Gymnogramme chrysophylla. Gold Fern.
G.—pulchella. Silver Fern.
G.—schizophylla.
Lomaria gibba. Dwarf Tree-fern.
Microlepia (Davallia) platyphylla. India, etc.
Nephrodium exaltata. India, etc. [etc.
*N.—molle.
N.—decurrens.
*Nephrolepis cordifolia.
N.—c.—var. compacta.
N.—davallioides. Java.
*N.—Duffii. Australia, etc.
*N.—exaltata. Tropics.
N.—tripinnatifida. Solomon Islands.
*Ophioglossum pendulum. Ribbon Fern; "Patia-dhatu," *S*.
Platycerium alicorne. Elk's Horn Fern.
*Polypodium pustulatum. Australia, &c.
P.—quercifolium. Bainduru, *S*. Tropics.
P.—verrucosum. Malaya.
Pteris argyraea. Tropics.

P.—cretica albo-lineata. Hort.
*P.—ensiformes. Trop. Asia.
*P.—quadriaurita. Tropics.
P.—serrulata. China, etc.

FERN-ALLIES.

SUITED TO LOW OR MEDIUM ELEVATIONS.

*Azolla pinnata. (See p. 173.)
*Lycopodium cernuum. Staghorn-moss; Badalwanassa, *S.*
*L.—Phlegmaria. Maha-hedaya, *S.*
L.—squarrosum. Kuda-hedaya, *S.*
L.—taxifolium. Trop. America.
*L.—zeylanicum.
*Marsilea quadrifolia. See p. 174.
Selaginella amoena.
Selaginella caulescens. Malaya, etc.
*S.—delicatissima. Andes.
S.—grandis. Borneo.
S.—laevigata. Madágascar.
S.—Martensii. Mexico.
S.—M.—variegata, Hort.
S.—uncinata. China.
S.—Vogelii. Trop. Africa.
S.—Wildenovii. India, Malaya, etc.



Ophioglossum pendulum.
RIBBON FERN.

FERNS SUITED TO MEDIUM AND HIGH ELEVATIONS.

*Adiantum Capillus-Veneris. Maiden-hair Fern
A.—cuneatum. Trop. America.
A.—Fergusoni.
A.—gracillimum. Finest-leaved Maiden-hair Fern.
*Anemia Phyllitidis.
*Angiopteris evecta. Trop. Asia.
*Aspidium aucleatum.
*A.—anomalum, see Polystichum.
Asplenium bulbiferum. Bears bulbils on fronds. See p. 159.
A.—furcatum.
A.—lunulatum.
*A.—tenuifolium.
*Blechnum orientale.
*Cheilanthus farinosa.
*Davallia bullata.
D.—elegans. Trop. Asia, etc.
*D.—majuscala.
*Diacalpe aspidioides.
Lomaria Patersonii and L. gibba. Dwarf tree-ferns.
Lygodium scandens. Creeping Fern; fine ornamental foliage.
*Nephrodium flaccida.
*N.—Walkerae.
*N.—zeylanica.
*Nephrolepis cordifolia.
*Osmunda javancia.
*Polypodium rufescens.
*Polystichum anomalum. Ceylon. Bears spores on upper side of frond.
*P.—aristatum.
*Pteris incisa.
*P.—quadriaurita. Cluster Fern.
P.—sagittifolia. Ivy-leaf Fern. Brazil
P.—Victoriae. Variegated linear frondlets.
*Stenoloma chinensis. Parsley Fern.
Woodwardia japonica. China & Japan.

TREE FERNS.

*Alsophila crinita. Woolly Tree Fern. Handsome species, 30-40 ft. high, young parts covered with brown fibrous hairs; common from 4,000 to 7,000 feet in Ceylon.

*A.—glabra. India, Malaya, etc.

*Amphicosmia. See *Hemitelia.*

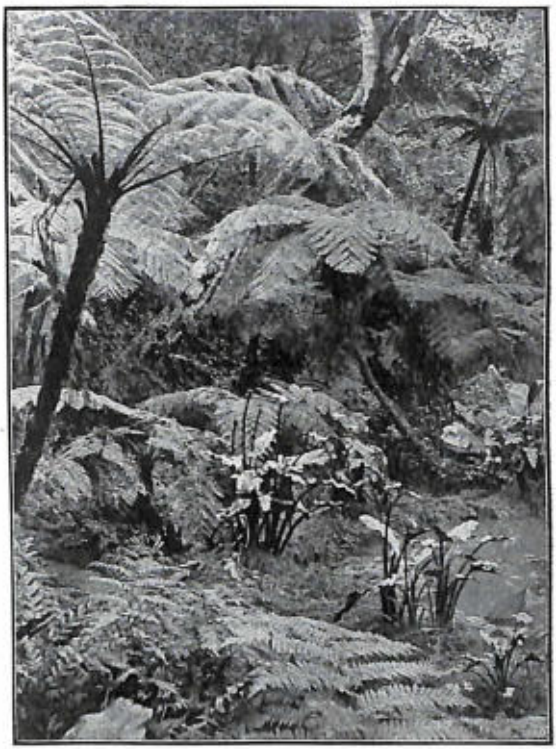
Cyathea dealbata. Silver Tree Fern.

*C.—Hookeri. Ceylon, endemic.

C.—sinuata. Ceylon, endemic.

Dicksonia antarctica.

Hemitelia Walkerae. Ceylon.



VIEW IN FERNERY, HAKGALA GARDENS, CEYLON.
Alsophila crinita in back-ground.

ZOOLOGICAL GARDENS CALCUTTA.

CHAPTER XIV.

1.—*PINNATE OR FEATHER-LEAVED PALMS.*
2.—*FAN-LEAVED PALMS.*
3.—*SUB-TROPICAL PALMS.*
4.—*CEYLON INDIGENOUS PALMS.*
5.—*SELECTED CACTI OR SUCCULENT PLANTS.*
6.—*ORNAMENTAL GRASSES AND SEDGES.*
7.—*BAMBOOS AND BAMBOO-LIKE GRASSES.*
8.—*ORNAMENTAL WATER-PLANTS.*

The large family of palms (*Palmae*) is pre-eminent in the vegetable world for their grandeur, which is especially remarkable in regions where palms grow naturally to their full luxuriance. Linnaeus appropriately styled them "Princes of the vegetable kingdom." There are some 1,150 species of palms known, and some doubtless still remain to be discovered. They may be divided into two main classes, (1) feather-or *pinnate*-leaved, and (2) fan- or *flabelliform*-leaved. About two-thirds of the species come under the former class.



Caryota urens. TODDY PALM.

Most palms have upright, straight, unbranched stems, many reaching a great height. Some are bushy, throwing out numerous stems from the base *e.g. Chrysa-*

lidocarpus lutescens, *Ptychosperma*, species of *Licuala*, etc.; while others, as species of *Chamaedorea*, are dwarf and flower and fruit at a height of but a few feet. A few are naturally branched or forked, as the Doum Palm (*Hyphaene*). Some have bent stems, as the Coconut; others are enormous climbers, *e.g. Calamus*,—see "Rattans," page 439. Palms are either wind-or insect-pollinated, or both. Some are dioecious, *e.g. Lodoicea* and *Phytelephas*, and others monoecious, as the Coconut. The following are some of the better known species of palms.

Those marked * are best suited to sub-tropical conditions or elevations above 3,000 feet. (See also *Ceylon Palms*, page 169).

(1).—PINNATE-LEAVED PALMS.

Acanthophoenix crinita. Mauritius and Reunion. Thorny stems.
Acanthoriza aculeata. Cent. America. 30—40 ft. Spiny rootlets on stem.
Acrocomia sclerocarpa. Gru-gru; Macaw Palm. Trop. America and W. Indies. Stout, erect, stem, 40-50ft. Very spiny; spines 3-4 in. long.
Actinnorrhytis calapparia. Malaya.
Archontophoenix Alexandrae. Queensland. Handsome sp., fl's in large white panicles.



1, *Ptycho-perma Macarthurii*; 2, *Chrysalidocarpus lutescens*.

A.—Cunninghami. (=Seaforthia elegans). Queensland. 40-50 ft.
Areca Catechu. Areca-nut; Betel-palm. Trop. Asia. See page 380.
A.—concinna. Ceylon. Small slender stem. See page 169.
A.—triandra. Assam and Burma. Similar to A. Catechu.
Arenga saccharifera. Gomuti-,or Sugar-palm. Java, Sumatra, &c. Leaves up to 25ft. or more in length; leaflets 2½-3 ft. by 3 in. broad. Very large, handsome species. See p. 361. A.—Wightii. Malabar.
Astrocaryum rostratum. Brazil. Petioles very spiny
Attalea Cohune. Cohune Palm. Honduras. 50-60 ft. Bears very large spadix.
A.—excelsa. Similar to latter. Brazil.
Bactris major. Peach-nut; Pejibaye; Pewa; Pupunha. Slender, numerous stems; whole palm very spiny, 30—40 ft. Fruit in clusters, reddish yellow, eaten boiled with salt or roasted. See page 256.
Bentinckia Condapanna. Travancore. Slender species, about 30 ft., high
Calamus, see under *Canes or Rattans*, page 433; also *Ceylon Palms*, p. 170.
Calyptrocalyx spicatus. Moluccas. 30-40 ft.; bright red berries on long spikes.

Caryota Cumingii. Philippines. Handsome genus with bipinnate leaves.
C.—ochlandra. China. C.—rumphiana. Malaya and Australia.
C.—urens. Toddy Palm. Trop. Asia. Handsome, bi-pinnate leaves; 40—50ft. See pages 169, 361. §
Catoblastus praemorsus. Small palm of Venezuela.
Ceroxylon andicola. Colombia, &c. Wax Palm. See page 410.
Chamaedorea elegans. Mexico. Dwarf, single stem; flowers when 2 or 3ft. high.
*C.—Sartorii, and C.—Tepijilote. Mexico. Dwarf elegant species.



Elaeis guineensis. OIL PALM. ON EITHER SIDE OF ENTRANCE TO PERADENIYA GARDENS.

Chrysalidocarpus lutescens. Madagascar. "Cane Palm." Numerous stems; handsome fine, feathery, leaves; excellent for pot culture. §
Cocos flexuosa. Brazil, 30—40. Handsome feathery l.; also C.—insignis.
C.—nucifera. Coconut palm. Nat. hab. unknown. See pages 163, 170, 389.
C.—plumosa and C.—schizophylla. Brazil. Handsome palms, 40-50 ft.
C.—weddelliana. Brazil. Small elegant species with narrow pinnae.
C.—romanzoviana. Brazil.
Cyrtostachys Renda (=*C. Lakka*). Sealing-wax Palm; "Pinang-rajah." Bright red leaf-sheathes, numerous stems; Sumatra.
Desmoncus major. Trinidad. Climbing palm, very spiny; small, round, red fruit.
Dictyosperma album. Mauritius.
D.—fibrosum. Madagascar.
Didymosperma distichum. Sikkim. See Wallichia disticha.
D.—porphyrocarpus. Java. D.—tremulum. Siam.
Diplothemium caudescens. Brazil. Very handsome, small palm. 10-12 ft.
Drymophloeus appendiculatus. Malaya. D.—ceramensis. Moluccas.
Dypsis madagascariensis. Madagascar. Several stems; leaflets whorled.
Elaeis guineensis. Oil Palm. See page 391. §
Eugeissona triste. Ovoid, smooth, prettily marked brown fruit with pointed top; common spiny palm of Malacca, &c.
Euterpe edulis. Tender stem-tops commonly used as a vegetable in Brazil, &c.
E.—oleracea. Brazil. Sometimes called "Cabbage Palm." 80-120 ft.
Geonoma gracilis; Costa Rica. G.—princeps; Colombia. G.—schottiana; Brazil. All small elegant species.
Guilielma speciosa. "Peach Palm"; "Pejibaye." See Bactris major.
Hedyscepe canterburyana. Lord Howe's Island. 25-30 ft.
Heterospathe elata. Amboyna.
Howea, see *Kentia*.
Hydriastele wendlandiana. Queensland. Slender palm; small round, scarlet fruit.
Hyophorbe amaricaulis. Mauritius. H.—Verschaffeltii. Rodriguez.
Jubaea spectabilis. "Coquita Palm." Chili. Very handsome palm. See p. 165.§
Kentia australis; K.—Belmoreana; and K.—forsteriana. Lord Howe's Island. Single stem, handsome pinnate leaves; latter two species especially are favourites for pot culture in Europe, &c.

K.—sanderiana. A recent introduction, similar to preceding spp.

Korthalsia Junghuhnii. Java. Spiny, climbing species, similar to Calamus.

Manicaria saccifera. Bussu Palm. Cent. America.

Martinezia caryotaefolia; M.—lindeniana. Colombia. Spiny leaves and stem.

Mauritia flexuosa. Brazil. Spiny. Inhabiting marshes.

Maximiliana regia. Cocurita; Inaja or Jagua Palm. Brazil and Guiana. Large handsome species.

Metroxylon Rumphii. Prickly Sago-Palm. Moluccas and New Guinea.

M.—Sagu. Sago Palm. Malaya, &c. See page 365.

Myrialepis Scortechnii. Malaya. Strong growing climber, spiny leaves and stem.

Nephrosperma van-Houtteana. Erect, slender, stem. Seychelles.

Nipa fruticans. Nipa; "Water-Palm." See *Water Plants*, pages 175, 362.

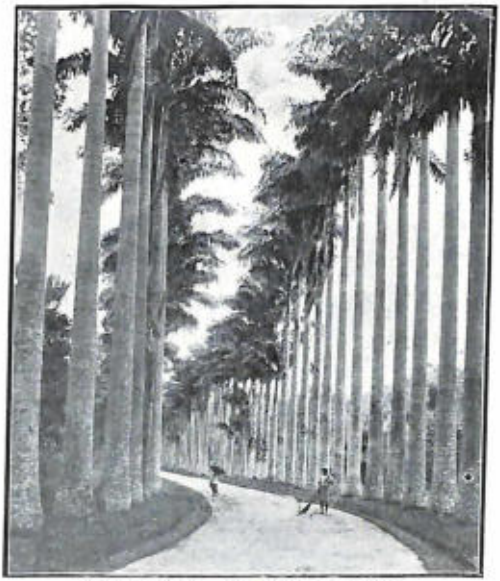
Oncosperma fasciculata. See *Ceylon Palms*, p. 170.

O.—filamentosa. Nibung or Nibong Palm. Java. Many stems; handsome, drooping leaflets.

Orania regalis. Pericarp edible.



1, *Jubaea spectabilis*, Cognito Palm; 2, *Corypha umbraculifera*, Talipot Palm, in flower; 3, *Thrinax argentea*; 4, *Loxococcus rupicola*; 5, *Oncosperma fasciculata*; 6, *Phoenix rupicola*; 7, *Ravenala madagascariensis*.



AVENUE OF *Oreodoxa oleracea*, IN PERADENIYA GARDENS.

Tall palm, with smooth stem. Philippines.

Orbignya Sagottii. Demerara.

Oreodoxa oleracea. Palmiste; Cabbage Palm. Trop. America. 80—100 ft. high, very stately, cylindrical stem; effective in avenues. S.

O.—regia. Royal Palm; Bottle Palm. Cuba, Panama, &c. Stem usually barrel-shaped. Tender top portion of stem of this and preceding species commonly used as a vegetable in Trop. America and W. Indies.

Phoenix dactylifera. Date Palm. N. Africa. See page 248.

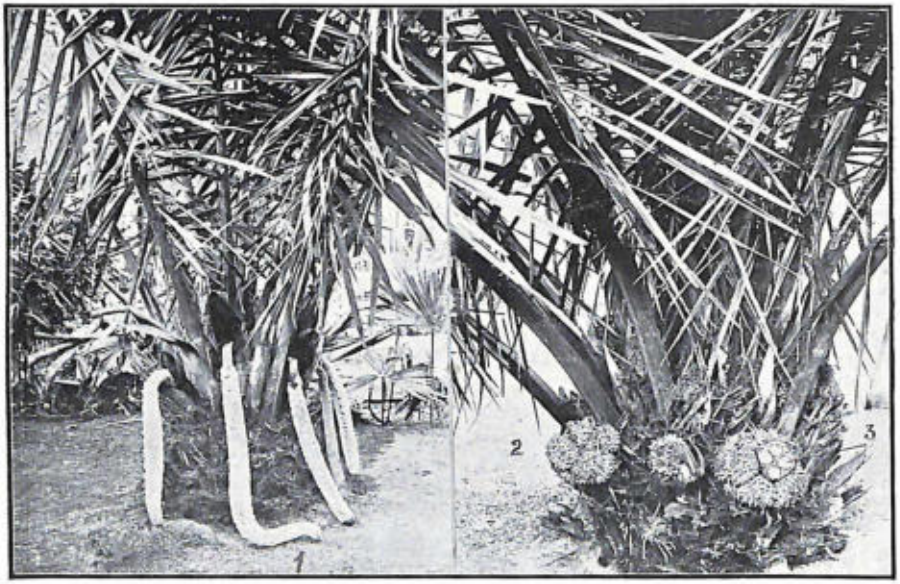
P.—paludosa. India and Cochin China; P.—reclinata. S. E. Africa;—all elegant species.

P.—Roebelinii. A handsome species, with long, narrow arching leaves and narrow, slender leaflets; a favourite for pots.

P.—rupicola. Sikkim. P.—sylvestris. Wild Date-palm; see Sugar Palms, page 361.

P.—zeylanica. See page 170.

Pholidocarpus Ihur. Malaya.



Phytelephas macrocarpa. IVORY-NUT PALM.
1, "male" palm, showing staminate inflorescence; 2, "female," showing fruit clusters at base; 3, section of a single fruit showing hard, white seeds.

Phytelephas macrocarpa. Ivory-nut Palm. Colombia. See p. 410. $

Pinanga Kuhlii. Java; P.—paradoxa; and P.—spectabilis, Malaya. All small species with several stems.

Plectocomia elongata. Sumatra, etc.

Prestoea trinitensis. Trinidad.

Ptychandra glauca. Single stem. Malaya.

Ptychococcus paradoxa. New Guinea.

Ptychoraphis augusta. Nicobar Islands.

P.—singaporensis. Malaya.

Ptychosperma Macarthuri. Trop. Australia. Small and bushy, several stems; suited for pots. P.—perbreve. Fiji. And other species.

Raphia Hookeri & R. vinifera, Trop. Africa; R.—Ruffia (=R. pedunculata). Madagascar.

Rhopaloblaste hexandra. Moluccas. 80-100ft., single, slender stem; narrow pinnae, ornamental in small state.

Roscheria melanochaetes. Seychelles. Many stems, spiny.

Scheelea excelsa. Colombia. Handsome species with large, broad leaflets.

Synechanthus fibrosus. Guatemala. Single stem; bears masses of brown fibre at base of leaves.

Veitchia Johannis. Fiji.

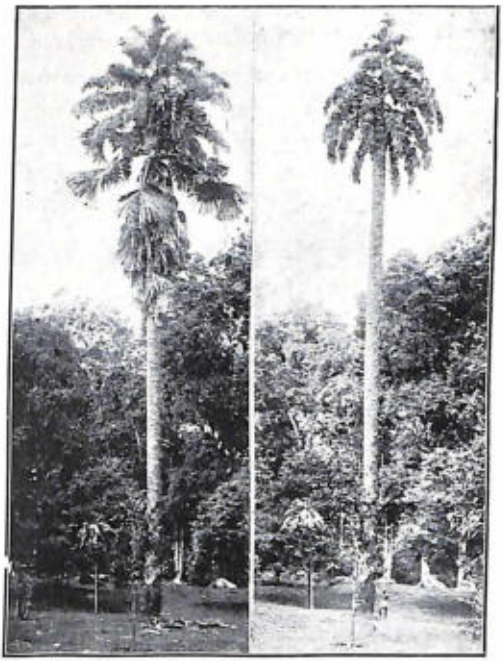


Wallichia (Didymosperma) disticha.

Wallichia caryotoides. Burma, etc. W.—densiflora. Himalaya region.
W.—disticha. Sikkim. Distinct, fan-shaped species, leaves arranged in 2 rows (distichous).
Zalacca edulis. Malaya. Stemless, very spiny.

(2).—FAN-LEAVED PALMS.

Bismarckia nobilis. Madagascar.
Borassus flabellifer. Palmyra Palm. India and Trop. Africa. See pages 169, 362, 461. S.
Brahea nitida. Mexico. A small, slow-growing species with short stem; sub-tropical.
Copernicia cerifera. Carnauba Wax-Palm. Brazil. See p. 409.
Corypha umbraculifera. Talipot Palm. Ceylon and S. India. See pp. 168, 170, 410, 439. S
Hyphaene thebaica. Doum Palm. One of the few branching palms. 30—40 ft. Nubia, Soudan, &c.
Latania Commersoni. Mauritius and Reunion. 40-50 ft. L. purplish, glaucous grey.
Licuala elegans. Sumatra. Small species with many stems; petioles prickly.



Corypha umbraculifera. TALIPOT PALM. LEFT, in full flower; RIGHT, same palm in fruit 12 months later.



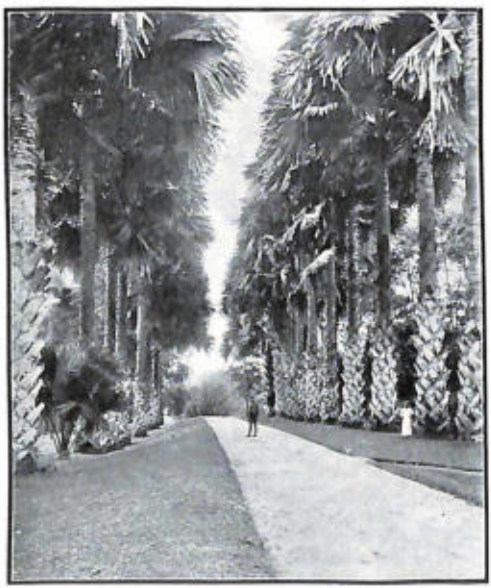
Licuala grandis. FAN PALM.

L.—gracilis. Java. Bushy, 5-7 feet.
L.—(Pritchardia) grandis. Pacific Islands. Single stem. 6-8 ft. L. almost circular, pleated fan-like; very elegant. S
L.—peltata. Assam, Burma, etc. Large leaves; single stem. L.—spinosa. Bushy, 5-8 ft. Malaya.
Linospadix Micholitzii. Malaya.
Livistona altissima. Java. 50—60 ft.; petioles prickly; berries scarlet.
L.—australis; Australia. L.—chinensis; China and Japan. L.—Hoogendorpii; Java. L.—humilis; Australia. L.—Jenkinsiana; Assam. L.—olivaeformis; Java. L.—rotundifolia (small, blue-skinned, round fruit); Malaya. L.—subglobosa; Java.
Lodoicea sechellarum. Double Coconut; Coco-de-mer or "Sea Coconut." Seychelles. A remarkable dioecious palm with immense leaves; stem up to about 80 ft., or more in height, to reach which it takes as many years or more. Normally it does not flower under 30 years of age. Bears clusters of enormous "nuts," each with husk weighing up to 45 or 50 lbs., taking about 10 years to ripen. Each fruit contains

from 1 to 3 large, 2-lobed " nuts," which on being sown take about 2 years to germinate. This is the largest seed known. Introduced into Ceylon in 1850.



Lodoicea sechellarum. " DOUBLE COCONUT " OR COCO-DE-MER. 1, male palm in Peradeniya Gardens; 2, female palm in Henaratgoda Gardens (50 miles distant), artificially pollinated and bearing 28 fruits in different stages of development; the oldest being about 10 years from setting and ripening at time of photograph (1922). The male palm is about 72 years old, and the female about 34 years.



AVENUE OF TALIPOT PALM, PERADENIYA GARDENS.

The "male" took about 40 years to flower, and the " feale ," at Henaratgoda Gardens, 34 years. The fruit took 10 years to ripen. The large, hard-shelled nuts, objects of many legends and superstitions, used to be found floating in the Indian Ocean long before the palm was discovered.*

Phoenicophorium sechellarum. See *Stevensonia grandifolia.*

Pholidocarpus Ihur. Malaya. Petioles spiny; leaves like *Borassus.*

Pritchardia aurea, and P.—grandis. Fiji. See *Licuala.*

P.—Martii. Sandwich Islands. P.—pacifica. Fiji.

Sabal blackburniana. Bermuda.

S.—glaucescens. Trinidad. 40—50 ft.; leaves glaucous beneath.

S.—filamentosa. Jamaica. S.—umbraculifera. " Great Thatch Palm" of Jamaica.

Stevensonia grandifolia. Seychelles. 40-50 ft., single stem; leaves spiny, of a reddish tint.

Teysmannia altifrons. Sumatra, Perak, &c.

**Treasury of Botany.*

Thrinax argentea. Broom Palm. West Indies. Slender stem, 20—30 ft. Petioles slender, enveloped at base with brown, fibrous network.
T.—barbadensis; Barbados. **T.—excelsis**; Jamaica. **T.—parviflora.** W. Indies.
Verschaffeltia splendida. Seychelles. Handsome species; stem and petioles very spiny.

(3).—SUB-TROPICAL PALMS.

Brahea dulcis. Mexico. Fan-leaved, dwarf species.
B.—filamentosa(=Washingtonia filifera).—See below.
Ceroxylon andicola. Wax-palm of Colombia. See page 410.
Chamaerops Fortunei(=Trachycarpus excelsus). Fan-leaved. S. China.
C.—humilis. Fan-leaved, dwarf species. South Europe.
C.—macrocarpa. N. Africa.
Erythea armata. S. California. Leaves fan-shaped and filiferous.
E.—edulis (=Brahea edulis). S. California.
Exorrhiza wendlandiana.
Nannorhops ritcheana. N. India. Small bushy palm; leaves used for making fans, baskets, etc.
Rhapis flabelliformis. China. Small slender palm, numerous stems, used for walking sticks.
Rhopalostylis (Areca) sapida. "Nikau Palm". New Zealand. Small, pinnate-leaved.
Sabal Andansoni. "Dwarf Palmetto." Fan-leaved, dwarf species.
S.—Palmetto. Palmetto Palm. S. United States.
Serenoa serrulata. Saw Palmetto S. United States. Dwarf, elegant, fan-leaved.
Trachycarpus excelsa. China. Fan-leaved, dwarf species.
Washingtonia filifera. Lower California. Handsome fan-leaved; leaf-blades copiously furnished with long, grey, filiform threads.



AVENUE OF PALMYRA PALM (*Borassus flabellifer*) IN PERADENIYA GARDENS, CEYLON.

(4).—CEYLON INDIGENOUS PALMS.

(Those marked* are endemic, *i.e.* confined to Ceylon).

Areca Catechu. Betel-nut; Puwak, *S*; Kamukai, *T*. Moist low-country. Stems straight, slender, 25—40 ft. Leaves pinnate.
***A.—concinna.** Lena-teri, *S*. Moist low-country. Small slender species. 8-12 ft.
Borassus flabellifer. Palmyra; "Tal," *S*; "Panai," *T*. Dry region. Fan-leaved, 50-60 ft. high. See pages 362, 461.§
***Calamus delicatulus.** Narawel, *S*. Moist low-country up to 1,000 ft.; climbing palm, with spiny, elegant, pinnate leaves. The slender stems of several species form the "canes" of commerce. See *Rattans*, p. 439. Other species are:
***C.—digitatus**; "Kukula-wel." ***C.—ovoideus**; "Thambutu-wel." ***C.—pseudo-tenuis.**
***C.—pachystemonus**; ***C.—radiatus**; ***C.—rivalis**, "Ela-wel".
C.—Rotang. Wé-wel, *S*; Perampu, *T*. Chiefly dry region.
***C.—Thwaitesii** and ***C.—zeylanicus.** Moist low-country, up to 1,000 ft.
Caryota urens. Toddy Palm. Kitul, *S*. Moist low-country up to 3,000 ft. Trunk 40 to 50 ft.; leaves bipinnate, very handsome; drooping spadices, 8-10 ft. long.

Cocos nucifera. Coconut; Pol, *S*; Tennai, *T*. Low-country up to 2,000 ft. Cultivated only. See page 389.

Corypha umbraculifera. Talipot; Tal-gaha, *S*. Moist region, below 2,000 ft. Trunk stout, erect, 50-80 ft. L. immense, 12-15 ft. diam. when young. Seeds the size of large marbles, ivory-like, made into buttons, etc. See pages 167, 168, 410, 439.§

*Loxococcus rupicola. Dotalu, *S*. Moist region, 1,000 to 5,000 ft. Stem slender, erect, 15-20 ft. Leaves pinnate.

Nipa fruticans. "Nipah"; Water-coconut; Gin-pol, *S*. South-west coast, in brackish waters. Rootstock 1½ ft. diam. L. pinnate, 10-15 ft. long. See *Orn. Water Plants*, pages 175, 362.

Oncosperma fasciculata. "Katu-kitul," *S*. Moist region up to 1,500 ft. Stems many, clustered, spiny, 40-60 ft. L. pinnate, leaflets long, pendulous.

Phoenix pusilla. "Inchu," *T*. Forest of dry region. Stem very stout. L. 4—5 ft., lower leaflets reduced to spines.

P.—zeylanica. "Indi," *S*. Moist low-country. Stem 6—20 ft. L. pinnate, with numerous, long, narrow leaflets.

(5).—SELECTED CACTI OR SUCCULENT PLANTS.

Plants of this class are generally best suited to a dry climate, the great majority being indigenous to arid regions, as Mexico and South Africa.

Those marked * flourish in a wet climate and up to about 4,000 ft. elevation, in sheltered situations. Letters in brackets indicate usual means of propagation, thus: (Su)=suckers; (C)=cuttings; (S)=seed; (Tu)=tubers; (S)=offsets figures=approximate height in feet.*

Agave americana variegata. Century Plant. *Amaryllideae*. South America. Stemless plant with large, succulent, variegated, spiny, sharp-pointed leaves. (S or Su).

*A.—densiflora. Mexico. Large succulent, sharp-pointed, spiny leaves. (S or Su).

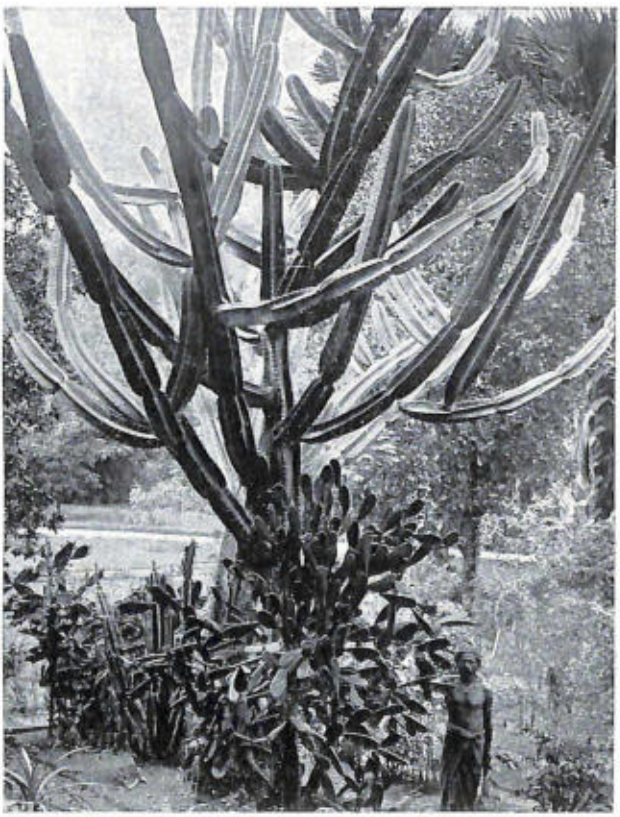
*A.—heteracantha. Texas, &c. Similar to latter species. (Su or S).

*A.—Morrisii. Jamaica. L. rather broad, spathulate and curved at base. (Su or S).

Aloe saponaria. S. Africa. *Liliaceae*. Small plant with a short stem, and succulent, prickly, spotted leaves. (C). Numerous other species.

Bromelia Pinguin. *Bromeliaceae*. Trop. America. 5-8. Stemless plant, with long strap-shaped leaves, edged with sharp hooked spines. (S or Su). See pp. 73, 429.

*Caralluma campanulata. *Asclepiadeae*. Ceylon and India. Dwarf leafless plant, with square stems. (C).



Cereus peruvianus. GIANT CACTUS, *Nopalea coccinellifera* in foreground.

*Cereus grandiflorus. Night-flowering Cactus. *Cactaceae.* W. Indies. Large creeper, reaching the tops of tall trees. Fl's large, white, opening at night. (C.)
C.—jamacaru. Brazil. Stout, single, leafless, unbranched stem, 4 to 5-angled. (Off).
*C.—peruvianus. "Torch-Thistle"; Giant Cactus. S. America. 30-40 ft. or more. Large, branching tree without leaves. Branches 5 to 6-angled, spiny. Large white fl's, which open at night. (C). See p. 171.§
*C.—serpentinus. Mexico. Creeper, with thin, hairy tail-like stems. (C).
Dyckia altissima. *Bromeliaceae.* l. Leaves narrow, wiry and recurving. (Off).
Echinocactus. *Cactaceae.* Numerous species. Mexico. Small, unbranched, ovoid or globose, succulent plants. (Off).
Echinopsis (Cereus) multiplex. *Cactaceae.* Brazil. Erect, unbranching plant with several spine-covered angles. (Off).
*Epiphyllum truncatum. *Cactaceae.* Brazil. Small leafless shrub, with handsome rose-coloured fl's. (C). Numerous other species.
Furcraea gigantea. Mauritius-hemp. *Amaryllideae.* Trop. America. See pp. 74, 424.
Gasteria trigona. "Salm-Dyck Aloe." *Liliaceae.* S. Africa. ½-1. Leaves very thick, distichously arranged. (Off).
G.—verrucosa. S. Africa. ½-1. Very thick leaves. (Off).
Haworthia attenuata, and numerous other species. *Liliaceae.* S. Africa. Small Aloe-like plants, leaves in a rosette. (Off).
*Kalanchoe laciniata. Life-plant. *Crassulaceae.* Trop. Africa. L. deeply cut. (C).
Lomatophyllum borbonicum. *Liliaceae.* Bourbon. Long, spiny, fleshy leaves on short stem, 2-3. (S).
Mamillaria glauca. *Cactaceae.* Mexico. Dwarf plant, composed of many tubercles, each terminated by a bunch of hairy spines. (Off).
M.—megacantha. Mexico. Similar to latter species. (Off).
M.—nobilis. Mexico. Numerous other species.
*Nopalea coccinellifera. "Spineless Cactus." *Cactaceae.* Mexico. 6-8. Branching, leafless shrub, with flat oval tubercles. Also known as "Cochineal Cactus." See pp. 170, 437. (C). §
Opuntia Dillenii. Prickly Pear; "Katu-patuk," *S. Cactaceae.* Mexico. 5-7. Branching leafless shrub, with large circular or oval tubercles, covered with tufts of sharp spines, 3-4 in. long. Some forms are almost spineless. See pp. 454, 475.(C).§
O.—grandis and O.—robusta, Mexico. (C). Both similar to preceding sp.
Pedilanthus tithymaloides. *Euphorbiaceae.* S. America. 4-6. Erect shrub. (C). Also a green and white variegated form.
Phyllocactus amabilis. Hort. *Cactaceae.* Small shrub, with flattened leaf-like branches; flowers showy, bright pink and other shades. (C).
P.—crenatus, P.—grandis, P.—speciosissima and several other species. Trop. America. (C).
*Rhipsalis Cassytha. *Cactaceae.* Trop. Asia. Epiphytic leafless plant, with cylindrical pendulous stems and branches. The only Asiatic Cactus. (C or S).
R.—pachyptera. West Indies. Large, flat, leaf-like branches. (C).
*Stapelia grandiflora. *Asclepiadeae.* S. Africa. Small leafless plant. (C).
Vitis quadrangularis. *Ampelideae.* Trop. Asia, etc. Climber, with square succulent stems. (C or Tu).
Yucca gloriosa. "Adam's Needle," &c. See pages 117, 118.

(6.)—ORNAMENTAL GRASSES AND SEDGES.

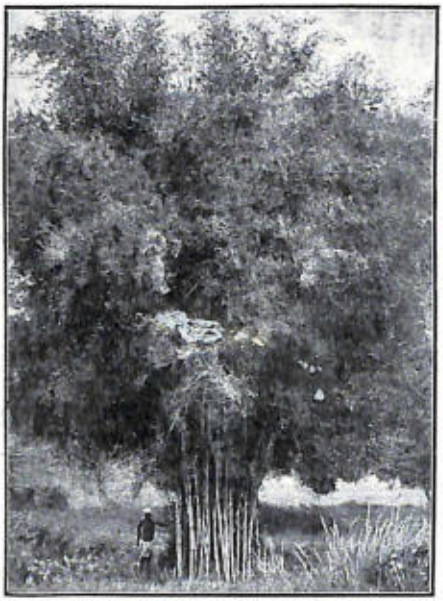
[THOSE MARKED† ARE BEST SUITED TO MEDIUM OR HIGH ELEVATIONS].

Anthistiria gigantea. Malaya. A handsome grass, 5-7 ft. high, with large, graceful, drooping, flowering panicles.
Arundo Donax variegata. Mediterranean, Egypt, etc. A bushy variegated grass, 6-8 ft. high, excellent for ornamental effect. Variegation best developed in poor sandy soil and sunny situation.
†Briza maxima. "Quaking grass." A small grass with elegant flowering panicles, valued for bouquets and cut-flower decorations. B.—minima is a smaller form.
Carex brunnea variegata. India. 1 ft. high. Suitable for growing in pots. (C)
Coix Lacryma-Jobi. Job's Tears; "Kirindi-maana," *S.* Ceylon, India & Malaya. An annual, 3-5, ft. high with hard, ovoid, bead-like fruit. See pages 308, 310, 448.
†Cyperus alternifolius. "Umbrella-plant." Australia.—An ornamental grass-like sedge, each leaf-stalk bearing a crown of diverging leaflets. See pp. 151, 174. §

C.—Papyrus. Egyptian Papyrus. Egypt.—A large, very handsome sedge, 6-8 ft. Each stout leaf-stalk bears at the top a brush-like bunch of long, filiform "leaflets." Suitable for swamps or water margins. See pp. 174, 430. $.

†Euchlaena (Reana) luxurians. "Teosinte." Guatemala.—An annual grass, 10-12ft. high or more; leaves 3 to 4 ft. long and 2 to 3 in. broad. Very handsome when in flower. See *Fodder Grasses*, p, 448.

†Eulalia zebrina. Zebra-grass. Stems and leaves with transverse bands of pale-yellow and dark-green, about 3 ft. high.



Bambusa siamensis. (SEE P. 174.)

†Gynerium argenteum. Pampas Grass, 4-6 ft.; produces large, handsome, erect, silvery white flowering plumes, 6-7 ft. high. Replant every second or third year, and manure well. See p. 187.

†Isolepis gracilis. Sub-tropics.—A favourite pot-plant for greenhouse and conservatory decoration, with pendulous filiform leaves, 6 to 9 inches long.

Oplismenus Burmannii variegatus. New Caledonia.—A very ornamental, creeping, variegated grass, the leaves being white with a central green or pink stripe.

†Panicum plicatum. Ceylon, India, etc.—A handsome grass, with large broad leaves, 2-3 ft. high.† P.—pulchrum; ornamental species, 2 ft.

Pennisetum longistylum. Abyssinia.—A handsome grass, 4-5 ft.

†Phalaris arundinacea. "Ribbon grass," or "Gardener's garter." S. Europe.—A small variegated grass, suitable for edgings, etc.

Tricholaena rosea. "Red-top Grass." Natal.—A handsome grass when bearing its masses of purplish crimson flowers, 1½-2 ft. high.

(7).—BAMBOOS AND BAMBOO-LIKE GRASSES, ETC.

(Prop. in rainy weather by su., div., or mature joints with buds.)

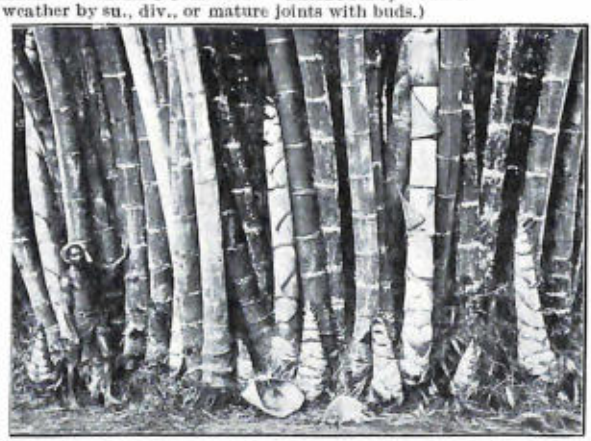
Arundinaria suberecta. A small elegant grass-like bamboo, with delicate, drooping foliage, 12-16 in. A favourite pot-plant in Ceylon; stands sun and drought well.

†Bambusa aurea. Japan. Stems yellow; light open foliage, very ornamental.

†B.—medake. "Female Bamboo." Japan. 10-15 ft. high, branches (culms) erect.

B.—nana. See p. 72.

†B.—nigra. India.—An interesting species, 25-30 ft.; stems dark purple when young.



Dendrocalamus giganteus. GIANT BAMBOO OF BURMA.

B.—siamensis. Burma and Siam. 25-30 ft. high. Fine foliage, in graceful plumes. An exceedingly graceful bamboo. See p. 172. §.

B.—vulgaris. "Una," *S.* Yellow-or Golden-bamboo. Ceylon, Tropics generally. A very handsome species, 35-50 ft., pale yellow stems, streaked with green, 3-4 in. in diameter. Most useful for scaffolding, building, making plant-pots, etc. Thrives best on river banks, up to 5,000 ft., in valleys.

Dendrocalamus giganteus. Giant Bamboo. Burma. A magnificent species attaining a height of over 100 ft., with clumps 40-50 ft. in diameter; stems 10 in. or more in diameter. Used for building, plant-pots, etc. The young shoots grow at the rate of a foot a day. §

D.—Hamiltonii. Tropical Himalaya. A fairly large species, suited to medium elevations.

D.—strictus. Male-or Solid-bamboo. India, Java, etc. A handsome spreading species, about 30 ft. high. Stems about 2 to 2½ inches or more in diam., sometimes almost solid; used for shafts, lance staves, fence posts, &c.

Garnotia Fergusoni. Ceylon. Graceful bushy grass; fl's in long panicles, 2-3 ft.

Gigantochloa aspera. Building Bamboo. Java. A graceful species, resembling the Giant-bamboo, 80-100 ft. or more, with stout, strong stems, 6-8 in. in diam.§



Gigantochloa aspera.
GIANT BAMBOO OF JAVA.

Gynerium saccharoides. Trop. America. A tall handsome grass, 15-20 ft., high with long ribbon-like leaves.

Melocanna bambusoides. "Muli" of India. A remarkable bamboo-like grass; stems isolated, not in close clumps; bears large, round, fleshy fruit, 2 in. or more in diameter, containing a large edible seed.

Ochlandra maculata. Mottled Bamboo "Rana-bata-li," *S.*, 12-15 ft., leaves 8-10 in. long by 2½ in. broad; stems blotched with brown, used for fancy furniture.

O.—Rheedii. Quill Bamboo. 12-15 ft. Leaves broad and long.

O.—travancorica. S. India. 15-20 ft. Large, handsome, broad leaves.

†Oxytenanthera Thwaitesii. Ceylon and S. India. A large reed, 10-12 ft., leaves 12 in. long by 1-1½ in. broad.

†Phyllostachys mitis. A handsome Japanese bamboo, 20-25 ft. high.

†P.—nigra. A striking bamboo with black stems. Japan.

Thysanolaena acarifera. Tropical Asia. A large, bushy, spreading reed, 8-10 ft., with large, broad leaves. Fl's in tall, greenish-white panicles.

(8).—ORNAMENTAL WATER PLANTS.

SUITED CHIEFLY TO LOW ELEVATIONS. See also pages 209-210.

[Those in brackets, though not aquatics, are adapted for growing in water, if in tubs or pots partly submerged.]

Acorus Calamus. Sweet Flag; "Wadakaha," *S. Aroideae.* L. 3-4, erect. (Div. or S).

Aponogeton distachyum. Water Ribbon-weed. *Naiadeae.* L. narrow, floating; fl's pale blue or white. (Div).

Azolla pinnata. *Rhizocarpeae.* Minute floating plants (pseudo-ferns) with pinnate leaves, forming a pretty light green or reddish sheet. Sporangia in leaf-axils.

(Carludovica palmata.) Large, palm-like leaves, 5-7. See under *Fibres*, page 425.

Ceratopteris thalictroides. Water-fern. *Filiceae.* Fronds pinnate, edible when tender; 1½-2. (Div. or spores).

(Chrysalidocarpus lutescens). Handsome, bushy, feathery palm. (Su or Div).
(Cyclanthus cristatus). *Cyclanthaceae.* Stemless plant, large leaves, 5-6 long. (Div).
(Cyperus alternifolius). " Umbrella grass. " See pale 171.



1, *Cyperus Papyrus.* 2, *C.—alternifolius.*

(C.—Papyrus). " Papyrus grass," See also pages 172, 430.

Eichhornia(Pontederia) crassipes. Water-hyancinth. *Pontederiaceae.* S.America. Upright, floating plants, leaves with large swollen petioles ; bears erect panicles of beautiful mauve or lilac fl's. See *Weeds*, p. 476. S.

Euryale ferox. *Nymphaeaceae.* Bengal. Large floating leaves with upright spines. Seeds edible. Cultivated in China for the latter.

Hedychium coronarium. *Scitamineae.* Fl's pure white, scented. (Rhiz).

H.—gardnerianum. Fl's pale yellow. Leaf-stalks of both spp. fibrous. See p. 184.

Lasia spinosa. " Kohilla, " S *Aroideae.* L. spinous, pinnatifid. (Div. or S).

Limnanthemum indicum. Water Snow-flake. *Gentianaceae.* Floating heart-shaped leaves. Fl's dingy white. (Div. or S).

Limnochairis (Hydrocleis) Humboldtii. Water Poppy. *Alismaceae.* L. oval, floating; fl's. bright yellow. (Div.or S).

L.—Plumieri. L. erect, pale green ; fl's small, yellow. (Div). Brazil.

(Ludovia crenifolia) *Cyclanthaceae.* Palm-like leaves, 3-4 ft. long. (Div.) See p. 153.

Marsilea quadrifolia. *Rhizocarpeae.* Small clover-like plant; each leaf composed of 4 leafflets, closing at night Resembles 4-leaved clover, but is allied to the Ferns. (Div. or spores). Fruit divided into several cells, springing from rhizome.

Monocharia hastaefolia. " Diya-habarala," *S. Pontederiaceae.* Fl's brilliant purplish blue. (Div). Myriophyllum proserpinacoides. *Haloragеae.* Floating feathery leaves. (Div).

Nelumbium speciosum. Lotus Lily ; " Sacred Bean " of Egypt; "Nelum," S. *Nymphaeceae.* Large handsome, peltate, circular, erect leaves; fl's large, bright pink or white, scented. leaves incapable of being wetted, owing apparently to waxy surface, but really to closely set minute hairs A beautiful plant Seeds and root-stock edible. See pages 379, 466. (S or Tu). S.



WATER LILIES IN PERADENIYA GARDENS.
1 and 4, *Victoria regia* ; 2 and 3, *Nelumbium speciosum.*

Nipa fruticans. "Nipa" or Water Palm. *Palmae.* Ceylon and Malaya. Pinnate-leaved palm, 8-10 ft., found in brackish water or lagoons near the sea. The leaves, in the form of "attaps," are largely used for thatch, &c., in Malaya. Toddy, sugar and spirit obtained from spadix. See pages 165, 362.

Nymphaea Lotus. Water Lily; "Olu," *S.* (*Nymphaeaceae*). Large, floating leaves; Fl's pale pink to bright crimson; open at night. Seeds edible. (Tu or S).$

N.—lutea. Fl's yellow, showy.

N.—stellata. "Manel," *S.* Fl's whitish-violet or pale blue. Liable to become a pest in up-country still waters. (Tu or S).

N.—sulphurea. Flowers pale to deep yellow.

Ouvirandra fenestralis. Lattice-leaf Plant. *Naiadaceae.* Madagascar. Curious lace-like floating leaves. (Tu).

Oxystelma esculentum. "Kulap-palai," *T.* (*Asclepiadeae*). Beautiful twiner with cream and pink fl's. (S or C). See p. 142.

Pistia Stratiotes. Water Lettuce. *Aroideae.* Small, floating, stemless rosette-like plants, resembling small cabbage-lettuces. (Su).

Pontederia crassipes. Water Hyacinth. See Eichhornia, p. 476. §

(Rhapis flabelliformis). Cane-palm. 5-6. (Div. or S). See page 169.



Victoria regia. GIANT WATER-LILY.

Sagittaria sagittifolia. "Arrow-head." *Alismaceae.* Large, sagittate leaves. (Div).

Schizocasia (Alocasia) Portei. *Aroideae.* Very large, pinnatifid leaves; stem 5-6 ft. or more. (Su). New Guinea.

Susum anthelminticum. "Induru," *S.* (*Flagellariaceae*). Long, floating shoots, with large erect, handsome panicles. (S or Div).

Typha angustilfoia. Bulrush. *Typhaceae.* Erect, ribbon-like leaves; fl's in long cylindrical brownish heads, borne on long stalks, 4-6. (Div). Trop. Asia.

Victoria regia. Giant Water-Lily. *Nymphaeaceae.* Immense, tray-like, floating, circular, peltate leaves, 5-7 ft. in diam., with a raised margin of 2½-3 inches; fl'r large, cream or pink, opens at dusk, strongly scented. A remarkably handsome plant of Guiana, introduced at Peradeniya in 1896. (S). $.

ZOOLOGICAL GARDENS CALCUTTA.

CHAPTER XV.

SELECTIONS OF ORNAMENTAL PLANTS, TREES, ETC. SUITABLE FOR UP-COUNTRY

1.—*FLOWERING TREES.*
2.—*FOLIAGE TREES.*
3.—*FLOWERING SHRUBS AND HERBACEOUS PERENNIALS.*
4.—*FOLIAGE SHRUBS AND HERBACEOUS PERENNIALS.*
5.—*ORNAMENTAL CLIMBERS & CREEPERS*
6.—*BULBOUS AND TUBEROUS PLANTS.*
7.—*ROSES.*
8.—*SHOWY ANNUALS AND PERENNIALS.*
9.—*SELECTED PLANTS SUITABLE FOR GROWING IN POTS AT HIGH ELEVATIONS.*

(1).—ORNAMENTAL FLOWERING TREES.

(THOSE IN LARGER TYPE ARE OF CHIEF IMPORTANCE).

Acacia dealbata. (*Leguminosae*). Silver Wattle; Mimosa Tree.—A small evergreen Australian tree with fine pinnate leaves, distinguished by the silvery-white under-side of the latter. Very ornamental when in flower, chiefly during Jan.-March and Sept.-October, with its large heads of yellow fragrant blossom. Excellent for wind-belts, but as a solitary tree its habit of sending up numerous suckers, which when once well established are difficult to eradicate, is an objection. Commonly grown at the higher elevations in India, Ceylon, &c.

A.—Baileyana.—A beautiful flowering and foliage tree of New South Wales, characterized by slender shoots and glaucous-green leaves, not unlike *A. dealbata*, bearing very long sprays of rich yellow flowers; grown in the Riviera commercially for the sake of the latter. The tree is grown on Fairfield Estate, Lindula, and elsewhere in Ceylon.

A.—cultiformis. (Knife-formed, in reference to the phyllodes). "Knife-leaved Acacia."—A small tree or large shrub, with pale yellow flowers, produced in the dry weather twice a year, and small oblong glaucous phyllodes which end in small sharp prickles. The tree is also ornamental on account of its foliage.

A.—decurrens. (Running down, in allusion to the union of the leaves with the stem). Common or Black Wattle (see pp. 217, 442). Bears a profusion of fragrant yellow flowers in the dry season. See p. 442.

A.—elata. "Mountain Hickory." Australia.—A handsome species with large, pale yellow inflorescence and open, feathery drooping foliage. Thrives at Hakgala Gardens.

A.—longifolia. (Long-leaved). "Sydney Golden Wattle."—A small spreading tree, very ornamental when in blossom, viz. during February to March, and July to August, the flowers being pale yellow.

A.—pycnantha. (Dense-flowered). Golden or Broad-leaved Wattle.—A medium-sized tree, with undivided leaves (*phyllodes*), native of Southern Australia. Very

ornamental during the dry season, when it bears masses of yellow blossom. Bark rich in tannin. See pages 217,-442.

Callistemon lanceolata. (*Myrtaceae*). Bottle-brush Tree.—A small tree with stiff, narrow leaves, native of Australia. It blossoms all the year round, but chiefly after the rains, when the scarlet flowers, crowded on spikes of the old wood in the form of a brush, are very attractive. Propagated by seed, which are very minute and should be sown in pots.

Calophyllum Walkeri. (*Guttiferae*). "Keena" or "Kina," *S.*—This is the familiar mountain "Kina" of Ceylon, a large handsome slow-growing tree with stiff coriaceous leaves, bearing from January to April a profusion of pinkish-white, sweet-scented flowers. C.—tomentosum is the "Keena" of mid-country. See p. 395.

Elaeocarpus glandulifera. (*Tiliaceae*).—A medium-sized tree, very handsome when in blossom, being then literally covered with racemes of creamy-white flowers.



Sterculia acerifolia.
FLAME TREE OF QUEENSLAND.

Eucalyptus ficifolia. (*Myrtaceae*). Scarlet-flowering Gum.—A small tree, native of Western Australia; the most showy of the Eucalyptus family, well worthy of cultivation for the sake of its magificent trusses of crimson flowers, irrespective of its claims as a shade or avenue tree.

Grevillea Banksii. (*Proteaceae*).—A small tree or tall shrub, 15-20 ft. high, bears terminal racemes, 4 to 5 in. long, crimson-pink blossom. Leaves silvery white, pinnatifid, 6-9 in. long.

Hymenosporum flavum. (*Pittosporaceae*). Eastern Australia.—A small tree, introduced into Hakgala Gardens about 1882; bears during the dry weather a profusion of small, pale yellow flowers. Propagated by seed.

Meliosma arnottiana. (*Sabiaceae*).—A moderate-sized tree, indigenous to the montane zone of Ceylon; bears a profusion of creamy-white flowers in April, being deciduous in January. "A great ornament to the montane forests when covered with its sheets of cream-coloured blossoms." (Trimen).

Pittosporum undulatum. (*Pittosporaceae*). "Victorian Laurel."—A small Australian tree, introduced and established at Hakgala Gardens; bears in March or April a profusion of fragrant, cream-coloured flowers.

Rhododendron arboreum. (*Ericaceae*). "Maha-ratmal," *S.*—A small tree, 15-30 feet high, common in the open patanas in the montane zone of Ceylon and South India, above 5,000 feet. Very conspicuous when bearing its large, dark-crimson or pink flowers, chiefly from May to August. Thrives best in clayey or humous soil, without lime.

Spathodea campanulata. See pages 94, 95. Thrives up to 4,000 ft.

Stenocarpus sinuatus. (*Proteaceae*). "Fire Tree" or "Tulip Tree" of Queensland.—An erect tree, 40 to 50 feet high, very showy when bearing its clusters of scarlet flowers, which are of peculiar construction. It has been established in Peradeniya Gardens since 1883; also thrives at

Hakgala Gardens. Flowers from May to July, and occasionally sets fruit in Ceylon. Suited to elevations of 1,500 to 4,000 feet.

Sterculia acerifolia. (*Sterculiaceae*). "Flame Tree."—A moderate-sized tree with large, glossy, angular-palmate leaves, native of Southern Australia, introduced into Ceylon in 1882. It grows and flowers at comparatively low elevations, but is more suited to the higher altitudes, thriving up to 5,500 feet in Ceylon. It produces in May and June, when bare of leaves, large masses of brilliant red blossom. Propagated by cuttings, or by seed when procurable.

2.—ORNAMENTAL FOLIAGE TREES.

Acacia decurrens var. mollissima. (*Leguminosae*). Black-, or Tan-Wattle.—A handsome quick-growing tree, 40 to 60 feet high, native chiefly of Eastern Australia; thrives in the tropics at elevations of 4,000 to 6,000 feet, on poor or rich soil. The tree has of late become popular at the higher elevations in Ceylon for planting amongst Tea for green-manuring or for wind-breaks. It affords good timber and excellent fuel. About 1,790 of the small flat seeds weigh 1 oz. See pages 217, 442.



Stenocarpus sinuatus.
A, SCARLET FLOWERS; *B*, FRUIT.

A.—melanoxylon. Blackwood or "Leafless Acacia."—A large, handsome tree, native of Southern Australia, characterized by usually having phyllodes only for leaves, rarely bearing pinnate leaves except in the young state. It furnishes a handsome and excellent timber; "one of the best woods in Victoria for railway carriages, furniture, etc." Wood splits well for shingles. The tree is rather a slow-grower and a greedy feeder, the roots spreading to considerable distances.

Acrocarpus fraxinifolius. Pink Cedar; Shingle Tree; Howlige-mara, *T.* (*Leguminosae*).—A medium-sized or tall, quick-growing, upright deciduous tree, with handsome, bipinnate leaves (crimson when young) and long, rather slender branchlets. Commonly grown in India as shade for Coffee. Wood used for shingles, furniture, tea-boxes, &c. Seeds small, flattish, brown; 1,600=1 oz. Several other species. See page 217.

Agathis (Dammara) robusta. See page 96.

Ailantus glandulosus. "Tree of Heaven" (*Simarubaceae*).—A very handsome tree, 60 to 70 ft. high, with large pinnate leaves; native of Malaya, &c. Similar to it is **A. excelsa,** see page 96.

Araucaria Bidwillii. (*Coniferae*). "Monkey Puzzle"; Bunya-bunya Pine.—A large stately tree with flat, scale-like, sharp-pointed leaves. See page 97.

A.—Cookii. See page 97.

A.—excelsa. Norfolk Island Pine.—A beautiful symmetrical tree, with regular tiers (whorls) of short, horizontal, spreading branches, attaining a great height; commonly grown in temperate countries as an ornamental pot-plant. Thrives at medium and high elevations in the tropics.

A.—Cunninghamii. Moreton-Bay Pine. Hoop Tree. See page 97.

Bucklandia populnifolia. (*Hamamelideae*).—A handsome tree, with large leathery, glossy leaves, native of the Himalayas. Thrives at Hakgala Gardens, but has not yet fruited there.

Castanospermum australe. (*Leguminosæ*). Moreton Bay Chestnut.—A moderate-sized tree with handsome pinnate leaves, native of Queensland, introduced into Ceylon in 1874. Bears stout brown pods, 6-8 in. long, containing 2-4 large chestlike seeds, which are edible though astringent. Thrives at low elevations.

Casuarina equisetifolia. (*Casuarineae*). See pages 97, 206, 216.

C.—montana. A handsome species on account of its very long drooping, cordlike branchlets (not true leaves), which are sometimes 20-24 in long, according to position; specially suited to the higher elevations.

C.—torulosa. Similar to C.—equisetifolia; specially suited to high elevations.

Cedrela serrulata. Red Toon; Red Cedar; "Java Mahogany." (*Meliaceae*). An upright, handsome tree with elegant, pinnate, serrated, long leaves, 50 to 60 ft. high, native of Sumatra, &c., much planted in the higher Tea districts of Ceylon for wind-breaks, timber, or ornament. Timber fragrant, of a reddish tint, easily worked.

C.—Toona. Toon Tree; "Indian Mahogany." India, Malaya, &c. A very handsome tree on account of its long, graceful, pinnate leaves, which when young are of a crimson tint. It grows to a height of 50 to 60 feet or more, and yields excellent reddish timber, which is of commercial value. See p. 216, 217.



1, *Cupressus macrocarpa*;
2, *Cupressus funebris*; BOTH IN FRUIT.

Cinnamomum Camphora. Camphor; "Kapuru-gaha," *S.* A small or medium-sized, evergreen bushy tree, suited to medium and high elevations. Usually furnished with foliage down to the ground, and generally assuming a conical shape, especially in a young state. See page 413.

Cryptomeria japonica. Japanese Cedar. (*Coniferae*).—An upright, conical, slow-growing tree, 25-50 ft. or more, leaves crowded in bunches; native of Japan, suited to high elevations in the tropics. Introduced to Ceylon about 1874, but rarely produces seed here and is not long-lived.

Cupressus (Chamaecyparis) funebris. Funeral-, or Weeping-Cypress. (*Coniferae*). North China.—An elegant tree with graceful, drooping branchlets ; a favourite tree for cemeteries.

C.—knightiana.—A tall, handsome, quick-growing tree, with feathery foliage, distinguished by its glaucous hue; native of Mexico, thoroughly established at the higher elevations in Ceylon and at hill stations in India. Seeds light brown, about 6,000 go to 1 oz.

C.—lawsoniana.—A small pyramid-shaped tree, with crowded fern-like foliage.

C.—macrocarpa. " Monterey Cypress."—A large, handsome, quick-growing tree, similar to *C. knightiana*, but distinguished from it by its more vertical, pointed branches and darker hue. Native of California. Seeds black, about 2,600 go to 1 oz.

C.—pyramidalis (=C.—fastigiata). A tall, somewhat erect tree, with whippy, closely adpressed branches, considered to be a variety of *C.—sempervirens.*

C.—sempervirens. Common Cypress.—A pyramid-shaped tree, with horizontal branches and feathery drooping foliage, native of South Europe, where it grows to a great height. It is especially ornamental in a young state. Thrives at high elevations.

C.—torulosa. Himalayan Cypress. Distinct, erect, rather close-growing tree.

Eucalyptus amygdalina. " Narrow-leaved" or " Peppermint Gum." *Myrtaceae.* Very tall tree of Victoria ; narrow, strongly scented leaves. The tallest tree recorded for Australia, see page 216, 513.

E.—citriodora. Lemon-scented Gum. A handsome tree with smooth white bark, native of Queensland. Leaves have an agreeable lemon-scented odour, and yield a valuable essential oil.

E.—globulus. Blue Gum. A tall tree, commonly grown in the hills of S. India, Ceylon, &c., for fuel and wind-belts. Very handsome on account of the glaucous-blue colour of the young leaves. Branches square-stemmed when young. Thrives best between 4,000 and 6,000 feet. In Australia, its native home, it attains a great height. Propagated by the minute seed.

E.—longifolia. " Woolly Butt." A medium-sized tree with long, drooping branches and long, narrow leaves, resembling " Weeping Willow."

Ficus macropyhlla. (*Urticaceae*). Moreton Bay Fig.—A large, spreading tree of Queensland ; large leathery leaves ; thrives in sheltered situations up to 6,000 ft.

Frenela (Callitris) rhomboidea. (*Coniferae*). An elegant Cypress-like tree, native of Australia, introduced and acclimatised at Hakgala Gardens, Ceylon, where it bears seeds freely. Very ornamental for lawns, etc.

Gingko biloba (Salisburia adiantifolia). Maiden-hair Tree, in allusion to the crowded fern-like leaves. (*Gingkoaceae*). China.—A handsome tree, 30 to 50 ft. high, commonly planted, especially around temples, in China and Japan for ornament or for its fruit, also in some warm temperate countries, sometimes as an avenue or street tree. The seed, called " Pa-kwo," is eaten and relished in China, being sold in the local markets. Not suited to tropical conditions. A small tree in Nuwara Eliya Park (6,000 ft.), Ceylon, has only grown to a height of some 6 ft. in about 12 years. The genus, formerly placed in *Coniferae*, represents a very ancient type, having occurred in the Tertiary strata of England.

Gordonia anomalum. (*Ternstromiaceae*).—A medium-sized handsome foliage tree, indigenous to the hill forests of Ceylon. " Very rare : I fear the extensive clearings have exterminated this fine species in most places." (Trimen).

Grevillea robusta. Silky Oak ; Silver Oak. (*Proteaceae*).—A medium-sized tree, native of Southern Australia, introduced into Ceylon in 1856, now extensively planted up-country amongst Tea for shade, as well as

for fuel, wind-breaks, and ornament. The pretty, fern-like leaves, which are silvery-white beneath, render the tree very ornamental. The tree does not thrive well under 1,000 feet. Wood very prettily marked, much used for furniture in Australia. Propagated by seed. See page 215.

G.—Barkleyana. A small, handsome tree with large, tri-lobed leaves, silvery white underneath.

Juniperus bermudiana. Bermuda Cedar. (*Coniferae*).—A medium-sized tree, with leaves of two forms. It thrives at elevations of 4,000 to 6,000 ft., and attains a height of 30 to 40 ft. at Hakgala Gardens.

Melaleuca leucadendron. (*Myrtaceae*). "Cajeput"; "Tea-Tree" of Australia.—A large tree of Malaya, N. Australia, etc., with graceful foliage and remarkable fibrous, scaly bark, which may be pulled off in large strips and is valued in native medicine. Thrives at medium to high elevations. See *Oils*, p. 398.

Pinus canariensis. (*Coniferae*). Canary Island Pine. An excellent pine for high elevations in the tropics and for sub-tropical regions. In its native home, the Canary Islands, it grows from sea-level to 9,000 ft. altitude. It is being extensively planted in S. Africa, and in Chili is said to be preferred to all other pines. The wood is remarkably durable, and the tree coppices well, *i.e.* sends out new shoots when cut down.

P.—densiflora. Japanese Pine. Long, slender, semi-erect branches; leaves in dense bunches. Established at Nuwara Eliya and Hakgala.

P.—insignis. Monterey Pine.—A Californian pine-tree, thrives best at elevations of 4,000-6,000 ft.; first introduced into Ceylon in 1868.

P.—longifolia.—An Indian pine-tree, remarkable for its long slender, pendulous leaves, which are 12 to 14 inches in length. Introduced at Hakgala Gardens, Ceylon, about 1885. Grows 60-80 ft. high in India.

P.—Montezumoe.—A large handsome pine-tree of Japan, with long spreading branches, introduced at Hakgala Gardens about 1880, and now well-established there. Leaves very long, in bunches of nine.

Quercus sessiflorus. British Oak. (*Cupuliferae*).—This and other species of Oak may, at least for a time, be grown with varying success at the higher elevations, but they seldom make good specimens. A plantation of British Oak was formed at Hakgala Gardens in 1883, and a few fertile acorns were produced in 1892. But the trees are not quite flourishing. The largest Oak tree in Ceylon is probably at Cuddesdon, Nuwara Eliya, being nearly 60 feet high and 8¼ feet round the stem at 3 ft. from the ground.

Rhodoleia Championi. (*Hamamelideae*).—A medium-sized spreading tree, with glaucous-grey foliage and bright-red flowers. It is a native of Hong-kong, and has become quite established in Hakgala Gardens, but does not seed there.

Salix babylonica. Weeping Willow. (*Salicaceae*).—A medium-sized tree with handsome drooping foliage and branches. Thrives at the higher elevations and is suited to moist localities. Easily propagated by cuttings.

Schinus molle. (*Anacardiaceae*). Pepper Tree; "Weeping Willow," so-called. A small, spreading tree with handsome, drooping, fine foliage (pinnate leaves), native of sub-tropical or temperate South America. It is best adapted to fairly high elevations or a sub-tropical climate; bears bunches of purple berries, which are ground and used for pepper. Prefers a dry district. Very ornamental. Prop. by seed or cuttings.

S.—terebinthifolius. An ornamental small tree of Brazil, similar to the preceding species, introduced at Peradeniya in 1884.

Syncarpia laurifolia. (*Myrtaceae*). "Turpentine-tree" of Queensland.—A tall, handsome, quick-growing tree, of an erect, symmetrical habit. Yields excellent timber. Established at Hakgala Gardens, where it bears seed. Introduced into Ceylon in 1890.

Thuja orientalis. Chinese Arbor Vitae. (*Coniferae*). A small, dense, bushy tree or shrub, of a conical shape, with latterally flattened branches, native of China and Japan.

Tristania conferta. (*Myrtaceae*). Queensland Box-wood.—A tall, handsome tree, with smooth, shiny, pointed leaves, suited to the higher elevations; attains a great height in Australia. Adapted for avenues, and yields excellent timber. Seeds not fertile in Ceylon.

(3).—FLOWERING SHRUBS AND HERBACEOUS PERENNIALS.

SEE ALSO PAGES 107-118.

(For abbreviations, see heading to Chapter 12, page 107).

Abelia chinensis. *Caprifoliaceae.* Pink fl's, 5-6. (C).
A.—grandiflora. White. 5-6. (C). A.—rupestris. Pinkish-white. 5-6. (C).
Abutilon, "Boule de Niege." *Malvaceae.* White. 4-5. (C).
A.—"Golden Fleece." Yellow, 5-6. (C). Numerous other varieties and species.
Allamanda Schottii. *Apocynaceae.* 3-5. Large, yellow, balloon-shaped fl's. (C or S).
Aloe Hanburyana. *Liliaceae.* Coral-red. 1-1½. (S or Su).
Althaea rosea. Hollyhock. *Malvaceae.* Rose-pink, etc. 3-5. (Div. or S). See p. 135.
Anigozanthus grandiflora. *Haemadoraceae.* Australia. 2-3. Yellowish-green. (C).
Aquilegia vulgaris (var's) Columbine. *Ranunculaceae.* Herb, perennial, 2-3. Fl's spurred, yellow, crimson, white, &c., very elegant. (S or Div.).
Aster Amellus. Michaelmas Daisy. *Compositae.* Hp. 2-3. Purplish-blue, mauve, &c. (Div).
Azalea, different varieties. *Ericaceae.* Red, pink, white, &c. 2-5. (L. or Div).
Begonia fuchsioides. *Begoniaceae.* Small, scarlet, drooping fl's; semi-climber. (C).
B.—bambusoides. 6 ft. or more. Tall bamboo-like stems; scarlet fl's.
B.—semperflorens. 1-2; pink or crimson shades. Several fibrous-rooted var's. See pages 191, 197.
Bellis perennis. Daisy. *Compositae.* White or pink. ¼. (Div).
Beloperone oblongata. *Acanthaceae.* Bright pink. 4-5. (C). Brazil.
Berberis cristata. Berberry. *Berberideae.* Yellow. 3-4. (C or S).
B.—Fortunei. Yellow. 3-4. (C or S).
B.—Leschenaultii. Yellow. 10-20. (C or Su). Many other species.
Brugmansia, see Datura.
Brunfelsia Hopeana. (=B.—uniflora, Franciscea bicolor). Floriferous; blue and white (blue fl's turn white), scented. 4-5. (C or S). Brazil.
Calliandra Guildingii. *Mimosae.* Pink, brush-like fl's; fine pinnate leaves. 6-8. (C or S). Mexico.
Callistemon brachyandrus. *Myrtaceae.* Yellow. 5-6. (C or S). Australia.
C.—lanceolatus. Bottle-brush. Crimson. 5-6. (C or S).
Camellia, numerous var's. *Ternstromiaceae.* White, pink, etc. 8-15. (L or C).
Campanula longifolia. *Campanulaceae.* Blue, 2-3. (C or S).



Callistemon lanceolatus. BOTTLE BRUSH.

C.—medium. "Canterbury Bells." Blue and white, large bell-shaped. 2-3. (S).
Carnations (Dianthus Caryophyllus). "Clove scented." *Caryophyllaceae.* White, rich shades of pink, crimson, mauve, &c. ½-1. Rich loamy soil. (C or S).
Cassia laevigata. (*Leguminosae*). Yellow fl's; glossy leaves. 6-8. (S).
C.—Tora. Bright yellow. 6-8. (S). C.—venusta. Australia. Yellow. 6-8. (S).

Cestrum aurantiacum. *Solanaceae.* See p. 109. Free-flowering. 5-6. (C or S). 8.
C.—(Habrothamnus) elegans. Crimson fl's and berries. 5-6. (C or S). Naturalised at Hakgala, etc. 8.



Cestrum elegans.

D.—chlorantha, fl. pleno. Yellow, double fl's. 6-8. (C).
D.—Knightii. Double Trumpet-flower. Large, white, double fl's. 8-12. (C.). See p. 385. All spp. of Datura poisonous.
Delphinium hybridum. *Ranunculaceae.* Several spp. or var's; rich shades of blue, mauve, &c. 3-4. (Div. or S).
Digitalis canariensis. *Scrophulariaceae.* Yellow. 2-3. (S or Div).
D.—purpurea. Foxglove. Purple. 2-3. Not generally suited to Tropics, but does fairly well at Hakgala Gardens. (S or Div).
Duranta Ellisii. "Duranta." *Verbenaceae.* White. 8-12. (C or S).
D.—Plumieri. Pale blue. 8-10. (C or S).
Erica. Different species and var's. *Ericaceae.* Small, beautiful flowering shrubs, chiefly of S. Africa; thrive best in peaty soil and dry climate.
Embothrium speciosa. See *Telopea.*
Eupatorium riparium. *Compositae.* Mexico. White. 5-6. (C).
Euphorbia splendens. *Euphorbiaceae.* Madagascar. Rose-scarlet. 2-3. Bronze, thorny stems and branches, sparsely foliaged. (C).
Franciscea bicolor. See Brunfelsia, p. 182.
Fuchsia arborescens. Tree Fuchsia. *Onagraceae.* Mexico. Lilac. 8-12. (C or S.)

Chelone (Pentstemon) barbata. *Scrophulariaceae.* Fl's scarlet, mauve, &c. 1½-2. (C).
Choisya ternata. "Mexican Orange." *Rutaceae.* White, scented. 4-5. (C).
Chrysanthemum pinnatifidum. *Compositae.* White, 2½-3. (C or S).
C.—sinensis. Numerous other species and varieties. White, pink, crimson, yellow, &c. 2-3. (C or S).
Clianthus Dampieri. "Glory Pea." of New Zealand. *Leguminosae.* Beautiful flowering, straggling shrub, difficult to cultivate.
Cleome pubescens. *Capparideae.* Panama. Greenish white, 4-5, spiny. (S or C).
Cotoneaster Simonsii. *Rosaceae.* Red berries. 3-4. (C or S).
Cuphea jorullensis (=C.—macrophylla). *Lythraceae.* Mexico. Orange-yellow. 2. (C. or Div).
C.—platycentra. "Cigar Flower." Red; 1-1½. (C, Div, or S).
Cyphomandra fragrans. *Solanaceae.* Argentina. Pale mauve or white. 10-12. (C or S).
Cytisus proliferus. "Tagasaste." *Leguminosae.* White. 4-6. (D or S).
Datura arborea. (=Brugmansia candida). *Solanaceae.* 8-10 ft.; fl's pure white, 7-8 in. long. (C).



Fuchsia arborescens.
TREE FUCHSIA.

F.—corymbosa. Peru. Scarlet fl's, in long drooping clusters. 6-8. (C or S).
Genista canariensis. Cape Broom. *Leguminosae.* Yellow. 3-4. (C or S).
Gynerium argenteum. Pampas Grass. *Gramineae.* Fl's in large white plumes; 4-6. (Div). Very handsome. See pages 172, 187.
Habrothamnus. See Cestrum.
Hedychium coronarium. *Scitamineae.* Pure white, scented. 4-6. (Div).
H.—gardnerianum. Similar to preceding sp. Fl's creamy-yellow. See p. 174.
Heliotropium peruvianum. Heliotrope. "Cherry Pie." *Borragineae.* Different. varieties. White, or pale to deep blue shades. 3-4. Sweet scented. (C).
Hibiscus rosa-sinensis. Shoe-flower. Numerous var's. See p. 111.
H.—syriacus. Small, erect sh.; bluish purple. Suited to high elevations. See p. 112. (C)
Hydrangea hortensis. Hydrangea. *Saxifragaceae.* Blue, pink, or white. 2-3. (C). See *Pot-Plants for Up-country*, page 203.
Hypericum canariensis. *Hypericineae.* Yellow. 5-6. (S or C).
H.—mysorense. Ceylon and S. India. Bright yellow, large fl's. 6-8. Very handsome shrub. (S or C).
Indigofera decora. *Leguminosae.* Pink, drooping racemes; 1½-2½. (C or Su). Naturalized at Hakgala, Ceylon.
Impatiens elongata. *Geraniaceae.* Bright rose-pink. 2. (S).
I.—Holstii. Rose-pink. 1-2. (C).
I.—Hookeriana. White fl's, veined with red. 3-4. I.—Walkeri. Scarlet. 2-3. (C)
Jasminum pubescens. *Oleaceae.* White, 6-8. (C).
J.—revolutum. Yellow. 6-8. (C). J.—Sambac. White. 5-6. (C). See p. 112.
Kniphofia aloides (=Tritoma uvaria). Torch Lily, or Red-hot-Poker. *Liliaceae.* Fl's in long, scarlet, erect spikes. 3-4. (Div).
Leptospermum scoparium. *Myrtaceae.* "Broom"- or "Tea-tree." Australia and New Zealand. Fine foliage; small white fl's, in great profusion. See also p. 187.



Pleroma macranthum (= *Tibouchina semidecandra*).

Lantana. Several spp. and var's. *Verbenaceae.* Flowers mauve, orange, pink, &c.; some var's very showy. 4-6. (S or C). See p. 113.
Laurestinus. See Viburnum.
Libonia floribunda. *Acanthaceae.* Fl's orange. 3-5. (C).
Lobelia cardinalis. "Cardinal Flower." *Campanulaceae.* Scarlet. 3-4. (C or S).
Luculia gratissima. *Rubiaceae.* Shrub, 2-4; fl's beautiful rose-pink, scented. (S or C).
Magnolia fuscata. "Madanakam-poo," *T. Magnoliaceae.* Fl's cream, strongly scented. Shrub, 6-8. (C or S).
M.—grandiflora. Large shrub or small tree. Fl's very large, 8 in. diam., pure white. (L.)
Melia Azedarach. Persian Lilac; Bead-, Nim-, or Neem-tree. *Meliaceae.* Shrub, or small tree with pinnate leaves; fl's pale lilac, in large panicles. India and China.
Montanoa bipinnatifida. "Tree Daisy." See pp. 113,115. White, in large sprays. 8-10. (C).
Moraea iridioides. *Irideae.* Herb. perennial. Blue and white. 2. (Div or S).
Musa coccinea. "Flowering Banana." See pp. 156,187. Scarlet, erect, inflorescence. 5-6. (Su)
Nandina domestica. Fl's pinkish white; numerous stems: 4-6. See pages 121, 122. S.
Nierembergia gracilis. "Cup Flower." *Solanaceae.* White and yellow. 2-3. (C or S).
Osbeckia rubicunda, see page 142.
Philadelphus coronarius. "Mock Orange." *Saxifragaceae.* Creamy-white. 6-7. (C).

Phlomis floccosa. *Labiatae.* Yellow; woolly foliage. 2. Egypt. (C).
Pleroma macranthum (=Tibouchina semidecandra). *Melastomaceae.* Large, violet-purple fl's. very showy; nearly always in flower. 8-12. (C or S). S

Plumbago capensis. *Plumbagineae.* S. Africa. Light-blue. 3-5. (C or Div). Prefers rather dry locality. Cut back after flowering.

Polygonum chinense. *Polygonaceae.* Creamy-white. 5-7. (C).

Reinwardtia trigyna. *Linaceae.* Bright yellow; fl's in small clusters. 4-5. (C).

R.—tetragyna. Yellow. 3-4. (C). Similar to latter species.

Rhododendron. *Ericaceae.* Numerous beautiful varieties, pink, crimson, mauve, white, etc. 4-8. (S). None of these most beautiful shrubs has yet been established in Ceylon, although R. —arboreum is indigenous. See p. 177.

Rubus rosaeflorus. *Rosaceae.* Dwarf bush, spreading by suckers; small, double, rose-like fl's, pure white. (C or Su).

Salvia involucrata. *Labiatae.* Bright pink. Distinct. 2. (C).

S.—leucantha. Silvery white foliage. Fl's purplish blue. (C or S).

S.—patens. Bright, deep blue. A beautiful plant, difficult of cultivation. 2. (C).

S.—splendens. Scarlet, very showy; free-flowering small shrub. 4. (C or S).

Sparmannia africana. "S. African Hemp." *Tiliaceae.* 5-8. Cordate, downy leaves; fl's in white clusters. S. Africa.

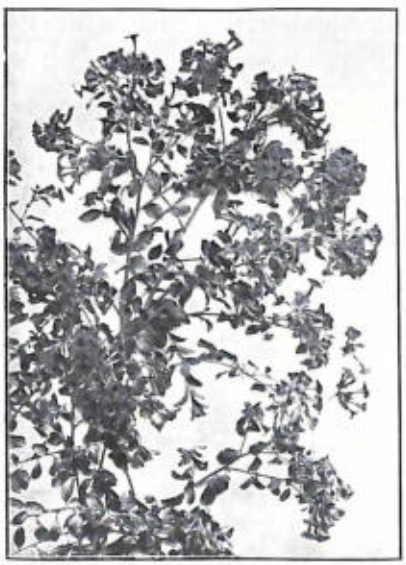
Spiraea media. *Rosaceae.* White. 4-5. (C or Div). See *Hedges*, p. 74.

S.—peruviana. Fl's white, double, large clusters. 5-6. (C or Div). See p. 74. §

Stevia Eupatoria. *Compositae.* Dingy white. 5-7. (C).



Spiraea peruviana. FLOWERS DOUBLE.



Streptosolen Jamesoni. FIRE BUSH.

Streptocarpus; numerous spp. and var's. *Gesneraceae.* Lilac, mauve, white, etc. ½. (S). Chiefly S. Africa.

Streptosolen Jamesoni. Fire-bush. *Solanaceae.* Fl's bright orange-yellow, in great profusion; very showy. 4-5. (C or S). Colombia.

Strobilanthes gossypinus. *Acanthaceae.* Fl's pale blue. 4-5. (C). See p. 188. Several other species, see p. 142.

Tecoma capensis. *Bignoniaceae.* Scarlet. 4-8. (C). S. Africa.

T.—Smithii. Hort. Orange-red. 6-8.

T.—stans. Yellow. 10-15. (S or C).

Telopea (Embothrium) speciosissima. "Waratah." *Proteaceae.* Beautiful flowering evergreen shrub of New S. Wales. 6-8. Fl's in large crimson spikes.

Tibouchina semidecandra. Correct name for Pleroma (or Lasiandra) macranthum. See p. 184.

Tree Daisy. See Montanoa.

Tritoma uvaria. See Kniphofia.

Veronica speciosa. Other spp. and var's. *Scrophulariaceae.* Blue, purple, white, &c. 2-3. (C or S). New Zealand.

Viburnum Tinus. "Laurustinus." *Caprifoliaceae.* White, scented. 5-7. (C).
Vittadinia triloba. Australian Daisy. *Compositae.* White, crimson-tinted. ½-1. (C).
Wigandia Viegieri. *Hydrophyllaceae.* Dark-blue, large fl's; large handsome leaves. 8-10. (C or S).
Yucca gloriosa. Adam's Needle. *Liliaceae.* Single-stemmed, 5-6. Fl's in large erect panicles. (Su. or C) see p. 118.

4.—FOLIAGE-SHRUBS AND HERBACEOUS-PERENNIALS.

See also pages 118-122.

Abutilon Thompsonii. *Malvaceae.* 3-4. Variegated leaves. (C).
A.—vexillarium. Lantern-flower. 4-6. Fl's yellow, balloon-shaped, drooping. (C).
Acalypha marginata. "Copper leaf." 4-5. L. coppery with a pink margin. (C).
Acanthus montanus. *Acanthaceae.* 3-4. Large, oval, spiny l.; fl's pinkish mauve. (C. or S).
Agave americana variegata. *Amaryllideae.* Large succulent leaves, streaked with pale-yellow, sharp-pointed; sometimes much recurved and grotesque. 6-8. (Su).
Aloysia citriodora. "Sweet-scented Verbena." See *Lippia.*
American Aloe, see Agave.
Anthericum liliastrum. "St Bruno's Lily." *Liliaceae.* 1-2. Variegated narrow leaves, suitable for edgings, etc. (Div).
Bambusa aurea. *Gramineae.* Japan. 10-15. Stems streaked yellow. (Div).
B.—Fortunei variegata. 3-6. Ornamental variegated foliage; thrives up to 6,000 ft. (Div or Su).
B.—nana. 6-8 or more. (Div). See pp. 72, 172.
Bay Laurel, see *Laurus.*
Beaucarnea longifolia. *Liliaceae.* Mexico. Stem 6-10, with large swollen base; long, strap-shaped leaves, like Dracaena. (S).
Begonia, fibrous-rooted. Numerous species and var's. 3-4. (C or div).
B.—bambusoides. 6-8. Handsome species; fl's scarlet, in large drooping clusters. (C or div.).
B.—socotrana. Different var's. 1-1½. Pink, crimson, &c. Floriferous. See pp. 133, 191, 197, 202.
Berberis Fortunei variegata. *Berberideae.* Variegated foliage. 4-5. (C).
Bocconia frutescens. "John Crow Bush." *Papavaraceae.* 8-12. Large handsome, oval, pinnatifid, leaves; fl's in large, creamy white panicles. (C or S).



Bocconia frutescens.

Buxus sempervirens. Boxwood. *Euphorbiaceae.* ½ to 6 ft. as desired. (C). See p. 75.
Cerasus Lauro-cerasus. Cherry Laurel. *Rosaceae.* Glossy, oval leaves. 8-10. (C). Only suited to high elevations.
Chlorophytum elatum. *Liliaceae.* Trop. America. 1-1½. Long variegated leaves. Suitable for edgings, etc.
Cineraria maritima. *Compositae.* 1-1½. Handsome silvery foliage, leaves deeply cut. (S or C).
Cordyline australis. *Liliaceae.* New Zealand. 15-20. Bears a crown of large, broad strap-shaped, green leaves.
Cotyledon metallica. *Crassulaceae.* Mexico. 8-12 in. L. large spathulate, succulent, purplish, glaucous.
C.—glauca. Mexico. 3-4. in. L. in dense rosette, glaucous, succulent. Excellent for edgings, etc. Formerly known as *Echeveria.*



Gynerium argenteum. PAMPAS GRASS.

Laurus nobilis. Bay Laurel. *Lauraceae.*

Leptospermum scoparium. *Myrtaceae.* New Zealand. 6-10. Fine foliage; fl's white, profuse. Leaves sometimes used as tea in native habitat.

Leucadendron argenteum. "Silver-leaf" of S. Africa. *Proteaceae.* 6-10. Prized for the silvery-white, long, narrow, deeply pubescent leaves, used as book-marks, etc. Not suited to wet regions. (S).

Libertia, see page 191,etc.

Lippa. ("Sweet-scented Verbena"). See page 189.

Melianthus major. "Honey Shrub." *Sapindaceae.* 3-4. Glaucous, pinnate leaves; fl's rich in honey. (C or Div). S. Africa.

Musa coccinea. Flowering- or Chinese Banana. See p. 184 S.

M.—Ensete. Abyssinian or Tree Banana. Abyssinia. 8-10. Very large handsome leaves; single stem. (S).

Myrtus communis. Myrtle. *Myrtaceae.* 8-10. Small evergreen l., fl's white, scented. (S or C).

Nandina domestica. "Nandin"; "Sacred Bamboo." *Berberideae.* China and Japan. Numerous erect stems. 5-7. Small leaves. (C or Div). See p. 184.

Nolina, see *Beaucarnea.*

Periwinkle, see *Vinca*

Dicentra (Dielytra) spectabilis. Lyre Flower. *Fumariaceae.* Pink. 1-1½. (C). Queensland.

Doryanthes Palmeri. Spear Lily. *Amaryllideae.* Large, sword-shaped, radical leaves, 6-8. Flowering stalk 15ft. or more. Fl's dark crimson. (Su or S).

Dracaena arborea. Small tree, 30-40 ft. Cent. Africa.

Echeveria, see Cotyledon.

Erigeron grandiflorus. *Compositae.* 2-3. Purple, mauve, &c. Perennial. (C).

Erythrina Vespertilio. See p. 120.

Furcraea gigantea. Mauritius Hemp. *Amaryllideae.* 6-8. See *Fibres,* p. 424.

Gunnera manicata. *Haloragaceae.* S. Australia, New Zealand, &c. Herbaceous stemless plant; very large, rough, palmately-lobed leaves, up to 6 or 7 ft. in diameter. Suited to high elevations, requiring moist shade, as by side of ponds. See "Ape-ape" of Hawaii.

Gynerium argenteum. Pampas grass. *Gramineae.* 5-6. Fl's in large, erect, white plumes, chiefly Jan-Mar. See page 172. S.

Iresine Herbstii. *Amarantaceae.* Herbaceous shrub, 2. Bright crimson leaves, with creamy white nerves. (C).

I.—Lindeni. 1½-2. Dark crimson or coppery, lanceolate leaves. (C).



Musa coccinea. FLOWERING BANANA. 1. Scarlet inflorescence.

Phormium tenax variegatum. *Liliaceae.* New Zealand Flax. 5-6. Leaves variegated, sword-shaped. (Div). See *Fibres*, p. 425.
Podocarpus macrophylla. *Coniferae.* 6-8. Long, linear, ornamental leaves. (S or C).
Prunus lusitanica. Portugal Laurel. *Rosaceae.* 6-12. (C).
Santolina chamaecyparissus. Cotton Lavender. *Compositae.* 1-2. Small linear leaves ; whole plant silvery white, strongly scented. (C or div). l. See page 75.
Strobilanthes gossypinus. *Acanthaceae.* India. 4-5. Dense bush ; leaves silvery grey, very striking. (C).



Strobilanthes gossypinus.

Thalictrum adiantifolium. *Ranunculaceae.* Fine Adiantum-like foliage. 2-3. (Div. or S.)
Vinca minor. Periwinkle. *Apocynaceae.* Creeper or trailing shrub, 1-2. Fl's blue. (C). There is also a form with variegated leaves.
Xanthorrhoea australis, and other spp. *Juncaceae.* "Grass-tree." Australia. Curious grass-like plants, attaining 10-15 ft. or more in height, with stout stems.

(5).—ORNAMENTAL CLIMBERS AND CREEPERS.

Indicating purposes for which mainly suited. See also pp. 122-131.

Abronia umbellata. (Annual). *Nyctagineae.* California. Lilac or pink. Hanging pots. (C).
Allamanda Hendersoni. *Apocynaceae.* Brit. Guiana. Large yellow fl's. Trees, fences, etc. (C). Several other spp. or var's.
Ampelopsis Veitchii. "Virginian Creeper." *Ampelideae.* N. America. Leaves bronze. Walls or pillars. (C). Only suited to sub-tropics or cool regions.
Begonia fuchsioides. *Begoniaceae.* Mexico. Scarlet. Pillars, verandahs, etc. (C).
Bignonia capreolata. *Bignoniaceae.* N. America. Pink and yellow. Arbours and arches. (C).
B.—venusta. "Tanga-poo," *T.* Orange-yellow. Arbours, banks, arches, etc. (C).
Bomarea Carderi. *Amaryllideae.* Colombia. Bright pink, spotted yellow or white, tubular, pendulous fl's, in clusters. Pillars, etc. (C).
Bougainvillea spectabilis. *Nyctagineae.* S. America. Several crosses or var's,—purple, rose, brick-red, &c. Very showy. Trees, fences, etc. (C). See pp. 108, 128.

Cassis viminea. *Leguminosae.* W. Indies. Yellow.—Trees, pillars, etc. (C).
Clematis. Several spp. and var's. *Ranunculaceae.* White, violet, blue, etc. Walls, arbours, etc. (C).
Clianthus Dampieri. "Glory Pea." New Zealand. See *Flowering Shrubs*, p. 183.
Cobaea scandens. *Polemoniaceae.* Mexico. Greenish purple, bell-shaped flowers. Suited to tall trees, fences, etc. (S and C).
Convolvulus, different var's. *Convolvulaceae.* Various shades. Fences, arbours, &c.
Crotalaria semperflorens. *Leguminosae.* Ceylon, etc. Yellow. Rockeries, etc. (S or C).
Dumasia villosa. *Leguminosae.* Nepal. Yellow. Pillars and arbours. (S or C).
Ecballium Elaterium. "Squirting Cucumber." *Cucurbitaceae.* S. Europe. Fruit 2. in. long when ripe; on being touched, it ejects a number of seeds with fluid.
Ficus repens (=F. stipulata). *Urticaceae.* Ceylon, etc. Small ornamental foliage. Creeper on walls or trellis work. (C). See p. 135.
Fuchsia radicans. *Onagraceae.* Brazil. Scarlet. Pillars, banks, etc. (C).
Hardenbergia monophylla. *Leguminosae.* Australia. Blue. Hanging-pots, etc. (S or C.).
Hedera Helix. Ivy. *Umbelliferae.* Europe. Handsome foliage, angular leaves. Creeper on walls, or banks. (C).
Hibbertia dentata. *Dilleniaceae.* Australia. Yellow fl's. L. entire, oval. Trees or trellises. (C).
Hoya carnosa. Wax Flower. *Asclepiadeae.* Queensland. Pale-pink. Pillars, trellis-work, tree-trunks, etc. (C).
Ipomoea rubro-coerulea. *Convolvulaceae.* Mexico. Large blue, crimson tinted. (C).
I.—Learii. Trop. America. Bright purplish blue. Trees, fences, &c. (C).
I.—versicolor. Correct name for Mina lobota, which see.
Jasminum pubescens. White Jasmine. *Oleaceae.* White. (C).
Lapageria rosea. *Liliaceae.* Chili Sub-tropical. White and crimson. (C).
Lathyrus latiflorus. Perennial Pea. *Leguminosae.* Europe. Pink, etc. Fences, walls, etc. (S or C).
Lippia citriodora. "Sweet-scented Verbena." *Verbenaceae.* 2-3. Leaves sweet-scented. (C). Slender shrub, suitable for training against walls, &c.
Lonicera caprifolia. European Honeysuckle. *Caprifoliaceae.* Yellow or white fl's, scented. Tree trunks, arbours, etc. (C).
L.—japonica. Japanese Honeysuckle. Red and white, strongly scented. (C).
Lophospermum scandens. See Maurandia.
Mandevilla suaveolens. *Apocynaceae.* Argentina. White, scented.—Trellis-work, etc. (C or S).
Maurandia barclayana. *Scrophulariaceae.* Mexico. Violet-purple.—Trellis-work, etc. (C or S).
M.—erubescens. Mexico. Rose-pink. Trellis-work. (C or S).
Mina lobata. (=Ipomoea versicolor). *Convolvulaceae.* Orange-yellow. Small, elegant climber, suited to dry districts, 4-6 or more; fl's one-sided raceme (scorpioidial). (C or S).
Nasturtium, see Tropaeolum, page 190.
Passiflora edulis. Passion-flower. *Passifloraceae.* W. Indies. Greenish white.—Fences, trees, etc. (S). See page 279.
Rhaphidophora decursiva. "Dada-kehel." *S. Aroideae.* See p. 132.
Rhyncosperma cyanosperma. *Leguminosae.* Bright red or white.—Rockeries, etc. (C or S).
Roses, climbing. See article on Roses.—Fences, arbours, etc. (C or L).
Rubus (Bramble). Several species. *Rosaceae.* Trees, fences, etc. (C or S).

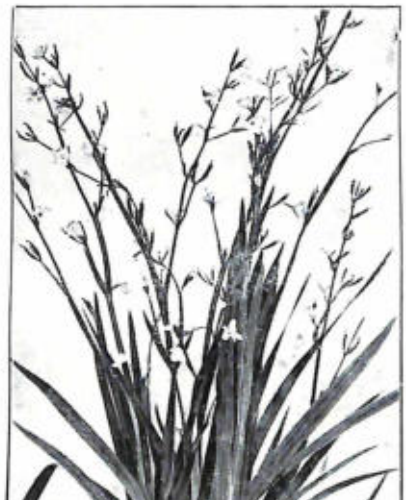


Solandra macrantha.

Schmidia bicolor (=Thunbergia wightiana). Arbours, arches, etc. See below.
Semele androgynus. *Liliaceae.* Canary Islands. Handsome foliage, no true leaves. Suited to tall trees. (C).
Senecio scandens. *Compositae.* S. Africa. White.—Fences, walls, or pillars. (C.)
Smilax argyraea. *Liliaceae.* Bolivia. Variegated foliage. Trees, etc. (C).
S.—ornata. Similar to latter species; large variegated leaves. Trees, etc. (C).
Solandra grandiflora. *Solanaceae.* Jamaica. Fl's large, trumpet-shaped, creamy white. Suited to large trees. (C).
Solanum jasminoides. *Solanaceae.* S. America. White, in large clusters, free-flowering. Fences, arbours, arches, trees, etc. (C).
Swainsona. Several spp. *Leguminosae.* Australia. 3-5. Fine pinnate leaves. Fl's white, pink, purple, &c. (C or S).
Tacsonia mixta. *Passifloraceae.* Peru. Long, drooping, pink fl's. Fruit yellow, ovoid 3-4 in. long, edible. Pillars, arbours, etc. (C).
T.—quitensis. Peru. Long, tubular drooping, pink fl's. Pillars, arbours, etc.
T.—vanVolxemii. Colombia. Scarlet. Pillars, arbours, etc. (S and C).
Tecoma jasminoides. *Bignoniaceae.* Queensland. Waxy-pink and white. Pillars, arbours, etc. (C).
Thunbergia fragrans. Ceylon, etc Pure white, not-scented. Rockeries, etc. (S and C).
T.—grandiflora. (See *Climbers for Low elevations*, pp. 127, 130). Trees and fences.
T.—wightiana, correct name for Schmidia bicolor. Elegant climber; fl's in drooping racemes, corolla yellow; bractlets large, half brown, half yellow.
Tropaeolum perigrinum. *Geraniaceae.* Bright yellow. Trellis-work, pillars, etc.(S)
T.—majus. Nasturtium. Peru. Orange-yellow. (C or S). Different var's, double or single fl's. Pillars, banks, rockeries, &c.
T.—Lobbianum. Colombia. Scarlet. (S or Tu).
Vinca minor. Periwinkle. *Apocynaceae.* Europe. Fl's blue.—Rockeries, hanging, pots, &c. (C). See page 188.
Wistaria sinensis. *Leguminosae.* Japan. Blue and purple.—Verandah walls, tree-trunks, pillars, &c. (C). Beautiful plant; thrives best under protection of a house, facing morning sun; does not flourish in a wet climate.

(6).—ORNAMENTAL BULBOUS OR TUBEROUS PLANTS.

(*See also pages* 136-139).



Aristea Eckloni.
FLOWERS BRIGHT BLUE.

Agapanthus umbellatus. "African Lily." *Liliaceae.* Beautiful bright blue; large heads. 2-2½. Also a white-flowered variety. S. Africa.
Albuca aurea. *Liliaceae.* S. Africa. Greenish-yellow. 2.
Allium fragrans. *Liliaceae.* White. 1. Also numerous other species.
Alstromeria multiflorus. *Amaryllideae.* Orange-yellow. 2-3. S. America.
A.—psittacina. Crimson. 1½-2.
Amaryllis Belladonna. Belladonna Lily. *Amaryllideae.* Bright pink. 1. S. Africa.
Anthericum liliastrum variegata. St. Bruno's Lily. *Amaryllideae.* Variegated narrow leaves. "Foliage" plant. 1. S. Africa.
Antholyza bicolor. *Irideae.* Scarlet and green. 2. S. Africa.
Arisaema Leschenaultii. *Aroideae.* Cobra Lily; Wal-Kidaran, *S.* Leaves lobed; fl's dark purple and green, 1-2. Ceylon and India.
Aristea Eckloni. *Irideae.* S. Africa. Bright blue. 1½-2. Naturalised in Ceylon.
Arthropodium cirrhatum. *Liliaceae.* White. 2. New Zealand.

Arum Lily. See *Richardia.*
Begonia, "Tuberous-rooted" and "Bedding." *Begoniaceae.* Numerous var's, scarlet, yellow, pink, etc. 1-1½.
Belamcanda chinensis. Leopard Lily. *Irideae.* Orange-red, spotted brown. 1½.
Canna, see p. 137.
Clivia, see *Imantophyllum.*
Crinum asiaticum. *Amaryllideae.* *S.* White. 3-4. India, etc.
C.—giganteum. Large, white. 3-4. Trop. Africa.
C.—Moorei. Monsoon-lily. S. Africa. Large fl's, delicate pink. 2-3.
Crocosmia aurea, =Tritonia aurea.
Cyrtanthus carneus. *Amaryllideae.* S. Africa. Bright-red. 1. Excellent for border edging and rockeries.
C.—sanguinea. Ifafa-lily. S. Africa. Fl's tubular, salmon-pink. 1.
C.—Mackenii. African-Bride Lily. White. 1. Natal.
Dahlia. *Compositae.* 2½-3. Double and single var's; several types, including "Cactus," "Paeony," "Collarette," "Anemone," &c. Very showy. See p. 138.
D.—imperialis. White fl's, strong-growing species. 5-6. Mexico.
Freesia refracta. *Irideae.* Creamy-white, strongly scented. 2½. S. Africa.
Gladiolus. Corn-flag. *Irideae.* S. Africa. Numerous species and var's; different colours, scarlet, yellow, purple, crimson, white, &c. 2-3. Thrives from about 2,000 ft. upwards.



Crinum Moorei MONSOON LILY.

Gloxinia, see pages 138, 203.
Hemerocallis aurantiaca. "Golden Lily." *Liliaceae.* Bright yellow, large fl's. 2½.
H.—fulva. "Day Lily." Orange-yellow. 1-1½. S. America.
Hippeastrum equestre. "Knight's Star-Lily." *Amaryllideae.* Trop. America. Bright red; 1-1½. Different var's and shades.
Imantophyllum (Clivia) miniata. *Amaryllideae.* Scarlet. 1-1½. S. Africa.
Iris, different var's. *Irideae.* Yellow, purple, blue, etc. 1-1½. Very showy, but suited to temperate or sub-tropical conditions only.
Ismene (Hymenocallis) calathina. "Peruvian Daffodil." *Amaryllideae.* White, fragrant, 1-2. Peru.
Isoloma bogotense. *Gesneraceae.* Yellow and red. 1-1½. Trop. America. See p. 138.
I.—molle. Scarlet and yellow. 1-1½. Forms runners above ground; scaly leaves.
Ixia pendula. *Irideae.* Fl's pink, on long drooping stalks. 2-2½. Different species: white, crimson, yellow. S. Africa.
Lachenalia aurea. *Liliaceae.* Orange-yellow. ½-¾. S. Africa.
Leucojum aestivum. "Snow Flake" *Amaryllideae.* White. S. Europe.
Libertia formosa. *Irideae.* White. 1½. L.—paniculata. White. 1½. Australia.
Lilium longiflorum. *Liliaceae.* Madonna Lily. Large, white; 2.
L.—Harrisii. Easter-or Bermuda-Lily. Large, white fl's.
L.—auratum. Golden-rayed Lily. White or yellow with orange spots. 3-4.
L.—candidum. White. 2-3. Said to be the true Madonna Lily.
L.—Martagon. Turk's Cap, or Martagon Lily. *Liliaceae.* Purple or lilac. 3-4.
L.—nepalense. Nepaul-lily. White 2-3. L.—tigrinum. "Tiger Lily." Orange 2-4. China and Japan. Bulbs edible.
Lycoris aurea. *Amaryllideae.* Yellow. 1.; China. L.—radiata. narrow leaves. L.—sanguinea; crimson, 1½. China.
Marica coerulea. *Irideae.* Blue. 2. Several other species. Trop. America.
Montbretia, see *Tritonia.*
Moraea iridioides. *Irideae.* Pretty blue and white. 2. S. Africa.

M.—i.— var. Johnsoni. Similar to latter, but with much larger fl's.
Nerine japonica (=Lycoris radiata). *Amaryllideae.* Red. l. China and Japan.
N.—sarniensis. Guernsey Lily. Crimson and rose. l. S. Africa.
Ornithogalum nutans. Star of Bethlehem. *Liliaceae.* White, etc. l.
Pardanthus, see Belamcanda.
Phaedranassa chloracra. *Amaryllideae.* Crimson. l. Ecquador.
Richardia (Calla) africana. Arum-or Easter-lily. *Aroideae.* Large, white. 2. S. Africa.
R.—elliottiana. Yellow. 2. Both species indigenous to S. Africa.
Sparaxis grandiflora. *Irideae.* S. Africa. Corn-lily. Purple, white, etc. 2.
S.—tricolor. Orange and yellow, large fl's. 2. S. Africa.
Sprekelia formosissima. "Jacobaea Lily." *Amaryllideae.* Deep crimson, declinate; distinct l. Mexico and Guatemala.
Tigridia Pavonia. Tiger Lily. *Irideae.* Mexico. Orange-red. 1½-2½.
Tritoma uvaria, see Kniphofia.
Tritonia (Montbretia) crocosmaelflora. *Irideae.* Bright orange-yellow. 1½-2½. Naturalised about Hakgala and Nuwara Eliya. T.—aurea.=Crocosmia aurea. Yellow and scarlet. 2. S. Africa.
Vallota purpurea. "Scarborough Lily." *Amaryllideae.* Red and crimson. 1-1½. S. Africa.
Watsonia augusta. *Irideae.* Scarlet. 1½-2. Resembling Gladiolus. S. Africa.
W.—densiflora. Bright-crimson or rose. 2. W.—rosea. Pink. 1½-2.
Zephyranthes candida. Zephyr Lily. *Amaryllideae.* White. l. S. America.
Z.—carinata. "Rose Amaryllis." Bright rose, l. Z.—tubispatha. White. ½.
A.—Andersoni. Crocus Lily. Yellow, ½. S. America.

(7).—ROSES.

The fact that certain classes of the Rose, "Queen-of-flowers," can, with careful attention to cultivation and to selection of varieties, be grown with considerable success, not only in the hills, but also at all elevations down to sea-level, is one of the most satisfactory features of horticulture in the tropics. Roses can usually be had in blossom all the year round, and though they are generally lacking, especially at low elevations, in size and form of bloom as well as in the delightful fragrance which is so characteristic of these flowers in cooler climes, in upcountry gardens blooms of remarkably good quality may sometimes be seen.



RAMBLER ROSE "EUPHROSYNE."

The following hints may be considered as preliminaries to success in growing roses: Choose a site with full exposure to the sun, shade from trees or houses being detrimental to the plants; protection from wind is necessary in the hills. Generally speaking, soil on a clay foundation (i.e. sub-soil) is best, while a light sandy

soil is the least suitable. Perfect drainage at the roots is essential, and terraced beds, especially in wet districts, are generally found to give the best results. The beds or borders should be dug 2 to 3 ft. deep, filled in with large and gradually smaller stones to about 8 or 10 inches, then a layer of litter covered with a layer of clayey soil, the remainder being filled with equal proportions of top soil and well decomposed manure. The plants may be spaced about 4 ft. apart each way, in rows. If the land be flat, the soil should be raised into beds, so as to ensure good drainage. During periods of drought, a mulching of stable manure should cover the surface of the beds, so as to check evaporation of moisture. Young plants should be chosen for planting out. Any flower buds that may appear early should be removed, as the plants should not be allowed to bear blooms until at least 3 to 4 months after planting. In dry weather, the plants must be liberally watered.

Manuring.—Roses require liberal manuring, and farmyard manure, though liable to attract white-ants unless in a well-decomposed state, is the best. If, however, a sprinkling of lime, vaporite, or cyllin powder is applied at the same time, this danger is obviated to a considerable extent. Castor-cake is also a good manure for roses. Phosphatic manures are conducive to free blooming; while basic-slag and bone-dust at the rate of about ½ lb. each per plant are especially recomended. An application of liquid manure once or twice a week is most beneficial (see *Manures*). The following is a useful mixture: Bone meal, 12 parts; sulphate of potash, 10 parts; sulphate of ammonia, 5 parts; gypsum, 1 part. This mixture may be used at the rate of ½ lb. to each plant or per square yard, and for practically all sorts of garden plant as well as roses.

Pruning Roses.—As a general rule Tea, Noisette, and Bourbons, which are the only kinds suited to low elevations, do not need much pruning beyond the removal of worn out or dead wood. Branches that have made vigorous growth or have finished flowering should be cut back, otherwise the plants will assume a ragged, straggling form. Roses always flower on new wood. Thin, spindly shoots should be removed from the centre of the bush. The Hybrid Perpetual varieties are generally benefited by hard pruning, and this is best carried out in Ceylon usually towards the end of October; thus the new growth which follows should afford a display of bloom during the "dry season" in the hills, viz., February to May. At low elevations, moderate pruning should be resorted to after each crop of blooms is over, the plants being cut back and shaped, and the soil forked up and manured after the operation. See *Pruning*, pages 52-54.

Propagation.—This is invariably effected in the tropics by cuttings or layering, as plants on their own roots usually thrive best. Cuttings of well ripened shoots may be put down at any time, except during a dry period; they strike best in fine sandy soil, or in a mixture of fine sand and charcoal or lime-rubble. They should be cut with a "heel," inserted in the ground sloping-wise, and kept moist and shaded. When new growth is visible, the shade may be gradually reduced. Layering is adopted in the case of varieties which do not propagate easily by cuttings, *e.g.* "Marechal Niel," and this may be effected almost all the year round. The layered shoot is pegged down into a bamboo-joint filled with fine sandy soil, the new plant being thus easily removed when it has developed roots and become independent of the parent plant.

Roses in pots or tubs.—In the low country or hot, dry regions, roses generally do better in pots or wooden tubs than in an open border, owing to unfavourable conditions of soil or climate. The requirements of the plants can thus be best supplied, the tubs being filled with only the best soil and provided with efficient drainage, while they may also be moved as desired and afforded the most suitable spot in regard to light and shelter.

Diseases.—Roses are, on the whole, comparatively free from diseases in the tropics, the most prevalent being mildew, "leaf spot" or "black spot," both fungus diseases. An occasional sprinkling of sulphur and dry arsenate of lead (1 part of the latter to 9 of the former), or spraying with diluted formalin (say, one tablespoonful to a gallon of soft water) are useful preventives. See p. 494. Mildew sometimes attacks roses as a result of severe drought or excessive moisture at the roots. Maintaining the plants in good condition, as by watering them frequently in very dry whether, pressing down the surface soil if loose, or covering it with a loose, rich mulch if hard is probably the best safeguard against diseases.

Importing Roses. When new plants or varieties are required, they should, when practicable, be obtained from a reliable firm which specialises in these plants. Being packed dry, when in a dormant state, the plants take up but little space and can be transmitted in small packages by post. A good firm can be relied upon to supply good varieties, but it is well to remember that only roses on their own roots are adapted to the tropics, also that "standard roses" are not suitable. Small rooted cuttings travel well when their roots are in a ball of adhesive earth and surrounded by moss and waterproof paper; the stems, however, must have air, or will rot in transit. When imported plants arrive, especially if the weather be dry, they should be grown in bamboo or other pots in the shade for a few weeks before planting out. See p. 505.

Classes.—The success of rose cultivation in the tropics very largely depends on the kinds or varieties chosen. This is more specially true of the plains or low elevations, where, as a rule, only "Teas," "Noisettes" and "Bourbons" will thrive. "Hybrid Perpetuals" are, as already stated, generally unsuited to elevations below 3,000 ft., and even in the hills may, with few exceptions, be superseded by beautiful Hybrid-Tea varieties, which flower more freely and almost all the year round.

HYBRID PERPETUAL ROSES.

SUITABLE FOR ELEVATIONS ABOVE 3,000 FT.

Abel Grand.—Rose blush.
Charles Lefebre.—Crimson.
Baron Rothschild.—Brilliant crimson.
Baroness Rothschild.—Bright pink.
Beauty of Waltham.—Rosy-crimson.
Ben Cant.—Bright crimson.
Black Prince.—Dark crimson, shaded with black.
Captain Hayward.—Carmine-red.
Duke of Edinburgh.—Scarlet crimson.
Dupuy Jamain.—Bright cerise.
Frau Karl Druschki.—Pure white, very large blooms; now "Snow Queen."
Her Majesty.—Satiny rose, large blooms.
Hugh Dickson.—Brilliant crimson.
John Hopper.—Bright rose.
Jules Margottin.—Bright carmine.
Lord Raglan.—Scarlet crimson.
Madame Eugene Verdier.—Deep pink
Madame Victor Verdier.—Cherry red.
Maharaja.—Deep crimson, single fl's.
Margaret Dickson. White, rose centre.
Marie Baumann.—Bright carmine.
Mrs John Laing.—Delicate pink.
Paul Neron.—Deep rose.
Prince Camille de Rohan.—Deep velvety crimson-maroon.
Senateur Vaisse.—Scarlet.
Victor Hugo.—Bright crimson.
Xavier Olibo.—Very dark-red, velvety.

CLIMBING ROSES

SUITABLE FOR TRAINING ON ARCHES, FENCES, PREGOLAS, PILLARS, ETC

(THOSE MARKED * ARE SUITED TO LOW ELEVATIONS).

*Aimee Vibert.—White.
Ard's Rover.—Crimson, good bloomer.
Blush Rambler.—Crimson.
*Celine Forestier.—Rich sulphur-yellow.
*Devoniensis. (Climbing). Creamy-white or carmine.
Euphrosyne.— Bright carmine. Commonly grown on fences, &c., at the higher elevations in Ceylon, where it flowers profusely, especially during March-May. See p. 192
Duchesse d'Anersloedt.—Yellow.
Felicite Perpetue.—Creamy white.
*Gloire de Dijon.—Orange-yellow, shaded salmon.
*Gruss an Teplitz.—Bright crimson; suitable as a pillar rose.
Lamarque Jaune.—Golden yellow.
Lamarque White.—White.
*Marechal Niel.—Beautiful deep yellow.
*Niphetos (Climbing).—Pure white.
Papa Gontier. Rose-pink, free grower.
Papillon.—White with coppery shading; splendid pillar rose.
Reine Marie Henriette.—Cherry red, excellent for the hills.
Noella Nabounand.—Crimson.
Reve d'or.—Deep yellow.
The Garland.—Blush white.
*William Allan Richardson.—Orange-yellow, an old favourite.

TEA-SCENTED ROSES.

FOR ELEVATIONS BELOW 2,500 FT.; THOSE MARKED † ARE ALSO SUITED TO UP-COUNTRY

†Adam.—Rose and salmon, large blooms.
†Beaute Inconstante.—Carmine yellow.
Catherine Mermet.—Light-flesh, exquisite in form.
†Devoniensis.—Creamy white, blush-centre.
†Enchantress.—Creamy white, free bloomer.
†Etoile de Lyon.—Sulphur-yellow. (Dry districts, up to 5,000 ft).
†Homer.—Blush-rose and salmon.
†Hon. Edith Gifford.—Flesh colour, or white, scented.
Jean Ducher.—Yellow salmon.
La Boule d'or.—Golden yellow.
Lady Roberts.—Pink-apricot, orange edges.
Madame Camille.—Salmon-pink.
„ de Watteville.—Salmon-rose.
† „ Lambard.—Salmon-rose, free bloomer.
†Maman Cochet.—Light pink, shaded salmon-yellow.
†Maman Cochet.—White variety.
Mrs. B. R. Cant.—Very vigorous, full, globular blooms; "always in bloom, also good for a fence."
†Marie van Houtte.—Creamy yellow, edged pink.
†Niphetos.—Pure white.
Peace.—Creamy white. "Makes a splendid bush, always in flower." (N.C. Rolt).
President.—Salmon-rose, very large.
†Safrano.—Coppery yellow.

HYBRID TEAS.

Avoca.—Crimson scarlet; long buds.
†Betty.—Exquisite, very large; coppery-rose, shaded golden yellow.
Black Prince.—Deep crimson; large blooms.
†Captain Christy.—Clear flesh, dark centre.
Caroline Testout.—Salmon-pink.
Clara Watson.—Salmon and pink.
Clio.—White, or pale pink.
Eearlute.—Scarlet, almost single; "one of the best bedders."
Gloire de Lyonnaise.—Lemon yellow.
†Grace Darling.—Large, full, rich pink.
†J. B. Clark.—Rich scarlet, shaded dark crimson.
†Killarney.—Pale pink.
La France.—Pale pink, strongly scented; upright habit.
†Laurette Carle.—Brilliant velvety carmine. "Splendid rose anywhere up-country." (N.C. Rolt).
Madame Abel Chatenay.—Salmon pink. One of the best decorative roses.
†Richmond.—Pure rich scarlet. Free bloomer.
Viscountess Folkestone.—White, tinted with pale salmon, very large.
Warrior.—Blood red, good for massing.

NOISETTES.

†Aimee Vibert.—Pure white.
†Boule de Niege. Pure white.
†Caroline Kuster. Bright orange-yellow.
Celine Forestier.—Rich sulphur-yellow.
Cloth of Gold.—Yellow, pale margins.
†Lamarque Jaune.—Golden-yellow, large blooms.
L'ideal.—Yellow or coppery-red.
†Reve d'Or.—Deep yellow, some times coppery yellow.
†William Allan Richardson.—Deep orange-yellow. Distinct.

BOURBONS.

Apolline.—Light pink.
Empress Eugenie.—Rosy-blush, purple edges.
Madame Plantier.—Pure white.
†Mrs. Paul.—Bluish white.
†Souvenir de la Malmaison. (="Hundred-petal"). Flesh colour; one of the best for low elevations.
Victor Emanuel.—Purplish maroon shade.

(8).—SHOWY ANNUALS AND BIENNIALS.

SUITED FOR BEDS OR BORDERS AT MEDIUM OR HIGH ELEVATIONS.

SEE ALSO PAGES 133-136.

(Figures indicate approximate height in feet. Propagation usually by seed, but in many cases also by cuttings).

Acroclinium roseum. "Everlasting." *Compositae.* 1½. Rose, pink, and white var's.
Ageratum mexicanum. *Compositae.* 1½-2. Blue.
Alonsoa Warscewiczii. *Scrophulariaceae.* 1½-2. Orange-red, etc. Several var's.
Alternanthera amoena. Joy Weed. *Amarantaceae.* ½-¾. Leaves bronze-green or yellowish green; several var's. Readily propagated by cuttings planted *in situ.*
Alyssum maritimum. Sweet Alyssum. *Cruciferae.* ½-¾. White, sweet-scented.
Amarantus caudatus. Love-lies-bleeding. *Amarantaceae.* 1½-2. Long, crimson, pendulous tails.
A.—tricolor. Several var's; 2-3. Whole plant coppery at first, the young top leaves becoming bright red, yellow, &c.



Arctotis grandis.

Ammobium alatum. Winged Everlasting. *Compositae.* 1½-2. White.
Anagallis grandiflora. Pimpernel. *Primulaceae.* ½-1. Blue. Several var's,—pink, crimson, lilac, white, &c.
Anemone fulgens. Numerous var's and other species. *Ranunculaceae.* Small, very showy flowering plants. Doubtfully suited to the tropics.

Antirrhinum majus. "Snapdragon." *Scrophulariaceae.* 1-2. Large and dwarf var's. Rich shades of crimson, pink, yellow, &c.; very showy.
Arctotis grandis. *Compositae.* 1½-2. Bluish-white, semi-drooping, closing in sun.
Argemone grandiflora. "Evening Primrose." *Papaveraceae.* 2-3. White. L. prickly, glaucous.
A.—mexicana. 1-2. Yellow. L. blotched with white, spiny. Fl's open in evening.
Asperula azurea. Woodruff. *Rubiaceae.* 1-1½. Light-blue, scented.
Aster, China. Numerous var's, as German, Victoria, Mignon, Crown, Quilled, etc. *Compositae.* ½-1. White, pink, lilac, etc. See *Callistephus.*
Athanasia annua. Everlasting. *Compositae.* 1. Yellow. 1½-2½. S. Africa, &c.
Balsam (Impatiens). *Geraniaceae.* Numerous var's. 1-1½. White, pink, rose, etc.
Bartonia aurea. *Gentianaceae.* 1-1½. Yellow, large fl's.
Begonia semperflorens, and several var's, 1-1½. Pink, crimson, &c.
Brachycome iberidifolia. Swan River Daisy. *Compositae.* 1. Blue and white var's.
Browallia grandiflora. *Solanaceae.* 1-2. Dark blue, large fl's.
Cacalia (Emilia) coccinea. *Compositae.* 1½-2. Scarlet: stems fleshy, leaves edible.



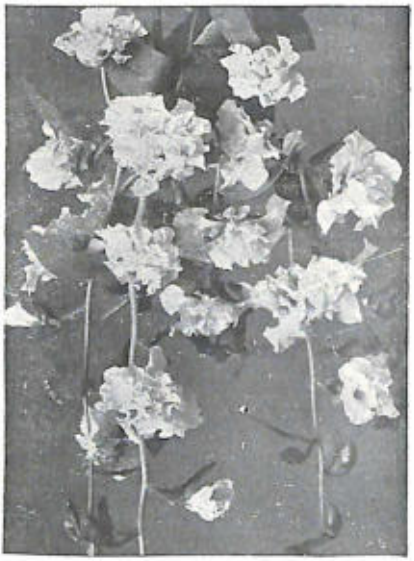
Chrysanthemum leucanthemum. OX-EYE DAISY.

Calandrinia grandiflora. Rock-purslane. *Portulaceae.* ½. Pink, rose, yellow, &c.
Calceolaria hybrida. Slipper-wort. *Scrophulariaceae.* ½-1. Bright-yellow.
Calendula officinalis. Pot-Marigold. *Compositae.* Several varieties, orange, yellow-striped, pale-lemon, etc. 1-1½.
C.—pluvialis. Cape Marigold. 1-1½. White and purple.
Callichroa (Layia) platyglossa. 1. Yellow.
Calliopsis. See *Coreopsis.*
Callirhoe digitata. Poppy Mallow. *Malvaceae.* 1. Bright magenta.
Callistephus chinensis. China Aster. 1-1½. Several var's, white, blue, purple, &c.
Candytuft (=Iberis). *Cruciferae.* 1-1½. Pure white; also crimson var's.
Centaurea Cyanus. Corn-flower. *Compositae.* 1½. Rich blue, lilac, pink, etc.
C.—moschata. Sweet Sultan. 2. Purple.
Centranthus macrosiphon. *Valerianaceae.* 1½. Rose-purple.
Chelone (Pentstemon) barbata. *Scrophulariaceae.* 2½. Scarlet, mauve, &c.
Chrysanthemum coronarium. *Compositae.* 1½-2. White, with yellow centre, etc
C.—carinatum. 1½. Tricolor varieties,—yellow, brown, white, &c.
C.—leucanthemum. Ox-eye or Shasta-daisy. 1½-2. Large, white, with yellow or brown centre.
C.—segatum. Corn Marigold. 1½. Yellow, several varieties.
Clarkia elegans. *Onagraceae.* 2-3. Pale rose, pink, etc.
C.—pulchella. 3-5 or more. Bright rose, pink, etc.
Clintonia (Dowingia) elegans. *Campanulaceae.* 1-1½. White, purple, etc.
C.—pulchella. 1-1½. Blue. California.

Collinsia bicolor. *Scrophulariaceae.* 1½. Purple and white.
Convolvulus. See page 189.



Dianthus barbatus. SWEET WILLIAM.



Clarkia pulchella.

Coreopsis (Calliopsis) bicolor. *Compositae.* 1-2. Yellow with brown or crimson.
C.—Drummondi. 1-2. Bright yellow. Carolina.
Cosmos bipinnatus. *Compositae.* 3-4. Pink, white, etc. Light feathery l.; showy.
C.—sulphureus. 3-4. Bright Orange-yellow. Mexico. See p. 440.
Cuphea miniata. *Lythraceae.* 1-1½. Scarlet, tipped with yellow.
Datura Stramonium. *Solanaceae.* 2. White. See page 110.
Delphinium cardiopetalum. Larkspur. *Ranunculaceae.* 1-2. Numerous var's,—rich shades of bright blue, purple, etc.; very showy.
Dianthus barbatus. Sweet William. *Caryophyllaceae.* ½-1. Variegated, scarlet crimson, &c., edged white, pink, &c. Very attractive.
D.—caryophyllus. Carnation. 1-1½. Shades of pink, mauve, white, &c. See p, 182.
D.—chinensis. Chinese or Indian pink. Several single and double var's. 1. White, crimson, etc.; petals large, fringed.
Erysimum perowskianum. *Cruciferae.* 1. Orange and yellow.
Eschscholzia californica. Californian Poppy. *Papavaraceae.* 1-1½. Rich orange-yellow, mauve, &c.
Exacum macranthum. *Gentianaceae.* Erect, 1-1½. Large, bright blue fl's. See pages 134, 141, 199. A beautiful plant.
Fumaria media. Fumitory. *Fumariaceae.* 1-2. Annual. Pink, crimson, &c.
Gaillardia picta. Blanket-flower. *Compositae* 1-2. Yellow and crimson.
Gamolepis tagetas. *Compositae.* ½-1. Bright yellow, single fl's. S. Africa.
Gaura grandiflora. *Onagraceae,* 2. White. N. America.
Gilia tricolor. *Polemoniaceae.* ½-1. Large, lavender or white, purple-eyed.
G.—multicaulis. 1. Blue.
Godetia Whitneyi. *Onagraceae.* 1. Numerous var's; pink, white, &c. Large, rather delicate fl's.
Gypsophila elegans. *Caryophyllaceae.* 1½. Lilac. Light feathery foliage, useful for table decoration, bouquets, &c.

Helianthus annuus. Sunflower. 5-6, Ann. Very large yellow fl's, dark-brown centre. The dwarf bushy sorts, 3-4 ft., with small fl's, bright yellow with black centre, are showy and useful for cut-flowers. See p. 134.

Helichrysum. *Compositae.* Everlastings. 2½. Yellow, orange, &c.

Iberis, see Candytuft.

Ipomoea rubro-coerulea. Morning-glory. 8-16. Various shades; large, blue, purple, showy fl's. See also p. 125.

Ipomopsis (Gilia) elegans. *Polemoniaceae.* 6-8. Tubular, crimson fl's, feathery leaves.

Jacobaea elegans. See Senecio.

Kaulfussia (Charieis) amelloides. *Compositae.* 1-1½. Blue, crimson, and violet daisy-like fl's.

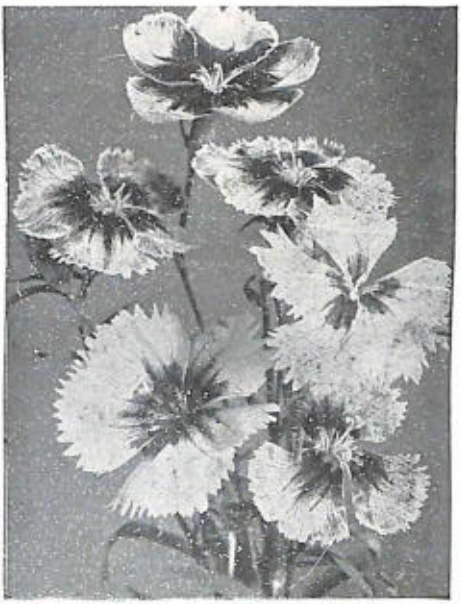
"Lady's Lace," see Pimpinella.

Larkspur, see Delphinium.

Lathyrus, see Sweet Peas.

Layia, see Callichroa.

Leptosiphon (Gilia) rosea. *Polemoniaceae.* ½. Rose-pink.



Dianthus chinensis.



Exacum macranthum.
(See pages 131, 144, 199).

Leptosyne californica. *Compositae.* 1½. Lemon-yellow, like Marguerites. California.

Linaria cymbalaria. *Scrophulariaceae.* ½-1. Several var's,—lilac, orange, yellow, crimson, etc.

Linum grandiflorum, var. *Liliaceae.* 1½. Several var's; scarlet, blue, &c.

Lobelia erinus. *Campanulaceae.* ½. Numerous var's, shades of blue, crimson, purple, and white.

Lupinus polyphyllus. Lupin. *Leguminosae.* 2-3. Several var's; blue, orange, yellow, etc.; very showy.

Malcolmia maritima; Virginian Stock.

Malope grandiflora. *Malvaceae.* 2-3. Large fl's, crimson, etc., white-striped.

Marigold, African, (Tagetes erecta). *Compositae.* 2-3. Bright lemon-yellow, orange, etc.

M.—, Corn; Chrysanthemum segatum.

M.—, French. (Tagetes patula). "Samie-poo," *T.* 1-2. Orange, yellow, and crimson varieties.

M.—, Fig. See Mesembryanthemum.

Mathiola annua, see Stocks.

Mesembryanthemum tricolor. Fig-marigold. *Ficoideae.* ½-1. Different shades of pink, etc.

Mignonette (Reseda odorata). *Resedaceae.* 1-1½. Greenish-white or cream, sweet-scented.

Mimulus maculosus. "Monkey-flower." *Scrophulariaceae.* ½-1. Pale yellow, blotched with brown.
Mirabilis Jalapa. "Marvel of Peru;" "Four-o'clock-Flower;" "Sendrikka," *Nyctagineae.* 1-1½. Rose-pink, white, etc.
Myosotis palustris. "Forget-me-not." *Boraginaceae.* ½-1. Blue. Several var's, as "Royal Blue" and others.
Nasturtium, see Tropaeolum, page 190.
Nemesia strumosa. *Scrophulariaceae.* 1. White, crimson, yellow, etc.
Nemophila insignis. *Hydrophyllaceae.* ½. Blue, white, and purple-margined.
Nicotiana affinis. Flowering Tobacco. *Solanaceae.* 2-3. Several var's, white, purple, pink, etc. N.—Sanderii; fine strain; different shades.
Nierembergia frutescens. *Solanaceae.* 1½. Blue, funnel-shaped.



Nigella damascena.

Nigella damascena. Fennel-flower; "Love-in-a-mist." *Ranunculaceae.* 1-1½. Fl's pale blue; feathery foliage.
Nolana grandiflora. *Nolanaceae.* ½-1. White and blue, bell-shaped; trailing habit.
Nycterinia selaginoides. *Scrophulariaceae.* ½-¾. Pink. S. Africa.
Oenothera biennis. Evening Primrose. *Onagraceae.* 1-1½. Large, bright yellow fl's, opening in evening. Semi-naturalised near gardens up-country, Ceylon.
Pansy (Viola tricolor). *Violaceae.* ½. Numerous var's, various colours; very pretty.
Papaver, see Poppy, 201.
Pentstemon. *Scrophulariaceae.* 1-1½. Numerous spp. and var's,—crimson, pink, rosy-purple, etc. See Chelone, p. 183.
Petunia, single and double var's. *Solanaceae.* 1½-2. White, purple and striped; large showy fl's. Single var's excellent for hanging pots, &c.
Phacelia campanularia. *Hydrophyllaceae.* 1½-2. Bright blue; several var's.
Philydrum lanuginosum. *Philydraceae.* 2-3. Yellow.

Platystemon californicus. Californian Poppy. *Papaveraceae.* 1. Bright lemon-yellow.
Phlox Drummondi. *Polemoniaceae.* 1. Numerous showy var's,—white, scarlet, purple, crimson, margined and fringed, etc.
Pimpinella monoica. "Lady's Lace" *Umbelliferae.* Annual. 2-4. Fl's small, white, in large, loose sprays. Very graceful, excellent for bouquets, &c. India.



Schizanthus pinnatus.

Poppy, Shirley. (Papaver Rhoeas) *Papaveraceae.* 2-3. Different shades,—scarlet, purple, white, etc.
Poppy, Opium. (P.—*somniferum*). 1-2. Different shades, single and double varieties; very showy.
Poppy, Californian, see *Platystemon.*
Portulaca grandiflora. Sun-plant. *Portulaceae.* ¼. Different brilliant shades.
Pyrethrum aureum. Golden-feather. *Compositae.* ½-¾. Handsome yellow foliage.
Reseda, see Mignonette.
Rhodanthe Manglesii. Everlasting. *Compositae.* 1-1½. Rosy-purple, etc.
Salpiglossis coccinea. Numerous var's. *Solanaceae.* 1½-2. Scarlet, blue, purple.
Salvia. Different varieties, shades of blue, purple, pink, &c. See p. 185.
Saponaria calabrica. Soapwort. *Caryophyllaceae.* 1. Bright pink.
Scabiosa. Several varieties *Dipsaceae.* 1½-3. Blue, yellow, etc.
Schizanthus pinnatus. Fringe-flower. *Scrophulariaceae.* 1½-2. Purple, crimson, etc.
Sedum. "Stone-crop". *Crasssulaceae,* Numerous species. ½. Yellow, white, purple, etc.
Senecio elegans. Purple Jacobaea. *Compositae.* 1½. Crimson, purple, white, etc.
Silene pendula. Catch Fly. *Caryophyllaceae.* 1½. Carmine, single and double var's.
Spartium junceum. Spanish Broom. *Leguminosae.* 2-3. Showy yellow fl's.
Sphenogyne speciosa. Several var's. *Compositae.* 1. Yellow, crimson, white, etc.
Statice sinuata. Sea Lavender. *Plumbagineae.* 1-1½. Several var's,—golden yellow, rose-purple, etc.
Stocks (Mathiola). "Ten Weeks," "East Lothian," and "Virginian." *Cruciferae.* 1½-2. White, purple, etc., scented; "Double" var's apparently not suited to Tropics
Sunflower. See *Helianthus.*
Sweet Peas. (Lathyrus odoratus). *Leguminosae.* 4-5. Numerous beautiful shades and var's. Thrives from 4,000 ft. upwards. Sow seeds 2 to 3 in. apart in a double or treble row, in well-manured trench. 1lb. seed should be sufficient to sow about 150 feet of double row, or 300 feet treble row. "Eckford" and "Spencer" varieties are well-known.
Sweet William, see *Dianthus barbatus.*
Tobacco, flowering-, see *Nicotiana.*
Torenia Fourneri. *Scrophulariaceae.* ½-1. Deep purple and pale-blue; also a white-flowered variety.
T.—Bailloni. ½-1. Yellow, semi-trailing.
Trachelium coeruleum. *Campanulaceae.* 1-1½. Blue.
Tropaeolum majus. Nasturtium. *Geraniaceae.* 6-10. Herb. cl.; Orange, yellow, etc.

T.—atrosanguineum. Dwarf Nasturtium. Several var's. 8-12 in. Orange, yellow, etc.
Verbena. *Verbenaceae*. 1. Numerous var's.—white, scarlet, purple, etc.
V.—bonariensis. Bright purple. L. deeply cut. Naturalised near up-country gardens in Ceylon.
Viola, see Pansy.
Violet (Viola odorata). *Violaceae*. ½. Several vars', single and double, blue, purple, white. See p. 204.
Whitlavia (Phacelia) grandiflora. *Hydrophyllaceae*. 3-4. Violet-purple.
Xeranthemum annuum. Everlasting. *Compositae*. 1-1½. Different var's.—rose, white, violet, etc.
Zinnia. *Compositae*. 1½. Different var's,—scarlet, pink, yellow, etc.
Z.—Haageana (Z.—linearis). 1. Orange-yellow, single; wiry, slender stems.

(10).—SELECTED POT-PLANTS.

SUITABLE FOR HIGH ELEVATIONS.

(See also page 81.)

Many of the foregoing up-country selections are adapted for pot-culture at medium to high elevations, and in addition to these the following may be mentioned as being especially suited for the purpose. With, however, the protection of a greenhouse or a glazed and well lighted verandah, palms and many other choice plants of lower elevations, which without such artificial protection would not thrive much above 3,500 ft., can sometimes be grown in the hills with success. The limit of elevation in Ceylon, under ordinary conditions, for the successful cultivation of purely tropical palms may be said to be about 3,000 ft., or about 4,000 ft. in sheltered localities. Palms of sub-tropical regions will, however, flourish at the higher altitude and are unsuited to low elevations. See *Sub-tropical Palms*, page 169. The following selection of plants for pot-culture at the higher elevations is, of course, capable of considerable extension.

Achimenes.—Small, tuberous-rooted, free-flowering, herbaceous plants. Very showy. Easily grown; prefers light, porous rich soil. (S. or tu.) See p. 136.

Asparagus decumbens,=A. crispus. S. Africa. 12-15 in.; elegant feathery foliage. (S. or tu.).

Aspidistra lurida, variegata. (*Liliaceae*). Japan. Hardy stemless plant, 2 ft., with large, handsome, white-striped, radical leaves. Rich loamy soil. Prop. by div.

Azalea indica.—Small shrubs, bearing a profusion of large, pink, white, or yellow flowers. Numerous, very showy, single and double varieties.

Begonia, fibrous-rooted.—Numerous varieties, showy flowers or foliage.

B.—tuberous-rooted. Very large, brilliant yellow or scarlet flowers.

B.—rex. About 10 to 12 inches high. Large, beautifully marked, ornamental leaves. Numerous varieties. See page 150.

Calathea.—See page 150.

Chrysanthemum, Japanese.—One of the most beautiful genera of flowering plants. Numerous varieties, white, yellow and pink shades. See also pp. 134, 197.

Cineraria.—A genus of showy flowering plants, 1½-2½ feet high, bearing large heads of blue purplish or crimson flowers; cultivated as annuals, under cover. Thrive in rich loamy soil, with abundant moisture. Propagated by seed.

Coleus. Annuals with beautifully marked, soft velvety leaves; easily propagated by cuttings, require rich loamy soil, abundant manure and moisture. See p. 134.

Cyclamen. Small tuberous plants, bearing very pretty, delicate pink, crimson or white flowers; suited only for growing under cover at the higher elevations.

Dracaena (Cordyline). Handsome palm-like plants, with long, bronze, crimson, or green leaves. Numerous varieties. Prop. by suckers or portions of the stem.

Epiphyllum. (*Cactaceae*). Succulent, leafless plants, bearing very showy, bright pink or crimson flowers. Numerous species and varieties.

Ferns. See *Ferns*, pages 157-161.

Francoa ramosa. (*Saxifragaceae*). An ornamental creeping plant, suitable for hanging pots. Propagated by division or cuttings.

Freesia. A Cape genus of small tuberous plants, producing a profusion of creamy-white, scented flowers. They require a cool atmosphere and protection from the rains, and are best grown under cover. See p. 191.

Fuchsia. (*Onagraceae*). A genus of small, very ornamental, flowering shrubs; numerous varieties. Propagated by cuttings or seeds.

Genista. Small free-flowering shrubs with yellow blossoms.

Geranium. (*Geraniaceae*). A universal favourite. Numerous varieties; flowers of many shades, very showy, leaves scented. With care, the plants thrive for a time at low and medium elevations, but require frequent pruning, partial shade, and protection from excessive rain and wind. They are much improved by a weekly application of a fertiliser, given in solution with water. Rich loamy soil. Prop. by cuttings.



Cineraria webberiana. GARDEN HYBRID.

G.—,Zonal, or **Tricolor.**—Leaves beautifully marked, greenish-yellow and brown, horse-shoe shaped, fragrant.

G.—,Ivy-leaved. Showy and free-flowering, suitable for training on pillars, sunny banks, etc. Leaves shiny, angular.

Gesnera. (*Gesneraceae*). Small showy flowering plants, generally tuberous-rooted. Numerous species. **G.—Douglasi** and **G.—magnifica** are especially attractive.

Gloxinia. (*Gesneraceae*). A genus of tuberous-rooted small plants, exceedingly showy when in bloom. Large bell-shaped flowers, different shades,—white, pink, crimson, &c. Require rich humous soil and partial shade.

Hydrangea. (*Saxifrageae*). These thrive and flower remarkably well at the higher elevations, producing large round heads of flowers, chiefly from March to

July. A sheltered border with rich loamy soil suits them best, a deficiency of lime being considered to encourage the production of deep blue flowers. Sulphate of iron in solution (¼ oz. per gallon of water) is also conducive to blue flowers, and a preparation known as *Cyanol* is supplied for this purpose. Cut back and repot the plants after flowering, or, if in the ground, fork up and manure the soil.

Impatiens.—A showy genus of herbaceous flowering plants, 1-2 ft. high. Among the best are *I.—Holstii*, *I.—Sultani*, and *I.—fasciculata* See p. 184.

Pelargonium.—A class of beautiful, low, bushy plants with scented, curly or cut leaves and showy flowers, allied to Geraniums. *Pelargonium* is the botanical name for the "Geranium" of gardens. The plant prefers rich loamy, soil, and a rather dry sheltered locality. Propagated by cuttings.

Petunia.—A very showy genus of flowering annuals, blooming freely and continuously. Single, double, and fringed varieties. Rich, loamy, well-drained soil suits them best. Propagated by seed or cuttings. See page 200.

Primula chinensis. (*Primulaceae*).—Small, annual, flowering plants; numerous varieties. Prefer rich loamy soil.

P.—obconica. Small perennial plants, flowering in the cold season.

Spiraea (Hoteia) japonica. (*Rosaceae*).—A popular plant for pot-culture; flowers creamy white, in large panicles. Loamy soil.

Streptocarpus (*Gesneraceae*).—A perennial herb with prostrate leaves, bearing erect scapes of large bluish or lilac flowers. Several species and hybrids.

Violets (Viola odorata. *Violaceae*).—Several single-and double-flowered varieties; can be grown successfully in sheltered but sunny and well drained borders, or in rockeries, pots, or boxes. Among the best are: *Double varieties.*—"Neapolitan," pale lavender, very sweet-scented; "Compte Brazza," white flowers; "Marie Louise," "Lady Hume Campbell," "Mrs. Astor," "Mrs. Arthur." *Single varieties,*—"La France," "Prince of Wales," "Czar," "Admiral Avellan."

CHAPTER XVI.

SELECTIONS SUITED TO SEA-COAST OR MODERATELY DRY REGIONS

1.—*ORNAMENTAL AND USEFUL TREES.*
2.—*ORNAMENTAL SHRUBS.*
3.—*ORNAMENTAL CLIMBERS OR CREEPERS.*
4.—*SAND-BINDING PLANTS.*
5.—*PLANTS SUITED FOR BINDING SAND-BANKS, &c.*
6.—*PLANTS OR TREES SUITED TO SWAMPY SITUATIONS:—*
(A) *FOR LOW ELEVATIONS.*
(B) *FOR MEDIUM OR HIGH ELEVATIONS.*

Although the majority of plants or trees are naturally suited to a moist humid climate, certain species are partial to the sea-coast or localities not far removed from it, and are botanically referred to as *halophytes*. Others are naturally adapted to dry arid districts (*xerophytes*), and generally refuse to thrive when removed to a moist climate, *e.g.* Palmyrah palm. With irrigation and cultivation, however, many kinds, such as fruit crops, which are normally suited to a moist climate may be found to thrive to perfection in a locality with a limited rainfall. See page 230.

1.—ORNAMENTAL AND USEFUL TREES

SEE ALSO PAGES 82-106.

*Not well suited to dry districts. †Not well suited to wet districts.

†Acacia arabica. Karuwel, *T*; Babul (*Hind.*).—A small tree or shrub of India, Arabia, Egypt, Trop. Africa, North Ceylon, &c. One of the sources of "gum arabic." See p. 411.

A.—leucophloea. Maha-andara, *S*; Velvel, *T*.—A large tree with spreading branches and bright pale-yellow flowers. Heart-wood hard and durable.

A.—planifrons. "Odai" or "Udai," *T*; Umbrella Tree. A small ornamental tree with erect stem and umbrella-like head (branches spreading in a plane), and very small leaves; native of North Ceylon and S. India. Wood hard, heavy, pale yellow.



Adansonia digitata. BAOBAB TREE.

†Adansonia digitata. Baobab Tree. A low, remarkable tree, native of Cent. Africa, famous for the great age and girth to which it attains. See pp. 205, 428, 513. A few trees have long been established and bear fruit in the dry northern part of Ceylon, where they were long ago introduced by Arab traders. The tree thrives naturally in sandy, almost desert areas, the trunk with age becoming decayed and hollowed out in the centre. It is supposed to be one of the longest-lived trees in the world. Wood soft and spongy ; inner bark fibrous. The white gourd-like fruits are spongy, farinaceous, acid and edible. $

Adenanthera pavonina. Bead Tree ; Madatiya, *S.* See pages 214,460.

Albizzia Lebbek. "Woman's Tongue" of W. Indies ; "Mara" *S* ; "Vahai," *T.* Large tree with fine foliage, native of Trop. Asia and Africa, often planted for shade. Excellent brown timber ; does not readily warp.

A.—odoratissima Suriya-mara, *S* ; Ponnaimurankai, *T.* Large tree, with pure white, sweet-scented fl's. Heartwood very hard, dark-brown.

*Artocarpus incisa. Bread-fruit. A beautiful foliage tree. See p. 97.

Azadirachta indica. Neem- or Nim-tree; Margosa ; Kohomba, *S.*—A tall, straight tree with long spreading branches and small pinnate leaves. Flowers white, sweet-scented. A much valued tree in India, Ceylon, &c. See p. 212.

*Barringtonia speciosa. Mudilla *S.* See page 97.

Bauhinia tomentosa. Petan, or Kaha-petan, *S* ; Tiruvatti, *T.* A small tree or large shrub, with slender branches and yellow flowers. Heartwood hard, dark-red, very tough.

Berrya ammonilla. Trincomalee-wood ; Halmilla, *S* ; Chavandalai, *T.* A large erect handsome tree ; valuable timber. See *Important Timbers*, page 219.

Borassus flabellifer. Palmyra Palm. See page 362.

Butea frondosa. Flame-of-the Forest ; Pulas, &c. See pages 85, 417.

Caesalpinia coriaria. Divi-divi.—A spreading, medium-sized tree, with fine feathery leaves, producing greenish white, sweet-scented flowers. See pages 212, 441.

Carallia integerrima. Dawata, *S.* See page 212.

Cassia Fistula. Indian Laburnum ; Ehela, *S.* See page 85.

C.—marginata. Ratu-wa, *S.*, Vakai, *T*, and C.—multijuga. See page 86.

Casuarina equisetifolia. Beef-tree ; Kasa, *S.*, and several other species. See pages 97, 99, 179.

Cerbera Odollam. Gon-kaduru, *S.* (*Apocynaceae*).—Small tree, about 30 ft. high ; fl's white, scented. Chiefly sea-coast.

Cochlospermum gossypium. Kinihiriya, *S.* See page 86.

*Cocos nucifera. Coconut palm. See page 389.

Diospyros Embryopteris. Timbiri, *S.* A moderate-sized, evergreen, symmetrical tree with handsome foliage and spreading branches.

Eucalyptus alba. White Gum. *Myrtaceae.*—A tall, slim tree with smooth, pale-grey bark, 70-80 ft. high or taller. One of the few species of Eucalypti suited to low elevations. See page 99.

E.—citriodra. Lemon-scented Gum Tree. Handsome slender tree, 40-50 ft.

E.—calophylla. Stringy Bark. Western Australia. Tall tree, excellent timber.

Gliricidia maculata. Madre, or Madre-de-Cacao. See pages 88, 214,215.

Holoptelea integrifolia. Indian Elm ; Goda-kirilla, *S* ; Velayil, *T.*—A tree with handsome drooping branches, 50-60 ft. high ; good timber.

Leucaena glauca. Wild- or Horse-tamarind. A small quick-growing leguminous tree, 15-20 ft. high or taller, with small bipinnate leaves, specially suited to dry districts. Sometimes used as shade for field crops ; may, however, become a weed in cultivated ground. Furnishes good fuel. Foliage relished by cattle. Seeds abundant and hard. See p. 26.

Melia Azadirachta. See Azadirachta indica.

Millingtonia hortensis. Cork Tree. See page 90.

Mischodon zeylanicus. Tammana, *S* ; Tampanai, *T.*—A tree 30-40 ft. high, with long lanceolate leaves ; young foliage bright pink. Excellent timber.

Murraya exotica, var. buxifolia. Etteriya, *S.*—A small graceful tree ; flowers pure white and sweet-scented.

Ochrosia borbonica. Mudu-kaduru, *S.* (*Apocynaceae*). 25-30 ft. Sea-coast ; large, handsome leaves ; small greenish-white fl's.

Peltophorum ferrugineum. Iya-vakai, *T.* (*Leguminosae*). See pages 90, 92.

Persea (Alseodaphne) semecarpifolia. We-warani, *S*; Ranai or Yavaranai, *T*.—A large, much-branched tree, common to the dry region. One of Ceylon's best timbers.

Pisonia alba. Lettuce-tree. See pages 102, 213.

Pithecolobium (Inga) Saman. Rain-tree; Peni-karal, *S*. See pages 102, 213, 451. If planted in good deep soil it thrives in a moderately dry district, where it is more suitable as a permanent road-side tree than in wet districts, as in the latter it grows rapidly to a great size and develops a shallow rooting system.

P.—dulce. Madras Thorn. 40-50 ft. Commonly used as hedges, stands coppicing well. See pp. 74, 213, 518.

Plumeria acutifolia. Temple Tree. (*Apocynaceae*). See page 91.

Poinciana regia. Flamboyante. See pages 91, 93.

Polyalthia longifolia. Mara-illupai, *T*.—A moderate-sized, handsome, ever-green, erect tree, with narrow, sinuate leaves; much planted as an avenue tree in Northern Ceylon and S. India. Seeds in Sept.-October. See page 213.

Spathodea campanulata. See pages 94, 95.

Swietenia Mahagoni. Mahogany; and **S.—macrophylla.** (Large-leaved Mahogany). See pages 104, 213.

Tamarindus indica. Tamarind; Siyambala, *S*.—A large handsome, spreading, symmetrical tree with very small pinnate leaves, specially adapted for road-sides, particularly in dry districts. Beautiful red timber. See pp. 213, 375, 380.

Thespesia populnea. Tulip Tree; Suriya, *S*; Kavarachu, *T*. (*Malvaceae*).—A small, evergreen, much branched, spreading tree with yellow funnel-shaped flowers; specially suited to the sea-coast, but not very ornamental. Good timber.

Vitex altissima. Milla, or Sapu-milla, *S*; Kadamanakku, *T*.—A large tree, with a dense head and somewhat drooping branches. Excellent timber; see p. 219.

Vitex leucoxylon. Nebedda, *S*; Kaddu-nochchi, *T*.—A large tree with a spreading head, common in dry region, especially near tanks. Wood hard, dark-grey, valuable timber.

(2).—ORNAMENTAL SHRUBS.

SEE ALSO PAGES 107-122.

[Letters in brackets indicate usual means of propagation, thus: (S)=seed; (C)=cuttings; (Su)=suckers. Figures=usual height in feet.]



Cryptostegia grandiflora.

Acalypha, different var's. (*Euphorbiaceae*). 8-10. Large, bright-coloured, coppery or crimson leaves. (C).

Agave americana variegata. American Aloe. (*Amaryllideae*). 6-8; long succulent variegated leaves; very striking. (Su or S).

Aralia filicifolia. (*Araliaceae*). 6-8. Young foliage yellow, feathery, and very handsome. (C).

Arundo Donax variegata. (*Gramineae*). 6-8. Handsome variegated grass. (Div. or C).

Asystasia coromandeliana. Puruk, *S*; Peyppatchotti, *T*. (*Acanthaceae*).

Caesalpinia pulcherrima. Peacock Flower. 5-6. Fl's bright yellow or scarlet; long protruding stemens. (S).

Carissa Carandas. Maha-karamba, *S*, Perunkila, *T*. (*Apocynaceae*). A spiny shrub with white fl's. See *Tropical Fruits*, p. 257.

Clerodendron inerme. Wal-gurenda, *S*; Pinari, *T*. (*Verbenaceae*). 3-5. Flowers white, tinged with pink. (S or C).

C.—Siphonanthus. 5-6. Large, erect racemes, white and pink; leaves in whorls of 4 or 5 (S or C).

Croton (=Codiaeum). Numerous var's. (*Euphorbiaceae*). 5-8. Very showy, brightly coloured foliage. (C). See p. 119.
Cryptostegia grandiflora. (*Apocynaceae*). Climbing shrub; showy magenta fl's. See p. 207. S.
Datura suaveolens. Trumpet-flower. (*Solanaceae*). 6-8. Fl's large, white. (C).
Dombeya angulata. 5-7. Spreading shrub; fl's pink, in drooping bunches. See p. 111.
D.—Mastersii. 5-6; Similar to preceding species; flowers creamy white.
Hibiscus. (Shoe-flower), numerous var's. (*Malvaceae*). 6-8. Fl's of various shades, pink to scarlet, yellow, white, &c. (C).
Ixora, different species and var's. (*Rubiaceae*). 4-6. Fl's various colours, pink yellow, scarlet, &c. (C).
Lagerstroemia indica. Indian Lilac; Crepe Myrtle. (*Lythraceae*). 6-8. Fl's purple-lilac, in large panicles. Very showy. Also white and pink var's. (C).
Nerium Oleander. Oleander. (*Apocynaceae*). 8-12 or more. Fl's in large clusters; crimson, pink, and white var's. A beautiful free-flowering shrub. See pp. 114, 115.
Panax fruticosum. (*Araliaceae*). 5-6. Evergreen; l. much cut, ornamental. (C).
Pandanus odoratissimus. Screw-pine; Mudu-keyiya, *S*; Talai, *T*. (*Pandanaceae*). 15-20. Fruit globose or oblong, scarlet. (Su or S). See p. 209.
Pavetta indica. Pawatta, *S*; Pavaddai, *T*. (*Rubiaceae*). 4-6. Bears profusion of white fl's. (C or S).
Punica granatum. Pomegranate; "Delun," *S*. Beautiful large scarlet fl's. See pp. 73, 269.
Scaevola Koenigii. Takkada, *S*. (*Goodenoviaceae*). A large evergreen bush, 6-10; fl's white. Wood soft, spongy. See pp. 209, 433. (C or S).
Sophora tomentosa. Mudu-murunga, *S*. (*Leguminosae*). 4-6. L. covered with soft, grey pubescence. (C or S).
Turnera ulmifolia. (*Turneraceae*). 2-3. Fl's yellow. See pp. 133, 135.
Vinca rosea. Madagascar Periwinkle. (*Apocynaceae*). 2. Fl's rose-pink, white, or white with red centre. (C or S).
Wrightia zeylanica. "Sudhu-" or "Wal-idda", *S*. (*Apocynaceae*). 3-5. Slender, erect branches; fl's pure white. (C or S).
Yucca gloriosa. Spanish Bayonet. (*Liliaceae*). 5-8. Leaves narrow rigid, sharp-pointed fl's white, in large erect panicles. (Su or S). See page 117. S.

(3)—ORNAMENTAL CLIMBERS.

SEE ALSO PAGES 122-132.

Allamanda Hendersoni. (*Apocynaceae*). Quick-growing; large, yellow, bell-shaped fl's. Leaves usually in whorls. (C).
Antigonon leptopus. (*Polygonaceae*). Moderate-sized; slender stems; lovely pink fl's. (C or S). Mexico.
Argyreia speciosa. Maha-dumudu, *S*. (*Convolvulaceae*). Large, handsome leaves, snowy-white beneath; fl's large, purple. Strong grower. (C or S).
Bignonia unguis. (*Bignoniaceae*). Slender creeper; yellow, bell-shaped fl's; very beautiful when in full blossom. (S or Su).
Clerodendron Thomsonae. (*Verbenaceae*). Fl's white and scarlet. (C or S).
Cryptostegia grandiflora. (*Asclepiadeae*). See above, also page 207.
Ipomoea Bona-nox. Moon Flower; Kalu-alanga, *S*. (*Convolvulaceae*). See page 304.
I.—Briggsii. Bright crimson, small fl's; very showy, free bloomer. (C).
I.—carnea. Fl's large, pale-pink. (C). I.—muricata. Alanga, *S*. Flowers edible.
I.—vitifolia. Fl's bright yellow. (S or Su).
Porana volubilis. Bridal Bouquet. (*Convolvulaceae*). Large, quick-growing climber; fl's creamy-white, in long panicles. (C).
Quisqualis indica. Rangoon Creeper. (*Combretaceae*). Long, tubular, orange-red, fl's in large clusters, sweet-scented. (C).
Tecoma capensis. (*Bignoniaceae*). Flowers scarlet; slow grower, 6-8 ft.
Tristellateia australis. (*Malpighiaceae*). Australia. Fl's small, in short, erect, yellow racemes; free bloomer.
Thunbergia grandiflora. Large, robust climber; flowers large blue; tuberous roots.

(4)—SAND-BINDING PLANTS.

Certain plants have a natural capacity for growing in loose, sandy soil, or even in almost pure sand, as on barren sea-shores or river banks.

Such plants have not only valuable sand-binding properties, by which they prevent the erosion of land or the shifting of sand banks, etc., but they also establish a foundation in which it may be possible to introduce and grow more useful plants. For sand-banks by the sea-shore, the following plants are among the most adaptable :

Barringtonia racemosa. Mudilla, *S.*—A small tree with drooping branches, common near the sea-shore in Ceylon.

Calotropis gigantea. Wara, *S.* (*Compositae*)—A large glaucous shrub with oblong leaves ; common near sea-coast. See page 429.

Canavalia obtusifolia. Mudu-awara, *S.*—A creeping leguminous perennial, with bright-pink (sometimes white) flowers. Grows luxuriantly on sandy sea-shores.

Cassia auriculata. Ranawara, *S.*—A large shrub, 6 to 8 ft. high, with spreading branches and bright-yellow flowers. The dried leaves form the " Matara Tea " of Ceylon, which see. Leaves and young pods edible.

Ipomoea biloba. Mudu Bin-tamburu, *S.*—A creeping plant with bright purplish-rose flowers and fleshy leaves ; common on the sea-shore sand along the south and west coast of Ceylon.

Pandanus odoratissimus. Screw Pine ; Mudu-keiya, *S.*—A spreading bush with numerous aerial shoots, which descend and fix the plant in the sand. See p. 208.

Scaevola Koenigii. Takkada, *S.*—A large spreading bush, with creamy white flowers and pithy stems ; common on the south-west coast of Ceylon. See p. 208.

Spinifex squarrosus. Water Pink ; Maharawana-rewula, *S.*—A greyish glaucous grass which grows in broad tufts on the sandy shores ; cultivated on the Madras coast for its sand-binding properties.

Tamarix gallica. Tamarisk ; Kiri, *T.* (*Tamaricaceae*). A large shrub or small tree, with small scale-like leaves, specially adapted to sandy sea-shores.

Tephrosia purpurea. Pila, *S.*—A leguminous perennial, 1-2 ft. high ; flowers small, purplish-pink. See p. 26.

(5).—PLANTS SUITABLE FOR BINDING SAND-BANKS, ETC.

In addition to possessing the quality of sand-or bank-binding, some plants may also afford valuable fodder or grazing for cattle. Thus in the low-country both purposes may be served by the Guinea-grass (*P. maximum*), and Etora, *S.* (*P. repens*) ; while in the drier localities the Doob-grass or Arugam-pillu, *T.* (*Cynodon dactylon*), Love-grass or Tutteri, *S.* (*Chrysopogon aciculatus*), and Hin-undu-piyali, *S.* (*Desmodium triflorum*) have similar properties. *Cassia mimosoides* and the "Sensitive-plant" (*Mimosa pudica*) also have useful binding qualities on loose sandy soils. At elevations of 4,000 to 6,000 feet, *Paspalum dilatatum* (" Golden Crown " grass) is an excellent plant for binding railway banks, etc., while it is also one of the best fodder plants for up-country. See pages 73, 450.

(6).—TREES, ETC., SUITED TO SWAMPY SITUATIONS.

See also Water Plants, Pages 173-175.

Though some trees and shrubs are adapted to growing in wet or swampy localities, along water margins, or in land occasionally submerged, very few if any will thrive in land saturated and soured with stagnant water. Therefore, when it is desired to plant up a swamp with a view to draining the land, it is essential that the conditions be suitable for plant-growth. Where this is not already the case, as by reason of stagnant water, drainage must be resorted to in order to draw off the latter. Deep channels should be cut, outlets made for the water to escape, the earth thrown up in ridges, and a liberal application of lime

given. By this means moisture-loving trees or crops may be established which will in time effect or aid the desired object. The following are a selection recommended for such conditions :

(A).—FOR LOW ELEVATIONS :

Anacardium occidentale. Cashew-nut. (T).
Barringtonia speciosa. Mudilla, *S.* (T).
Carludovica palmata. Panama-hat plant.
Casuarina equsetifolia, and other species.
Cerbera Odollam. Gon-kaduru, *S.* (T).
Colocasia Antiquorum. See p. 295.
Cyperus Papyrus. Papyrus-grass. (S).
Eucalyptus robusta. Swamp Mahogany.
Mauritius- or Water-grass, which see.
Heritiera littoralis. Etuna, *S.* (T).
Lagerstroemia Flos-reginae. "Muruta" (T).
Metroxylon Sagu. Sago Palm. (S. or T.)
Nipa fruticans. Water Coconut. (S).
Ochrosia borbonica. "Mudu-kaduru" (T).
Saccharum arundinaceum. Rambuk. *S*; Elephant-grass. (S).
S.—officinarum. Sugar-cane.
Scaevola Koenigii. Takkada, *S.* (S).

(B).—FOR MEDIUM OR HIGH ELEVATIONS :

Acacia dealbata. Silver-wattle. (T).
Eucalyptus globulus. Blue-gum. (T).
E.—leucoxylon. Iron-bark. (T).
E.—robusta. Iron-bark; Swamp Mahogany; and other species of Eucalyptus. (T).
Fatsia papyrifera. Rice-paper plant. (S).
Fodder grasses, which see.
Gunnera manicata. See page 187.
Hedychium coronarium. Elamal, *S.* (S).
H—gardnerianum. Stems of both species recommended for paper pulp.
Phormium tenax. New Zealand Hemp.
Salix babylonica. Weeping Willow. (T). Also other species of Willow.
Terminalia glabra. Kumbuk, *S.* Very large tree ; good timber. Often found on banks of rivers, &c.

(T)=TREE ; (S)=SHRUB.



Bougainvillea formosa.
(See page 108.)

CHAPTER XVII.

SHADE, WIND-BELT, TIMBER, FUEL TREES, Etc.

(1).—*TREES SUITABLE FOR AVENUES, ROADSIDES, ETC.*
(2).—*TREES FOR PARKS, OPEN SPACES, ETC.*
(3).—*SHADE TREES FOR FIELD CROPS.*
(4).—*WINDBREAK TREES CHIEFLY FOR MEDIUM OR HIGH ELEVATIONS.*
(5).—*TREES FOR FUEL, TIMBER, WINDBELTS, &c., FOR LOW AND MEDIUM ELEVATIONS.*
(6).—*TREES FOR FUEL, TIMBER, WINDBELTS, ETC., SUITED TO MEDIUM AND HIGH ELEVATIONS.*
(7).—*TEA-BOX WOODS.*
(8).—*IMPORTANT TIMBER AND CABINET WOODS OF THE TROPICS.*
(9).—*WOODS REASONABLY IMMUNE FROM TERMITES.*

The importance of shade trees in the tropics is impossible to overestimate ; they are in many cases essential to the successful cultivation of crops, and a boon to man and beast on account of the shelter they afford from the fierce sun, as well as for their effect in tempering the atmosphere and conserving moisture in the soil. Most crops in the tropics are benefited by moderate shade, especially in the earlier stages of growth ; while in windy situations protection from strong winds, as may be afforded by suitable trees, is equally important. Shade trees, suitably selected and planted in moderation, enhance the beauty of one's surroundings and render the atmosphere cooler and healthier. In malarial districts, the hygienic effect of certain trees in draining marshy land is well known. (See page 209). Trees must not, however, be planted so closely as to interfere with the free circulation of air around dwellings, or to cause excessive damp shade, which encourages mosquitoes. Brittle or soft-wooded trees, as Spathodea, if planted near buildings, may be a source of danger from their liability to be blown down by wind, while others, as species of Ficus, are objectionable on account of their extensive or shallow root-system. Others again, *e.g.* Casuarina, frequently block gutterings, drains, etc., by the almost constant dropping of their leaves.

Qualities of Shade Trees.—The suitability of shade trees depends much on local conditions and individual requirements. In some localities, shade-trees are selected with a view to providing crops of marketable fruit or other useful product in addition to shade. Thus in parts of India, Mangoes, Tamarind, etc., are sometimes employed for this dual purpose, while in some European countries the leasing of fruit-trees planted along public roads is a national source of revenue.

The following are essential qualities of a good shade tree : (1) It should be evergreen, or at least have the habit of putting on fresh foliage immediately after

shedding the old leaves ; (2) it should have un upright spreading form ; and (3) the foliage should be of a light feathery nature, preferably consisting of small leaves with the habit of closing at night. Too rapid a growth is to be deprecated for roadside shade, as being productive of brittle wood and short-lived trees. The merit of any shade tree depends largely upon the attention given it when young, as well as on the manner of planting. Careless or improper planting, injury by cattle, etc., when young, or ruthless treatment by disinterested owners of adjoining land, will permanently impair or disfigure trees, however good their qualities may otherwise be.

It is therefore desirable that certain recognised rules, such as the following, be adopted in the case of trees planted along roadsides, or in other public places :

(a) Proper holes to be prepared before planting, each to be about 3 ft. deep by 4 ft. in diameter and, beginning with a layer of drainage material, filled in with good soil and some well-rotted manure.

(b) Where possible, holes to be well behind the side-drains and not in the road, thus allowing for the trees when full-grown almost to meet near the centre of the road.

(c) Plants to be well established in bamboo-pots or baskets before being planted out.

(d) Planting to be, as far as possible, done at the commencement, not towards the end, of the rainy season.

(e) Distances for planting apart in the case of small or slow-growing trees to be about 30 or 35 ft. according to species, and 50 to 60 ft. for large trees. By adopting half these distances the ground will of course be covered more rapidly, but in that case every alternate tree must be cut out as soon as the trees begin to touch each other. Or, as an alternative, a quick-growing species may be interplanted with the slower-growing permanent trees, and cut out when it begins to encroach on the latter.

(f) Proper protection to be provided, either collectively or individually, against cattle, etc., by means of fences, or tree-guards until the trees are sufficiently established to take care of themselves.

(g) Wilful damage to, or interference with, the growth and proper development of the trees to be prohibited by law.

(1).—TREES SUITED FOR AVENUES, ROAD-SIDES, ETC.

Qualities desired in trees for road-sides or wide thoroughfares are : upright or horizontally spreading (not drooping) branches, forming a round canopy, erect stem, foliage which is evergreen or almost so (not deciduous), small leaves, and a deep root-system forming good anchorage. Characters which are not desired are : large leaves or dense foliage, large or heavy fruits, stem leaning from the perpendicular, and a shallow, surface-rooting system. A tree answering all requirements is difficult to find, but the following have certain qualities to recommend them.

Azadirachta indica. Margosa ; Kohomba, *S* ; Vempu, *T*; "Thini" of India. (*Meliaceae*). —Small or medium-sized, evergreen tree, with straight stem and small, pinnate leaves. Stands drought well ; much planted in avenues in India. See p. 206.

Caesalpinia coriaria. Divi-divi.—A small or medium-sized, slow-growing, evergreen tree, with very small bipinnate leaves and small, sweet-scented, greenish-white flowers. See pages 206, 441.

Carallia integerrima. Dawata, *S.* (*Rhizophoraceae*).—A small or medium-sized, slow-growing, symmetrical tree with a spreading head and rather small, dark-green leaves. Specially suited to the sea-coast; entirely evergreen.

Doona ovalifolia. Yakahalu or Pini-beraliya, *S.* (*Dipterocarpaceae*).—Large handsome tree, with drooping branches and small, ovate, tailed leaves. Ceylon, moist low-country, endemic.

Fagraea fragrans. Tembusu. (*Loganiaceae*).—A handsome, upright, evergreen, small-leaved tree of Malaya, often planted for ornament in that country. Though of rather slow growth, this has excellent qualities for an avenue tree, retaining its upright, well-balanced habit. Introduced at Peradeniya in 1891. See p. 99.

Filicium decipiens. Pihimbiya, *S* ; Fern-leaf Tree. See page 100.

Lafoensia vandelliana. (*Lythraceae*).—A small or medium-sized, erect, evergreen tree with small leaves. Native of Brazil, introduced into Ceylon 1856.

Lagerstroemia Flos-reginae. Muruta, *S*; Queen Flower.—A medium-sized tree with spreading branches. Sheds the leaves for a short period in the dry season. See page 89. §.

Mesua ferrea. Ceylon Iron-wood; Na-gaha, *S*.—A medium-sized, slow-growing, evergreen tree with small close foliage. See pages 90, 91, 216. §.

Peltophorum ferrugineum. Iya-vakai, *T*.—A large, quick-growing, spreading tree with fine feathery foliage, bearing a profusion of bright yellow flowers. A handsome tree for wide thoroughfares. See Pages 90, 92. §.

Pisonia alba. Lettuce Tree; "Lady Love".—A small evergreen tree, very striking on account of its bright, greenish-yellow foliage, specially adapted to the sea-side. See page 102.

Pithecolobium Saman. Rain-tree. (See page 102).—An excellent tree for roadsides up to a certain age, but in hot, moist regions assumes an enormous size, with large spreading surface roots, becoming top-heavy after the age of about 40-50 years. See pages 102, 207, 451, 518. §.

Pithecolobium dulce. Madras Thorn. *Leguminosae*.—A small or medium-sized tree, with small leaves (in 2 pairs) and prickly branches; thrives either in deep soil or in a dry sandy locality; naturalised about Colombo; commonly planted as a barrier hedge, but is naturally a tree of a somewhat ornamental character. See pp. 73, 74, 207, 518.

Poinciana regia. Flamboyante; Golden Mohur.—One of the most ornamental trees of the tropics, characterised by a spreading habit, very graceful feathery leaves and gorgeous flowers. (See pp. 91, 93). Suited only to very wide thoroughfares, being a rapid grower and liable to develop surface and buttressed roots. See p. 91. §.

Polyalthia longifolia. Mara-illupai, *T*. (*Anonaceae*). A moderate-sized, evergreen, symmetrical, upright tree with narrow, wavy leaves, much planted as an avenue tree in India; drought-resistant and suited to poor or rich soil.



Pithecolobium Saman.
RAIN TREE OR GUANGO.

Pongamia glabra. (*Leguminosae*). Indian Beech; Punku, *T*; Magul-karanda, *S*.—A handsome tree with glossy-green pinnate leaves, bearing racemes of creamy-white, scented flowers. Esteemed in India as a shade tree for streets, &c. Good timber; foliage relished by cattle in time of drought. See page 215.

Pterocarpus indicus. Padouk.—A large, very handsome tree; especially suited to parks or wide thoroughfares. See page 103.

Swietenia Mahagoni. Mahogany. An evergreen, upright tree with small leaves and a well-balanced, even-spreading head. A favourite shade tree in the north of Ceylon, where it seeds freely during July-August. See page 104.

S.—macrophylla. Large-leaved Mahogany. See page 104.

Tamarindus indicus. Tamarind; Siyambala, *S*; Pulli, *T*; (*Leguminosae*).—A moderate-sized or large, handsome, evergreen, slow-growing tree, with straight, erect stem and small pinnate leaves; thrives in moist as well as dry districts up to 2,000 feet elevation, and in the dry northern part of Ceylon as well as in parts of India is commonly planted as a shade-tree for road-sides. It is a long-lived tree, well adapted for avenues. It is noted for its hard and beautifully marked timber. Several varieties are recognised in India. Readily propagated from seed. See pages 207, 375, 380.

(2)—TREES FOR PARKS, OPEN SPACES, ETC.

SEE FOREGOING SELECTION, ALSO PP. 96-106.

Scenic effects should here be considered as well as the shade qualities of trees. Those of bold appearance, with striking foliage and drooping branches, will produce an imposing effect. Provided sufficient clearance is kept between the lower branches and the ground, trees generally improve the conditions for the growth of grass or pasture, owing to their cool shade. Beautiful flowering- as well as fine foliage-trees should be represented in a selection for this purpose.

(3).—SHADE TREES FOR FIELD CROPS.

SEE ALSO PAGES 25 & 27

Suitable shade-trees, thinly planted and properly attended to, have beneficial effects, physically and chemically, upon most crops in the tropics (see pp. 25-27). They help to conserve moisture in the soil, and aerate the latter by means of their deep-feeding roots, which bring plant-food from the under strata to be returned again in the form of mulch by the fallen leaves. Leguminous trees are generally preferable for the purpose, for the following reasons :

(1) They are usually fast growers; (2) their thin feathery foliage does not form too dense a shade ; (3) their leaves have often the habit of closing up at night; and (4) they are generally rich in nitrogen and have the property of collecting free nitrogen by means of bacteria nodules on their rootlets. In order to obtain the greatest benefit from such trees, the branches should be frequently lopped, and the young green foliage and twigs buried among the crop.

The following is a selection suitable for shade purposes (see also p. 353) :—



Gliricidia maculata. "MADRE."
(See page 215).

Adenanthera pavonina. Bead-tree ; Madatiya, *S.* (*Leguminosae*).—A moderate-sized, quick-growing, upright tree, with small, pinnate leaves and light, open foliage. The hard bright-red seeds are characteristic. See page 460.

Albizzia moluccana. Sau Tree ; Ratamara, *S*; Sahki-marram, *T*. (*Leguminosae*). A large, very quick-growing tree, with thin feathery foliage ; flowers in Dec.-Jan. Wood soft, suitable for tea-boxes, &c.

A.—stipulata. Kabal-mara, *S*. Similar to the preceding species, but distinguished by the reddish stipules.

Dalbergia (Deguelia) microphylla. (*Leguminosae*).—A small tree with fine foliage, used as a shade tree for Coffee in Java.

Erythrina lithosperma. Dadap ; Murunga-mara, *T*. (*Leguminosae*). A moderate-sized spineless tree of very rapid growth, with trifoliate leaves ; affords a quantity of foliage valued for mulching or green-manuring. 1 ton of green loppings has been found to contain 61.50 lb. nitrogen, 57.38 lb. potash, 15 lb. lime, and 13.68 lb. phosphoric acid;

readily propagated by stem- or branch-cuttings planted *in situ*, or from seed. Thrives up to 5,000 ft. Occurs in scarlet and orange-fl'd varieties; rather showy. See p. 27. §

E.—umbrosa. "Immortel" or "Mortel".—A moderate-sized tree with large, trifoliate leaves, used as shade for Cacao and other crops in the West Indies. Readily propagated by large cuttings or from seed.

E.—velutina. "Bocare".—A popular shade tree for Cacao in the West Indies; has soft, tomentose, trifoliate leaves.

Ficus glomerata. "Crattock"; "Guler".(*Urticaceae*).—Medium-sized tree, much used as shade for coffee in S. India; also popular as an avenue tree. *F. infectoria* and other species are also used in India for shade. Propagated by cuttings.

Gliricidia maculata. Madre, or Madre-de-Cacao, Mother of Cacao. (*Leguminosae*). – A quick-growing small tree, with long leafy branches; excellent shade for general crops. Readily propagated from small or large cuttings planted *in situ*, or from seed. Young trees should be topped at a height of about 6 ft., and lower branches removed. Loppings form an excellent mulch or green-manure for crops or borders, etc.; commonly used in S. America, etc., as shade for Cacao. Planted 16 × 16 ft., 170 go to 1 acre. See pp. 85, 214, 206.

Grevillea robusta. Silky Oak. An upright, medium-sized tree of Australia, with light feathery foliage, silvery-white underneath, much planted for shade amongst Tea, also for wind-belts, fuel reserve, &c., in Ceylon, India, and elsewhere. Propagated by seed. See pages 180, 216.

Inga laurina. Pois-doux; Spanish Ash. (*Leguminosae*).—A medium-sized-tree, used in the West Indies as a shade tree for Cacao.

Myroxylon toluifera. Balsam-of-Tolu. (*Leguminosae*). Suitable as a permanent shade tree for field crops. See pages 101, 217.

Pongamia glabra. Punku, *T*; Magul-karanda, *S*.—A large tree of the low-country, Ceylon, with small leaves. See page 213.

Tecoma leucoxylon. White Cedar. (*Bignoniaceae*).—An upright tree, commonly used in parts of W. Indies as a wind-break and shade tree for limes, &c.

(4).—WIND-BREAK TREES.

Chiefly for Medium or High Elevations.

A wind-break may be defined as a belt of trees which gives protection to growing crops from prevalent, strong winds. In some localities, as on exposed ridges, especially at the higher elevations, such protection is indispensable to most crops. An ideal wind-break would be a belt consisting of rows of tall trees in the centre; rows of shorter trees closely planted on either side, and outside these bushy shrubs. Suckers should be allowed to grow up and form an undergrowth, so that when the older trees are used for fuel, timber, etc., their place may be naturally supplied from the latter. The line of such a wind-belt should, as far as possible, be at right-angles to the direction of the prevailing winds. Where the roots of wind-break trees are liable to encroach on the crops, a deep trench should be dug to prevent encroachment by the former. Well established wind-belts may become a useful source of timber and fuel for home use; or they may be constituted so as to yield a subsidiary crop, as by planting with Camphor, Annatto, Croton-oil, Cashew-nut, &c. An ideal wind-break tree should be of a spreading habit, with strong tough wood, dense and evergreen foliage, and have the habit of producing suckers, as the Silver-wattle and other species of Acacia. The following is a general selection.

Acacia dealbata. Silver-wattle.
A.—decurrens. Black-wattle.
A.—melanoxylon. Black-wood.
} Suited to elevations of about 4,000 to 6,000 ft. First named especially suitable. See pages 176, 178, 217.

Acrocarpus fraxinifolius. See page 178.

Andira inermis. "Angelin"; Bastard Mahogany of the W. Indies. Leguminous tree, used for wind-belts in St. Vincent.

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Calophyllum Walkerii. "Kina," *S.* (*Guttiferae*).—A large tree, with a stout, straight trunk and a round head; common in Ceylon at the higher elevations.

Cedrela serrulata. Red Toon.
Cinnamomum Camphora. Camphor.
Cupressus knightiana.
C.—macrocarpa.
} Suited to elevations of about 3,500 to 6,000 ft. or higher. See pages 179, 180.

Eucalyptus marginata. Jarrah. West Australia. See *Timber Trees*, below; also p. 217.
E.—diversicolor (Karri Gum); E.—obliqua (Stringy Bark); and E.—amygdalina (Peppermint Gum), see p. 513.
E.—robusta. Iron-bark: "Swamp Mahogany."—An upright, tall tree with rough brown bark, and large ovate leaves, much planted for timber and fuel reserves at about 3,500 to 6,000 ft. in Ceylon and S. India. See below, also p. 217.
Eugenia Jambos. Jambu. A small, medium-sized, dense, evergreen tree. See *Trop. Fruits*, pages 217, 260.
Grevillea robusta. Silky-Oak. See pages 180, 215, 217.
Inga laurina. Pois-doux; Spanish Ash, or Spanish Oak. A leguminous medium-sized tree, used for wind-breaks, &c., in Dominica and other West Indian Islands. See also page 215.
Mesua ferrea. Ceylon Iron-wood. See pages 90, 91. 101.
Michelia nilagirica. Wal-sapu, *S.*—See page 218.
Myroxylon toluiferum. See p. 101.
Tecoma leucoxylon. White Cedar. See p. 215

(5).—TREES FOR FUEL, TIMBER, WIND-BREAKS, ETC.

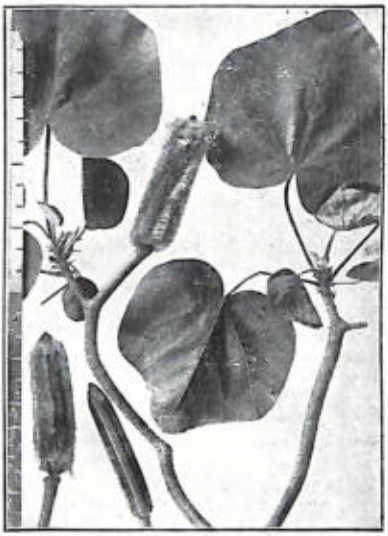
See also pages 218-219, *Important Timbers of the Tropics.*

(A).—FOR LOW AND MEDIUM ELEVATIONS.

Albizzia moluccana. "Albizzia;" Vachi-maram, *T.* A very quick-growing tree, yielding a large quantity of fuel; wood suitable for tea chests. See also pages 214, 217.
Artocarpus integrifolia. Jak; Kos, *S.*—A large tree, affording excellent timber, yellow when fresh, becoming dark-red like mahogany with age; much used for furniture, &c., in Ceylon. See *Tropical Fruits*, page 253.
Canarium bengalense. (*Burseraceae*). A tall erect tree, with straight, smooth, cylindrical stem and large pinnate leaves. Wood white, light, much esteemed in Bengal for tea boxes; also used for shingles. Yields a resin used in incense.
Cassia siamea. Wa, *S*: Vakai, *T.*—A large, quick-growing tree; heart-wood yields hard and dark red timber; excellent fuel.
Casuarinia equisetifolia. She Oak; Beef-wood; Kasa-gaha, *S.*—Very hard, durable timber, suitable for beams, posts, &c., but not for planks; does not last well under-ground. Excellent fuel. See pages 97, 99, 179, 443.
Cedrela odorata. Toon Tree.
C.—serrulata. Red Toon.
} Suited to medium or high elevations. See also p. 218.
Eucalyptus robusta. Iron-bark; Swamp Mahogany. (*Myrtaceae*).—See above, also p. 217. Other useful species are: E.—marginata (Jarrah), see page 217; E.—globulus (Blue-gum), page 180, &c.
Filicium decipiens. Pihimbiya, *S.*—A slow-growing tree; excellent, reddish timber, rather heavy, valued for cart-wheels, &c. See page 100.
Grevillea robusta. Silky Oak. See pages 180, 215.
Melia dubia. Lunu-midella, *S*; Malai-vempu, *T.*—A large, handsome, quick-growing spreading tree; wood light, soft, brownish red; much used for ceilings, also as outriggers for native boats. Seeds (in season Jan.-Mar.) enclosed in a hard, horny shell, which should be soaked in hot water for 2-3 days before sowing. Each shell contains 2-4 small seeds. See page 101.
Mesua ferrea. Ceylon Iron-wood; Na-gaha, *S.*—Slow-growing, straight-stemmed tree; timber dark-red, very hard and durable. See pages 90, 91, 101.
Michelia Champaca. Champac; Sapu, *S.* (*Magnoliaceae*).—Large quick-growing tree, with long leaves and scented, creamy-white flowers. Yields serviceable building timber and good fuel. Heartwood dark purple when freshly cut, turning to brown.
Mischodon zeylanicus. Tammana, *S*; Tampanai, *T.*—A small or medium-sized, much branched tree, good tough timber.

Myroxylon toluiferum. Balsam-of-Tolu.—A moderate-sized or large, leguminous, evergreen tree; splendid timber, dark-red and close-grained. See pages 101, 215.

Ochroma Lagopus. Down Tree; Cork- or Balsa-wood. (*Malvaceae*).—A quick-growing tree of tropical Cent. America, with large, palmate, soft leaves, 50 to about 70 ft. high. Wood notable for its light pith-like quality, much used for floats and rafts; largely in demand during the war for life-rafts, mine barrage, insulating purposes, aeroplane construction, &c. When dry, it has a weight of about 7 lbs. per cubic foot, while cork weighs 13½ lbs. Some of the heaviest woods, as iron-wood and ebony, weigh as much as 70 to 80 lbs. or more per cubic foot. The fine silky down from the fruit is used for stuffing pillows, etc. Introduced at Peradeniya in 1884; grows rapidly and produces fruit and seed regularly from March to May. See *Curious Fruits*, page 462. §



Ochroma Lagopus. DOWN TREE.

Pterocarpus marsupium. Gammalu, *S.*—A wide-spreading, handsome tree, fine dark, hard timber.

Thespesia populnea. Tulip-tree; Suriya, *S.*—See page 207.

Vitex altissima. Milla, *S*; Kadamanakku, *T.* (*Verbenaceae*).—A large tree with a dense head and drooping branches, common in dry low-country of Ceylon; valuable timber, hard, heavy, close-grained, smooth, tough and durable.

(6).—TREES FOR TIMBER, FUEL, WINDBREAKS, ETC.

(B).—FOR HIGH AND MEDIUM ELEVATIONS.

Acacia decurrens, var. mollissima. Black- or Ta -wattle. Australia. A large, quick growing tree, suited to high elevations or sub-tropical conditions, but is susceptible to very heavy rains and strong winds. See page 178; also *Tan Barks*, pages 176, 442.

A.—melanoxylon. Black-wood Tree. A fairly large tree, of comparatively slow growth; stands wind well; excellent timber and fuel. See page 178.

A.—pycnantha. Golden Wattle. 40-50 ft. high. Good timber. See pages 177, 442.

Albizzia moluccana. Suited to medium elevations. See pages 214, 216.

Acrocarpus fraxinifolius. Shingle Tree; Pink Cedar. (*Leguminosae*). See page 178. Sapwood white, heartwood light red, moderately hard; used in S. India for furniture, building, etc., and in Darjeeling for tea-boxes.

Cedrela serrulata. Red Toon; Red Cedar; "Java Mahogany." See pages 179, 216.

C.—Toona. Toon Tree. See page 179.

Cupressus knightiana and C.—macrocarpa. See page 180.

Eucalyptus leucoxylon. Iron-bark Tree. (*Myrtaceae*). Australia. A large tree, affording very hard, durable and strong timber, used by cartwrights, shipbuilders, &c., in Australia.

E.—marginata. Jarrah. West Australia. Large tree; yields valuable, durable timber, resistant to termites and other insects; largely exported and used for sleepers, street-paving, house- and jetty-building, etc. See page 216.

E.—robusta. Iron-bark. Swamp Mahogany. Tall upright tree, with rough brown bark and large ovate leaves; much planted for timber and fuel reserves at elevations of 3,000 to 6,000 ft. in Ceylon.

Eugenia Jambos. Rose-apple; Jambu. A much-branched, small or medium-sized tree, suitable for windbreaks up to about 4,000 to 5,000 ft. See *Fruit Trees*, pages 216, 260.

Grevillea robusta. Silky Oak. See pages 180, 215, 216.

Michelia nilagirica. Wal-sapu, *S.* (*Magnoliaceae*).—A moderate-sized shrubby tree, with a round head, common in moist forests above 4,000 ft.; one of the best of the indigenous mountain timbers of Ceylon.

(7).—TEA-BOX WOODS.

The following are among the most suitable woods for tea chests. Those marked * are considered to be of second-class quality.

Aridda, *S.* (*Campnosperma zeylanicum*).
Bakmi, *S.* (*Sarcocephalus cordatus*).
*Bombe, *S.* (*Litsea chinensis*).
Cananga, see Wana-sapu.
*Et-amba, *S.*, or Wild-mango (*Mangifera zeylanica*).
Hal, *S.* (*Vateria acuminata*).
Iriya, *S.* (*Myristica Irya*).
Kaju, or Cashew-nut (*Anacardium occidentale*).
*Katu-imbul, *S.* (*Bombax malabaricum*).
*Kenda, *S.* (*Macaranga tomentosa*).
Lunu-midella, *S.* (*Melia dubia*).
Malabodda, *S.*, or Wild-nutmeg (*Myristica laurifolia*).
Mara, *S.* (*Albizzia*, several species).
Momi, of Japan (*Abies firma*). Imported.
*Ruk-attana, *S.* (*Alstonia scholaris*).
Shingle Tree (*Acrocarpus fraxinifolius*).
Telambu, *S.* (*Sterculia foetida*).
Tel-kekuna, *S.*, or Candle-nut tree (*Aleurites triloba*).
*Wana-sapu *S.* (*Cananga odorata*).

(8).—IMPORTANT TIMBERS AND CABINET WOODS OF THE TROPICS.

Botanical Name and Natural Order in brackets.

Altingia excelsa. "Rasamala". (*Hamamelidaceae*). One of the largest of tropical trees, native of Java, &c. Clear stem often reaches 100 ft. high and a diameter of 8 ft. or more at base. Good timber.
Black-wattle. (Acacia decurrens, var. mollissima. *Leguminosae*). S. Australia.
Black-wood of Australia. (Acacia melanoxylon). S. Australia.
— — , of India. Bombay-wood. (Dalbergia latifolia. *Leguminosae*).
Billion. (Eusideroxylon Swageri. *Lauraceae.*) Borneo.
Blue Gum (Eucalyptus globulus). See page 180. One of the best of Australian timbers.
Boxwood, commercial. (Chiefly Buxus Macowani. *Euphorbiaceae*). S. Africa.
Boxwood, Ceylon; Gal-karanda, *S.* (Canthium didymum. *Rubiaceae*). Ceylon, India, &c. Wood hard, grey, fine-grained.
Brazilletto-wood. (Peltophorum Linnaei. *Leguminosae.*) West Indies.
Bullet Tree. (Mimusops globosa. *Sapotaceae.*) Very hard and durable; sometimes used as a substitute for "Greenheart".
Calamander. (Diospyros quaesita. *Ebenaceae*). Ceylon. Fancy cabinet-wood, rare.
Cam-wood. (Baphia nitida. *Leguminosae*). West Trop. Africa.
Cedar-wood, Red; Toon Tree. (Cedrela Toona. *Meliaceae*). Bengal and Burma. Light, reddish, mahogany-like timber.
Cedar-wood, Jamaica- or Honduras-. (Cedrela odorata). Wood similar to preceding species, but more fragrant.
Chengal or Penak. (Balanocarpus maximus. *Dipterocarpeae*). Malaya. Large, upright tree; standard timber of Malaya.
Chittagong-wood; Red Cedar; Hulan-hik, *S*; Kaloti, *T.* (Chickrassia tabularis. *Meliaceae*). Burma. Hard, brownish red, durable wood, valued for carving, furniture-making, &c.
Chloroxylon excelsa. *Meliaceae.* A handsome tree. Trop. Africa. Excellent timber.
Coffin Tree. (Machilus Namnu. *Lauraceae*). China. Upright, conical, evergreen tree, much planted at temples, &c., in China. Esteemed for its timber.
Crab-wood; Crappo or Carapa (Carapa guianensis. *Meliaceae*). Large, handsome tree of Guiana. Excellent timber for building, furniture, &c. Good substitute for mahogany. Seeds yield a fatty oil (crab-or carap-oil) used for burning, &c.
Dattock. (Detarium guineense. *Leguminosae*). Trop. Africa. Large handsome tree; wood exported from Africa under name of African Mahogany.
Ebony, Ceylon. (Diospyrus Ebenum. *Ebenaceae*). Ceylon. The hard, black heartwood is exported and worth from £20 to £40 or more per ton.
— , Jamaica; Cocos-wood. (Brya Ebenus. *Leguminosae*). Jamaica and Cuba.
— , Malabar; (Diospyrus melanoxylon. *Ebenaceae*). S. India.

Gammaiu, *S.* (Pterocarpus marsupium. *Leguminosae*). Ceylon and India.
Green-heart. (Nectandra Rodioei. *Lauraceae*). Brit. Guiana. Very hard and durable, especially under water; largely used for piles, dock-gates, &c.
Hal-milla. See Trincomalie-wood.
Iron-bark. (Eucalyptus robusta & E. leucoxylon. *Myrtaceae*). New South Wales, etc.
Iron-wood, Ceylon. (Mesua ferrea). See page 90.
" , Borneo. (Eusideroxylon Swageri. *Lauraceae*). See also Billio n.
Jak-wood. (Artocarpus integrifolia. *Urticaceae*). India, Ceylon, etc. Standard timber of Ceylon. See page 253.
Jarrah. (Eucalyptus marginata. *Myrtaceae*). West Australia. Very hard and durable, much exported; used for paving, sleepers, building, &c.
Lignum Vitae. (Guaiacum officinale. *Zygophyllaceae*). Tropical America.
Locust Tree. (Hymenaea Courbaril. *Legiminosae*). Hard, tough, durable. Brit. Guiana.
Mahogany. (Swietenia Mahagoni. *Meliaceae*). Trop. South America, Chiefly Honduras. See pages 104, 213.
—, African. (Khaya senegalensis. *Meliaceae*). West Trop. Africa.
—, Australian. See Jarrah.
—, Bastard. (Andira inermis. *Leguminosae*). Trop. America, etc.
—, Indian. (Cedrela Toona. *Meliaceae*). India, Java, etc.
—, Philippine. See Padouk.
—, Swamp. (Eucalyptus robusta. *Myrtaceae*). Australia.
Milla, *S.* (Vitex altissima. *Verbenaceae*). Ceylon and India.
Mirabow. (Afzelia palembanica. *Leguminosae*). Borneo and Malaya.
Mora. (Dimorphandra Mora. *Leguminosae*). British Guiana. Very large tree; hard, durable wood; good for sleepers, paving, &c.
Mosquito-wood. (Mosquitoxylum jamaicense. *Leguminosae*). West Indies.
Mountain Mahoe. (Hibiscus elatus. *Malvaceae*). West Indies.
Nedun, *S.* (Pericopsis mooniana. *Leguminosae*). Ceylon. Beautiful cabinet wood.
Oak, African. (Lophira alata. *Ochnaceae*). W. Trop. Africa.
—,Ceylon. (Schleichera trijuga. *Sapindaceae*). Ceylon, India, Java, etc. Foliage resembles that of English Oak. Wood reddish, hard and durable.
—,She. (Casuarina equsetifolia. *Casuarineae*). Queensland, New S. Wales, &c.
—,Silky. (Grevillea robusta. *Proteaceae*). Wood white, prettily marked.
Padouk. (Pterocarpus indicus. *Leguminosae*). Burma. Excellent hard, reddish timber; much exported.
Palisander-wood. (Machaerium firmum. *Leguminosae*). See Rosewood.
Palu, *S.* (Mimusops hexandra. *Sapotaceae*). Ceylon and India. Very hard and durable, used for sleepers, etc.
Pehimbiya, *S.* (Filicium decipiens. *Burseraceae*). Ceylon and W. India. See p. 100.
Porcupine-wood; Coconut (Cocos nucifera. *Palmae*).
Purple-heart. (Copaifera pubiflora. *Leguminosae*). British Guiana.
Red-wood, Andamans. (Pterocarpus dalbergioides. *Leguminosae*. Handsome tree.
" , Indian. (Soymida febrifuga. *Meliaceae*). Central India, etc. Resistant to termites. Bark used in fevers.
Rosewood; Tiger-wood. (Machaerium firmum. *Leguminosae*). Brazil.
—, Burmese, see Padouk. (Pterocarpus indicus. *Leguminosae*). Burma.
—, Indian, or Bombay-wood. (Dalbergia latifolia. *Leguminosae*). Bengal, &c. Valuable cabinet wood; also used for gun-carriages, &c.
—, Jamaica. (Linociera ligustrina. *Oleaceae*). Jamaica.
Sal. (Shorea robusta. *Dipterocarpeae*). India, Burma, etc.
Sandalwood. (Santalum album. *Santalaceae*). Mysore. Wood reddish, fragrant, valued for carving and made into ornamental articles, &c. See p. 399.
Satinwood. (Chloroxylon Swietenia. *Meliaceae*). S. India and Ceylon. Beautifully marked, especially "Flowered satinwood," which is exported and worth from 40*s.*-50*s.* or more per cubic foot.
Sissoo-wood. (Dalbergia Sissoo. *Leguminosae*). Valuable timber of India.
Tamarind-wood. (Tamarindus indica. *Leguminosae*). India. Hard, dark wood, well-grained.
Tampines. (Sloetia sideroxylon. *Moraceae*). Malaya. Very hard wood.
Teak. (Tectona grandis. *Verbenaceae*). Burma and Siam, &c., from whence it is largely exported. One of the most important commercial timbers of the tropics. Best teak considered to be produced on calcareous soil.
—, African. (Oldfieldia africana. *Euphorbiaceae*). Sierra Leone.

Tembusu. (Fagraea fragrans. *Loganiaceae*). Malaya. Heavy wood; used for building, flooring, &c.
(Trachylobium verrucosum. *Leguminosae*). Madagascar.
Trincomalie-wood. Halmilla, *S.* (Berrya Ammonilla, *Tiliaceae*). Ceylon, S. India, Burma.
Tulip-wood, Australian. (Harpullia pendula. *Sapindaceae*). Queensland.
Wallaba. (Eperua falcata. *Leguminosae*). Large tree of Brit. Guiana, with drooping branches; wood hard, reddish brown, with white streaks. Exported.
We-warani, *S.*; Ranai, *T.* (Alseodaphne semecarpifolia. *Lauraceae*). Ceylon, dry region. Exported from Ceylon.

(10).—TIMBERS REASONABLY IMMUNE FROM TERMITES.

Artocarpus integrifolia. Jak; Kos, *S.*
A.—nobilis. Wild Bread-fruit; Del, *S.*
Bassia longifolia. Mi, *S.*
Berrya Ammonilla. Halmilla, *S.*
Bridelia retusa. Keta-kela, *S.*
Cassia siamea. Wa, *S.*; Vakai, *T.*
Casuarina equisetifolia. Beef-wood; She-oak; Kasa, *S.*
Cedrela Toona & C. odorata. Cedar Wood.
Chloroxylon Swietenia. Satin-wood.
Doona zeylanica. Doon, *S.*
Eucalyptus leucoxylon. Iron Bark.
E.—robusta. Swamp Mahogany.
E.—marginata. Jarrah.
Eusideroxylon Swageri. "Billion"
Filicium decipiens. Pihimbiya, *S.*
Grevillea robusta. Silky-oak.
Hemicyclia sepiaria. Wira, *S.*
Melia dubia. Lunu-midella, *S.*
Mesua ferrea. Ceylon Iron-wood; Na, *S.*
Mimusops hexandra. Palu, *S.*
Myroxylon toluiferum. Balsam-of-Tolu.
Pericopsis mooniana. Nedun, *S.*
Pterocarpus marsupium. Gammalu, *S.*
Swietenia macrophylla. Large-leaved Mahogany.
S.—Mahagoni. Mahogany.
Tamarindus indica. Tamarind; Siyambala, *S.*
Tectona grandis. Teak.
Terminalia glabra. Kumbuk, *S.*
Thespesia populnea. Tulip Tree; Suriya, *S.*
Vateria acuminata. Hal, *S.*
Vitex altissima. Milla, *S.*

CHAPTER XVIII.

RAILWAY-, SCHOOL-, AND REST-HOUSE GARDENS, AGRI-HORTICULTURAL SHOWS, &c.

(1). *SELECTIONS SUITED TO LOW, MEDIUM, AND HIGH ELEVATIONS.*

(2). *TREES SUITABLE FOR MEMORIAL PURPOSES.*

(3). *PLANTS, ETC., SUITABLE FOR CEMETERIES.*

(4). *AGRI-HORTICULTURAL SHOWS*

(a). *ARRANGEMENT OF CATALOGUE.*

(b). *HINTS TO EXHIBITORS.*

(c). *RULES FOR JUDGING.*

(5). *HINTS FOR JUDGING PLOTS OR FIELD CROPS.*

FOR FULLER INFORMATION, SEE CHAPTERS 9 AND 10.

The vicinity of Railway Stations, Schools and Rest-houses affords in many cases excellent opportunities of establishing attractive and useful little gardens, often in isolated or sparseley cultivated districts, capable of serving as object lessons to the peasantry, in addition to their primary purpose of ornament or utility. Through the agency of such gardens, useful and ornamental plants may be introduced and established, and opportunity afforded of demonstrating the kinds of plants or crops most adapted to the particular climate and soil of the locality. The most cheerless and bleak situation may be made attractive and interesting by establishing and maintaining neat little gardens suited to the surroundings, and the effect of these in rendering a vicinity salubrious and agreeable can hardly be over-estimated.

In the case of School-gardens especially, they serve (1) to train the children to habits of observation, and afford a basis for nature study; (2) to relieve the routine of indoor with outdoor work of a pleasant nature; (3) to cultivate a love of gardening ; and (4) to teach the dignity of labour.

Laying-out and Planting. The outline of the garden being decided upon, the boundary should be planted with suitable trees for the purpose of providing shade or shelter. These should be planted closer than they are intended to remain when grown up, allowance being thus made for thinning out as the trees approach maturity. Deciduous trees should not, as a rule, be planted for shade, as they are likely to drop their leaves when shade is most required. It will help to make one's idea clear by first sketching on paper the general contour of the ground and the outline of the scheme it is proposed to follow, afterwards marking off the space with string and pegs. The general plan should, of course, depend on the area, also on the labour available for maintaining the garden in a proper condition. Therefore, never make a garden larger than you can manage to maintain in good order. A small garden well kept is obviously preferable to a larger one which always presents an untidy or neglected appearance. Persons in charge of Rest-houses and Railway-gardens

in Ceylon frequently make the mistake of thinking that a great number of miniature beds and borders, sometimes but a few inches in width and of fantastic outline, constitute an attractive garden. Such geometrical figures are neither ornamental nor practical, being unsuitable for the growth of most ornamental plants, and too small and intricate to allow of their being maintained in a proper condition. Simple beds of moderate dimensions, either oblong, round, or oval in shape, and borders of suitable width and natural curves are therefore preferable.

Borders should, as a rule, be confined to the outskirts of the garden, and planted with tall shrubs so as to form a striking background for the beds of smaller plants in front. Flower-beds may be dotted about the lawn and by the sides of paths, but care should be taken generally to leave the foreground as open as possible. Where only a narrow strip of ground is available, as at some railway stations, no elaborate design should be attempted; a bold border consisting of mixed ornamental shrubs in the back row, finishing with smaller plants in front, is in such cases the most practical and effective arrangement. The ideal small garden should present a striking background of tall shrubs and a few shade-or flowering-trees, with beds of gradually smaller plants in the foreground, the latter being set in a smooth level lawn, with plenty of space between them. This will present the best effect when looked at from the front, as from the railway carriages.

Paths. These should always be wide enough for two persons to walk comfortably abreast, or not less than 3½ ft. wide, and may be either straight or gracefully curved. It must be remembered that paths are meant for convenience rather than for ornament; therefore avoid having any more than are necessary. Cleanly kept, smooth paths, of uniform width and with neatly trimmed edges, add, however, to the general effect of a garden.

Hedges. It is essential at the outset to afford protection against wandering cattle and, in some cases, also deer, porcupines, etc., by means of a wall, a paling of old sleepers, or a good barbed-wire fence; the latter may be concealed and beautified by showy climbers, or by a neat hedge of ornamental shrubs in front. A live fence or hedge of some formidable prickly plant (see *Hedges*, page 72) may in some cases afford an efficient barrier when well established.

Climbers. Ornamental climbers can be used with charming effect over bamboo, rustic, or iron arches; or they may be twined round tree trunks, or trained in festoons between pillars. They may also serve useful purposes in screening off an unsightly outhouse, or shading an exposed verandah. Climbers, however, may be injurious to buildings if allowed to grow unchecked over the roof, and should therefore be kept within definite bounds.

Lawns. The beds or borders should be so arranged as to leave plenty of working space between them, and the intervening spaces should, when possible, be laid in turf. Lawn forms the best setting and, if well kept, will not only enhance the ornamental effect of the plants, but will in itself always present a very pleasing appearance. A lawn is easily produced, and when made entails less labour in upkeep than if the same area were laid out in miniature paths and beds. The ground should first be dug up and uniformly levelled; the surface may then be covered with turf, or, if this is scarce, roots of grass may be dibbled in at three or four inches apart, and the surface afterwards rolled. Seed of any good local turf grass, as "Tutteri," if sown and covered with a sprinkling of soil, will soon form a green sward. Wet weather should, of course, be chosen for any work of this nature. When the turf is well established the grass should be kept short, which may easily be done by an edged bamboo-splint, if a small lawn-mower is not available. See page 68.

Upkeep. However well a garden may be laid out and planted, its success will depend upon proper upkeep. It may be accepted, as a general rule, that the condition of a garden invariably reflects the extent of personal interest of its owner or the person in charge. Keeping the grass short and the turf uniformly level, the paths clean-weeded with neatly cut edges, hedges neatly trimmed, weeding, forking, and mulching the soil—these are operations which should never be neglected, and go far to make a perfect garden.

Propagation. Simple propagation, as by cuttings, bulbs, division of roots, etc., may easily be carried out in small gardens, as at Railway stations, Resthouses, Schools, etc. Too often valuable plants are neglected and allowed to run out of stock, the Government Gardens being expected to replace them when required. All that is necessary is a bed of loose, rich soil in a shady corner, with water near at hand for watering when required. The ground should be dug about 1½ to 2 feet deep,

so as to afford good drainage, encourage the retention of moisture in the soil during dry weather, and enable growing roots to penetrate through it. Remove coarse stones, etc., and place on the surface a layer of fine soil, adding some leaf-mould and well decomposed manure, also a little fine river-sand if the soil is of a clayey nature.

Shading and watering the beds when necessary, or protecting them from excessive rain, must be attended to. The advantages of having one's own nursery are obvious, for not only are plants thus ready at hand when required for planting out or for filling vacancies, but the supply of special kinds suitable for definite purposes or locality can be relied upon.

(1). SELECTIONS SUITED TO LOW, MEDIUM, AND HIGH ELEVATIONS.

SEE ALSO PAGES 107—210.

FLOWERING AND FOLIAGE SHRUBS:

Lagerstroemia indica. "Indian Lilac."
Tabernaemontana coronaria. "Wax-flower." Fl's pure white.
Croton. Different var's. Ornamental fol.
Palms. Different var's. Handsome foliage
Acalypha. Different var's; large, coloured leaves.
Pisonia alba. Lettuce-tree. Greenish-yellow foliage.
Arundo Donax. Large, variegated grass.
Hibiscus. Different var's. Showy fl's.
Amomum magnificum. Large ornamental leaves.
Poinsettia pulcherrima. Showy scarlet bracts.
Heliconia aureo-striata. Large, ornamental, plantain-like leaves.
Panax fruticosum. Feathery leaves.
Cordyline (Dracaena). Ornamental, purple, crimson, or bronze leaves.
Aralia filicifolia. Ornamental feathery leaves.
Mussaenda erythrophylla. Showy scarlet fl's (enlarged sepal), lasting several weeks.
Gardenia florida. White, scented fl's.
Kopsia fruticosa. Pink and white fl's.
Plumeria rubra. Red Temple-tree. Crimson fl's.

CLIMBERS:

Solanum Wendlandii. Large blue flowers.
Allamanda Hendersoni. Large, yellow, bell-shaped fl's.
Bignonia magnifica. Beautiful magenta flowers.
B.—unguis. Bright yellow flowers.
Cissus discolor. Satiny crimson leaves.
Antigonon leptopus. Lovely pink fl's.
Clerodendron Thomsonae. Beautiful white and scarlet flowers.
Petrea volubilis. Beautiful blue and violet flowers
Congea tomentosa. Showy pink flowers, in large sprays.
Ipomoea Briggsii. Dark crimson fl's.
Bignonia venusta. "Tanga-poo." Flowers orange-yellow.
Solanum seaforthianum. Blue flowers.

Sea Level

2,500 Ft.

LOW PLANTS SUITABLE FOR BEDS, FRONT ROWS, OR EDGING:

Canna. Numerous var's. See p. 137.
Vinca rosea. Pink or white flowers.
Coleus. Different var's; ornamental fol.
Caladiums. Different var's. See p. 136.
Alternanthera. Several varieties. Dwarf plants, useful for edging and designs.
Coreopsis. Yellow flowers.
Ageratum. Blue flowers.
Angelonia. Bluish-purple or white flowers.
Cosmos. Pink and white flowers
Ananas variegata. Variegated pineapple.
Turnera elegans. Creamy white flowers, closing towards noon.
Gynandropsis. Large pink blossoms.
Torenia Fournieri. Small plant, violet and blue fl's; also a white var.
Chrysanthemum. Perennial. White, yellow, purple, &c.
Gomphrena globosa. Purple flowers.
Phrynium variegatum. Variegated leaves.
Salvia farinacea. Pale blue flowers.
Pentas carnea. Pink, mauve, white, &c.
Ruellia colorata. Purple bronzy leaves perennial, creeping.
Salvia. Scarlet flowers.
Petunia. Showy purple or white flowers.
Cuphea jorullensis. Fl's orange-yellow
Marigolds. Fl's yellow, orange, etc.

FLOWERING AND FOLIAGE SHRUBS:

Pavetta indica. Flowers white.
Russelia juncea. Flowers pink.
Sanchezia nobilis. Variegated leaves.
Strobilanthes coloratus. Fl's dark purple.
Montanoa bipinnatifida. Tree-daisy.
Graptophyllum hortense. Variegated fol.
Tecoma stans. Yellow flowers.
Beloperone oblongata. Pink flowers.
Duranta Plumieri. Pale blue flowers.
Plumbago capensis. Pretty blue fl's.
Pleroma macranthum. See page 184.
Bocconia frutescens.
Iresine Herbstii. Variegated foliage.
Musa coccinea. Flowering-banana; scarlet flowers.
Streptosolen Jamesoni. See page 185.
Brunfelsia Hopeana. Blue & white fl's.

SHOWY FLOWERING ANNUALS:

Acroclinium and other "Everlastings."
Asters, Balsams, Browallia, Celosia or Cock's Comb.
Chrysanthemums (Annual).
Clarkia. Pink flowers.
Candytuft. White or purple.
Coreopsis. Bright yellow.
Cosmos. Pink and white.
Dianthus. Indian Pink.
Exacum macranthum. See p. 199.
Hollyhock, single.
Larkspur, Linaria, Linum.
Mignonette. Nemesia, 6 to 8 in. high.
Nicotiana, different varieties.
Petunia; Phlox Drummondi; Poppies.
Portulaca or "Sun plant;" dwarf.
Salpiglossus, Schizanthus, Verbena, Zinnia.

3,500 Ft.

FLOWERING AND FOLIAGE SHRUBS:

Azalea, different var's; pink, white, etc.
Brunfelsia Hopeana. Blue and white.
Datura fastuosa. Flowers large, white.
Cestrum (Habrothamnus) elegans. Bears bright crimson berries.
Libonia floribunda. Orange-red fl's.
Fuchsia arborescens. Showy lilac fl's.
Salvia. Different var's.
Spiraea peruviana. Creamy white fl's.

TUBEROUS AND HERBACEOUS PLANTS, ETC:

Agapanthus umbellatus. Lovely blue fl's
Aster, perennial. Different shades.
Ixia pendula. Orange yellow.
Hippeastrum. Different varieties; large showy flowers.
Dahlias. Purple, yellow, scarlet, etc.
Tritonia aurea. Orange-yellow.
Cyrtanthus. ("African Bride"). White or pink, scented.
Cannas. Yellow, scarlet, pink, etc.
Heliotrope. Blue, mauve, &c.
Roses. See page 192.
Hydrangea. Fl's blue, white, or pink.
Hedychium coronarium. White, scented.
Vinca (Periwinkle). Blue or white.

POT-, BORDER-PLANTS, ETC.

Cineraria. Blue, white, etc. (For pots).
Chrysanthemums. White, yellow, etc.
Violets. Blue, violet, purple, white.
Daisies. White, scarlet, etc.
Geraniums. Scarlet, pink, white, etc.
Santolina. "Cotton Lavender." White, cottony foliage, scented.
Pansies. Different colours.
Sweet Peas. Various shades.

ORNAMENTAL CLIMBERS:—

6,000 Ft.

Cobaea scandens. Strong grower; flowers purplish white.
Mandevillea suaveolens. Chili Jasmine; flowers large, pure white.
Thunbergia wightiana. Flowers half yellow and half brown.
Solanum jasminoides. Fl's white, showy.
Tacsonia. Tubular, pink, drooping fl's.
Tropaeolum (Nasturtium). Flowers yellow, orange, etc.
Wistaria sinensis. Bears clusters of beautiful blue and pale-purple fl's.

(2).—TREES SUITABLE FOR MEMORIAL PURPOSES.

[*FOR DESCRIPTIONS, SEE PAGES 82-106, 176-182.*]

(*A*).—FOR THE MOIST LOW-COUNTRY:—

FINE FLOWERING TREES:

Amherstia nobilis.
Brownea grandiceps.
B.—macrophylla.
Cassia grandis.
C.—nodosa.
Couroupita guianensis. Cannon-ball Tree.
Jacaranda mimosaefolia.
Lagerstroemia Flos-reginae.
Peltophorum ferrugineum.
Plumeria acutifolia. Temple Tree.
P.—rubra. Red fl'd Temple Tree.
Poinciana regia. Flamboyante.
Schizolobium excelsum.
Spathodea campanulata.

HANDSOME FOLIAGE TREES:

Agathis robusta.
Araucaria Bidwillii.
Artocarpus incisa. Bread-fruit.
Bertholletia excelsa. Brazil-nut Tree.
Enterolobium cyclocarpum.
Fagraea fragrans. Tembusu.
Ficus Benjamina. "Java Willow."
Mesua ferrea. Ceylon Iron-wood.
Myroxylon toluiferum. Balsam Tree.
Parkia Roxburghii.
Podocarpus cupressinus.
Pterocarpus indicus.
Swietenia macrophylla. Large-leaved Mahogany
S.—Mahagoni. Ordinary mahogany.

(*B*).—FOR THE DRY REGION:

(See Chap. 16.)

Cassia Fistula. "Indian Laburnum."
Millingtonia hortensis. See p. 90.
Plumeria acutifolia. Temple Tree.
P.—rubra. Red Temple Tree.
Polyalthia longifolia.
Tamarindus indica. Tamarind.

(*C*).—FOR UP-COUNTRY:

(See Chap. 15.)

Araucaria Bidwillii.
Cupressus, and other Coniferae.
Frenela rhomboidea.
Grevillea robusta.
Stenocarpus sinuatus.
Syncarpia laurifolia.

(3).—PLANTS SUITABLE FOR CEMETERIES.

Dwarf or slow-growing plants, which are either evergreens or produce white or blue flowers, are usually preferred for planting on or around graves. The following species are suggested for the purpose. For fuller descriptions, &c., refer to Index.

(*A*).—FOR LOW AND MEDIUM ELEVATIONS.

SMALL TREES AND PALMS:—

Casuarina equisetifolia.
Cupressus funebris. Weeping Cypress.
Cycads. Ceylon Sago; "Madu."
Palms; Chrysalidocarpus, Ptychosperma and other bushy species.
Plumeria acutifolia. Temple-Tree.
Schinus molle. Pepper Tree.
Thuja orientalis. Arbor Vitae.

SMALL SHRUBS WITH WHITE OR BLUE FLOWERS:—

Angelonia alba; fl's white.
Brunfelsia americana; fl's cream.
B.—Hopeana; fl's white and blue.
Clerodendron macrosiphon; fl's white and pink.
Heeria macrostachya; flowers white.
Plumbago capensis; blue flowers; also a white-flowered var.
Tabernaemontana coronaria; fl's pure white.
Vinca alba; white-flowered variety.
Wrightia zeylanica; fl's pure white.

DWARF OR EDGING PLANTS:—

Alternanthera; dwarf plants, foliage greenish yellow or bronze.
Amaryllis; white-flowered var's.
Caladium argyrites; small, variegated white and green leaves.
Coleus; handsome velvety, variously-coloured foliage.
Eucharis Lily; pure white flowers.
Eurycles; white flowers.
Ophiopogon; creamy white flowers.
Pancratium zeylanicum; pure white fl's.
Phalaris arundinacea; variegated grass.
Phyllanthus myrtifolius. Fine evergreen foliage; coppices well, like Boxwood.
Pilea muscosa; dwarf moss-like plant, stands drought well.
Salvia farinacea; pale blue flowers.
Tuberose; creamy white fl's, scented.
Zephyranthes; white flowers (tuber).

(*B*).—FOR UP-COUNTRY CEMETERIES:—

Alternanthera; see above.
Amaryllis (Hippeastrum), different var's.
Begonia, different varieties.
Carnations; fl's white, crimson, etc.
Coleus; see above.
Crinum speciosa; large white fl's.
Cyrtanthus Mackenii; white flowers.
Eurycles; white flowers.
Hydrangea; white or pale blue fl's.
Leptospermum scoparium. Fine fol., white fl's.
Pancratium; white flowers (tuber).
Santolina; Cotton Lavender. Pale grey, scented foliage.
Sweet-william; white and pink fl's.
Tuberose; white fl's, see above.
Zephyranthes; white flowers (tuber).
Also various white-flowering annuals, etc.

(4).—AGRI-HORTICULTURAL SHOWS.

RULES FOR JUDGING, HINTS FOR MANAGING COMMITTEES AND FOR EXHIBITORS.

(*A*)—ARRANGEMENT OF CATALOGUE OR PRIZE LIST.

(1) The catalogue or prize-list should be drafted, or at least passed, by a person or persons of experience. It should be arranged in Sections and Classes, the latter being numbered in continued sequence, at the left-hand margin.

(2) Indefinite or ambiguous terms, as sub-classes, divisions, and sub-divisions, should be avoided.

(3) Special conditions affecting a Section or Class should be indicated at the heading of such section or class, or in small type as foot notes.

(4) Prizes should not be offered for flowers or crops which are not likely to be in season at the time of the Show, for this only limits the prizes which would be available for other classes, or may result in bringing forward only inferior specimens.

(5) Discretion is necessary in stating the quantities or numbers required for an exhibit. These should be just sufficient to form representative samples, and no more. An example of what should be avoided is : "Best collection of varieties of paddy."

(6) Descriptions of classes should be definite and incapable of misinterpretation. For instance, "species" should not be referred to when "variety" is meant, or *vice-versa*. Ambiguous terms should be avoided—*e.g.* "Lilies," a popular term of uncertain definition, generally implying plants of Amaryllideae, Liliaceae, Irideae, Aroideae, &c. This is a frequent cause of misunderstanding and disputes at Shows.

(7) A distinction should be made when practicable between market-gardeners (or nurserymen) and amateurs, providing separate classes for these.

(8) Prize cards and rosettes should be of uniform sizes and colours, according to their respective value, for all classes in the Show. Thus the first-prize cards should be red, the second-prize blue, and the third or "highly commended" lavender or yellow.

(9) It is important that the staging provided for the cut-flower class or other exhibits necessitating the use of vases or other vessels holding water, should have a level, boarded surface. Flimsy and uneven staging is very unsatisfactory.

(10) Definite positions and spaces should be allotted and prominently labelled for the different classes, before the exhibits are received. The Managing Committee should see that the allotted spaces are in charge of persons who will see that the exhibits are placed in their correct positions.

(11) Fruits or other exhibits which have an objectionable odour, such as durian, especially when cut open for judging, should not be placed among the more attractive exhibits, but confined to an isolated corner or shed.

(12) The Managing Committee should aim at arranging the classes as nearly as possible in the sequence in which they are given in the catalogue.

(*B*)—HINTS TO EXHIBITORS.

Preparation and arrangement of exhibits.

(1) Intending exhibitors should sow or plant crops of vegetables, flowers, etc., in time to allow these to mature and be at their best at the date of the Show. The period required in each case will vary according to kind, locality, climate, and soil. One is best guided by experience in this respect.

(2) Should the specimen ripen a little too early or a little late, a resourceful cultivator can adopt measures which will to some extent retard or hasten the process, as by protecting artificially from excessive rain or sun, checking growth by making a cut in the stem, as with lettuce, cabbage, cauliflower, &c., or hastening it with applications of liquid manure or nitrate of soda. Flowers may be kept back by nipping the earlier blooms, or they may be advanced by affording protection from rain by means of a sheet of glass placed over them.

(3) Greater size and perfection may be induced in flowers or fruit by a judicious thinning out, always retaining the best formed bunches or individuals.

Sufficient growing space is essential for the best development of any crop, whether fruit, flowers, or vegetables.

(4) In selecting exhibits, adhere to the rules laid down in the catalogue, more especially in regard to the number or quantity required ; disregard of these may disqualify an exhibit, whatever its merits. Rules are made to be observed and as a necessary basis for the judging of exhibits.

(5) Wash root-crops carefully and cut off unnecessary roots before sending to the Show.

(6) Support the stems of flowering plants in pots, but avoid obtrusive stakes or ties, which should as far as possible be invisible. Do not use pots that are too large or out of proportion to the size of the plants ; see that all pots are scrubbed clean.

(7) Remember that quality counts for more than quantity, that vegetables, fruits and other edible products should be in their best state for consumption when exhibited. Overgrown vegetables are generally unfit for eating. Fruit should be just ripe ; if unripe or over-ripe, it is unfit for judging.

(8) Solitary flowers, such as Roses, Hibiscus, &c., for exhibition should, after they are cut, be kept intact by tying a soft piece of wool or cotton around each. This of course must be removed by the exhibitor before the judging commences. Cut flowers of any kind should have their stalks placed in water immediately after cutting ; these will keep longer if, when being trimmed, their stalks are cut under the water instead of in the air.

(9) An important point is that the exhibit as a whole should present a uniform appearance or quality, *i.e.*, it should be a "good sample".

(10) In transporting delicate fruits, such as mango, papaw, sapodilla, tomatoes, etc., they should be packed with fine shavings, sawdust,or some soft material to prevent them from being bruised. Smaller fruits, as uguressa, strawberries, purple guava, etc., may be packed in layers with a large leaf between each layer. Large fruits, such as plantains, pineapples, durians, jak, etc., should be packed with dry straw or shavings, in crates or well-ventilated boxes.

(11) Plants, if sent over a long journey, should be packed in crates, the stems, flowers, or leaves being securely tied and held in position. Flowering plants in bloom should have each stem staked separately. Pots or tubs should be well wrapped in straw or shavings, and bound round so as to prevent the soil from being shaken or tipped out.

(12) Lids or wooden cases should be screwed down (not nailed), or, better still, hinged and locked with a padlock. Packages sent by rail or other public conveyance should be addressed clearly and marked *Urgent* ; when closed, the top should be marked *This side up*, and *Fragile* when containing glass or breakables.

(13) Fruits, vegetables, herbs, etc., should be exhibited in shallow basket-trays or plates of uniform sizes. Small fruits, as grapes, strawberries, guavas etc., are rendered more effective by having a few of their own leaves arranged neatly around them.

(14) Do not stage small articles in large and unsightly receptacles. In England, regulation dishes or plates are sometimes lent on the Show ground by the Committee at a small charge.

(15) The educational value of an exhibit may be enhanced by having a neatly written label attached to it, giving the common, and if possible the botanical, name of the exhibit, also any other information in brief.

(16) Flowers which naturally grow in clusters, such as Verbena, Phlox, Schizanthus, etc., are best shown in bunches, while blooms of a large size and distinctive form, *e.g.* Dahlias, Roses, Hibiscus, etc., are seen to best advantage when displayed singly.

(17) Though bottles or tins, if of uniform size and securely held in position, may answer the purpose of displaying cut-flowers, the correct article to use in order to display these to the best effect and facilitate arrangement, is an *exhibition box*. This may be made of any light wood and painted green; it should have a sloping top, on the principle of a writing desk when open.

(18) Above all, note carefully and observe strictly the conditions laid down in the catalogue in regard to the number or quantity required, time for receiving exhibits and completing arrangements, commencement of judging, &c.

(19) The exhibitor's name should be given on a card or slip of paper inside an envelope attached to the exhibit, and should on no account be exposed to view until after the judging.

(C)—RULES FOR JUDGING

(1) Persons selected to act as judges should possess a practical knowledge of the classes they are to judge, not only of the crops as they appear on the market, but also, if possible, of their cultivation.

(2) No judge should have private interest in the class or classes in which he or she officiates.

(3) It is usually advisable, especially where exhibits are fairly extensive and competition is close, to appoint three judges to form a quorum, either for each section or for a group of classes.

(4) First dismiss from consideration all exhibits which are manifestly inferior. Then compare those which remain. In the case of close contest, proceed to judge by points, *i.e.* awarding a definite number of marks out of a possible maximum to the principal points of merit. The possible maximum may be agreed upon according to the number of points considered desirable in the exhibit. Thus, fruits and vegetables may be allotted a maximum of 10 marks each on the following points:—quality, shape, uniformity, size, and general condition for consumption; while with flowers, size, colour, condition and form would be the principal points of merit. Effective arrangement and correct naming may also be taken into consideration and awarded marks. It is not necessary to resort to points when the exhibits show unmistakable differences in quality.

(5) The judges should not disclose the name of the exhibitor until their decision has been arrived at, after which the envelope attached must be opened, and the exhibitor's name, award, class, and description of article written on the prize card.

(6) Exhibits of produce which have not been grown by the exhibitor or his employer for at least two months before the Show should be disqualified, unless stated to the contrary in the catalogue. This rule need not apply to flowers for table decoration. The common practice, in the tropics, of purchasing produce from villagers and exhibiting this in the purchaser's name in a competition should be condemned.

(7) Judges should, if possible, adhere strictly to the rules and conditions laid down in the catalogue, except perhaps where an obvious mistake or oversight necessitates a departure. Otherwise disputes are liable to arise.

(8) The judging should always be done as punctually as possible and, needless to remark, before the public are admitted to the Show. Frequently the judges have too much to do in the allotted time, which must result in their work being unduly hurried, or its being delayed until it has to be carried out in the presence of the public, which is very unsatisfactory.

(9) Each set of judges should be provided with an interleaved copy of the catalogue, the interleaf being ruled to correspond with the printed prize-list opposite. One judge should write down the winners, while another writes the prize card. The latter should be filled in and fastened to the exhibit at the time the award is made.

(10) The judges' lists of awards should be handed in to the Secretary personally, when they should at once be placed in a secure place.

(5)—HINTS FOR JUDGING PLOTS OR FIELD WORK

In the case of plot or field work, it is especially necessary to adopt the system of judging by points, and in order to facilitate correct valuation it is convenient to take 10 as the maximum award for each point. The number of points considered should not be unnecessarily increased, five being usually sufficient. Thus:

(1) Condition and uniformity of crops.
(2) Cultivation and tilth.
(3) Regularity of lines and spacing.
(4) Tidiness and freedom from weeds.
(5) Healthiness and freedom from pests.

To these, other points may be added according to circumstances, such as variety, selection, labelling, &c.

SECTION 3.

CHAPTER XIX.

FRUIT CULTURE

Though certain tropical fruits are unsurpassed for their lusciousness, *e.g.* the pineapple, the great majority have, in contrast to fruits of temperate countries, undergone but little improvement by means of selection and cultivation. That many are, nevertheless, capable of being considerably improved by a process of selective or asexual propagation, as by budding, grafting, layering, cuttings, &c., or by hybridisation and high cultivation, cannot be doubted. Fruit-growing in the tropics often follows the line of least resistance, and seed propagation instead of grafting, budding; &c., is generally adopted when this entails less trouble.

Selective Propagation is essential as a means of standardising chosen varieties. Briefly, it consists in carefully choosing individuals or types with specially desired qualities, and the propagation of these by vegetative means, as mentioned above. Sexual or seed propagation, although commonly practised in the tropics, cannot be relied upon to produce fruits true to type and of uniform quality. Selective propagation should aim at developing the following qualities in fruits, viz: sweetness and juiciness, moderately large size, good shape, pleasant aroma, freedom from fibre and acidity, few or no seeds, and attractive colour. Tropical fruits are sometimes marred by an objectionable odour, *e.g.* durian, or by the presence of numerous or large seeds, *e.g.* pomegranate and inferior oranges or mangoes.

Fruit-growing for market.—In recent years fruit-growing on commercial lines has made important progress in some tropical and subtropical countries, as, for example, the pineapple industry in Hawaii, Porto Rico, Cuba, Singapore, Florida, &c.; bananas and oranges in Jamaica; oranges, grape-fruit, figs, &c., in California; and grapes, peaches, &c., in South Africa and Australia. There are, however, other fruits which are as yet but little known outside the tropics, such as mangosteen, mango, sapodilla, avocado-pear, &c. Fruit-growing in Ceylon has hitherto been limited to local requirements, and carried on in a rather haphazard manner, owing partly, no doubt, to causes incidental to the tropics generally, the chief of which is probably the difficulty of protecting the crops. See *Garden & Estate Enemies*, p. 470.

Pruning.—For most fruit-trees, pruning in some form is indispensable, as on it depends largely the continuance of yield, quality of

fruit, and the maintenance of the trees in a healthy and productive state. The proper degree of pruning varies according to kind and individual. Some trees, as the mangosteen, require little or no pruning beyond being kept in proper shape, and others, such as the mango, orange, avocado-pear, &c., need only periodical thinning out and removal of sickly or dead portions of wood, admitting light to all parts of the tree and maintaining an upright evenly balanced form.

Time to Prune.—No hard and fast rule can be laid down with regard to time for pruning in the tropics. Generally speaking, the proper time to prune fruit trees is before the flush of new growth, which usually occurs twice a year, but varies according to the dry and rainy seasons and even in individual trees. (See *Pruning*, page 53). In the south-west part of Ceylon the flush or new-growth seasons are usually March-April and September-October. In the tropics generally, where most trees are practically evergreen and growth is continuous, the operation of pruning need not be strictly confined to any definite period, and should be carried out as may seem necessary in individual cases. Periods of severe drought should be avoided for pruning of any kind, as should also the "flush" season, when there is risk of bleeding from wounds.

Manuring has, of course, a most important effect, not only on yield, but also on the quality of fruits. Fruit trees vary in their manurial requirements. Organic or farmyard manure is indispensable and the most lasting, but certain artificial manures are very active in their effect. (See *Manures*, pages 17-24). Thus phosphatic and potash manures are especially conducive to fruitfulness. A mixture of phosphatic guano, basic-slag and sulphate of potash, in the portion of 3, 2, 1, is recommended for fruit-producing crops under average conditions. This may be applied at the rate of ½ lb. each for small plants, up to 4 lbs. or more for mature or full-grown trees, forking it in in a circle round the tree, but not too close to it. Surface roots should not be cut or injured more than necessary, so that in forking around well-established trees the soil should not be turned over if the surface is occupied with roots. If the ground becomes stagnant, a good plan is to cut a deep trench round the tree, about 6ft. from the stem, and fill it in with new soil, with a liberal addition of manure and lime.

Climate, etc.—A dry rather than wet climate is generally best for fruit crops, with perhaps few exceptions, *e.g.* the mangosteen and durian. A dry atmosphere favours the setting of fruit as well as their ripening and colouring, while it also facilitates harvesting, storing, &c. Means for watering, or for intermittent irrigation, should be available, so that water may be given or withheld as desired. Thus the control of moisture is an important factor in fruit-growing.

(1).—SELECTED TROPICAL FRUITS SUITED FOR LOW OR MEDIUM ELEVATIONS.

(The Natural Order is given in brackets after the name).

See also pages 509 to 512, *Recipes for Jams, Preserves, &c.*

Achras Sapota.—Sapodilla-plum : Zapote ; Bully-tree ; Naseberry ; Chikku ; Rata-mi, *S* ; Shimai-eluppai, *T.* (*Sapotaceae*, Gutta family).—

A small or medium-sized symmetrical tree, 20 to 30 ft. high, with dark-green, shining, leathery leaves, native of Tropical America and the West Indies ; introduced into Ceylon about 1802, but as yet only occasionally cultivated here, chiefly in the Kalutara and Galle districts. The round or ovoid, russet-brown, thin-skinned fruit contains when fully ripe a mass of pale brown, soft, luscious pulp, in which the large black shining seeds are embedded. Firminger said : "A more luscious, cool and agreeable fruit is not to be met with perhaps in any country in the world." It is not, however, relished by every one, and unless perfectly ripe is unfit for eating, owing to its gummy consistency. The tree is commonly cultivated in Lower Bengal, and thrives up to 3,000 ft. elevation in Southern India ; but in Ceylon it is seldom productive above 2,000 ft, in the wet region, and succeeds best at low elevations. It is a slow grower, and may be propagated by seed, but preferably by grafting ; usually bears two crops a year, viz. during August-September, and February-March. In India the fruit is sometimes erroneously called " mangosteen." There are several varieties, differing in size and form of fruit. See *Chickle Gum*, page 410. $.



Achras Sapota. SAPODILLA.

Ananas sativus. Pineapple; Annasi, *S.* (*Bromeliaceae*).—A perennial stemless plant, with long, narrow, fibrous and usually spiny leaves, native of tropical America, introduced into all tropical countries, sometimes cultivated on extensive commercial lines, as in Hawaii, Cuba, the West Indies, Florida, Singapore, Queensland, etc. The fruit is borne on an erect, stout stalk issuing from the centre of the plant; the latter dies after maturing the fruit, and is usually reproduced by suckers (ratoons) from the base. Pineapples thrive in Ceylon from sea-level to about 3,000 ft. elevation, or higher in sheltered situations. The plants are naturally suited to a rather dry climate, but flourish also in moist and hot districts, provided the land is naturally well-drained. They thrive best in rich, sandy, humous or loamy soil. Virgin or jungle soil, under light shade, generally yields the largest and most luscious fruits. Permanent shade, however, is not essential except at low elevations and in dry sandy soil. Botanically, the fruit is a *sorosis*, resulting from a number of flowers, the latter being represented in the mature fruit by the " eyes."

Propagation is by suckers or slips, which should have the lower leaves trimmed off for a length of 1½ or 2 inches. " Crowns " from the fruit may also be used, but these take 2 years or more to come into bearing

whereas good strong mature suckers should bear fruit within 15 to 18 months from planting, according to elevation and climate; cropping is earlier at low elevations. The ground being well tilled, the suckers may be planted out either in single rows about 4 feet apart with 2½ ft. between the plants in the row; or in double or treble rows 5 ft. apart, with smaller distances between the plants in the row. The former method has the advantage of facilitating weeding and cultivation, whilst in the double or treble row system better support for the fruit as well as economy of space is obtained. In Hawaii, a spacing of 3×2 ft. is often preferred. Close planting results in rapid ground-cover and, therefore, in suppression of weeds.

Replanting should be done once in 3-4 years, ratoon crops being obtained after the original suckers have fruited, provided due attention is paid to cultivation, thinning out of superfluous suckers, removal of stumps which have fruited, and manuring. In some cases, however, plantations last for 8-10 years without renewal. A change of site should, as a rule, be given when replanting, though with systematic cultivation and manuring continuous cropping in the same ground is possible. Manuring is essential, and organic or nitrogenous manures are generally the best. As a forcing manure, nitrate of soda, bone meal, and sulphate of potash are recommended.

Yield.—As already stated, plants take from 1 to 2 years to come into bearing, being earlier at low than at high elevations. With good cultivation vacancies or blanks should not exceed 10 per cent. Cropping is spread over the greater part of the year, except perhaps during a prolonged wet season. The fruits vary in weight from about 4-14 lbs. each (see below); for market purposes an average size of 6-8 lbs. is preferred. In Hawaii an average yield of 10 to 12 tons of fruit per acre is recorded.

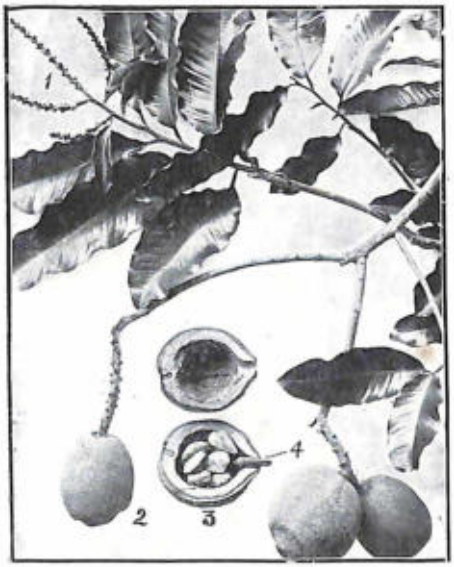
Varieties.—A number of varieties are recognised, many differing but little or are known by different names. One of the best and most distinct is the "Smooth Cayenne," known in Ceylon as "Kew Pine," a large, luscious, juicy fruit with yellowish flesh, often weighing from 12-14 lbs., sometimes 16 or even 20 lbs. or more. This variety has the additional merit of having spineless leaves, thus facilitating cultivation and harvesting. It is extensively cultivated in Hawaii, Florida, and Azores, and usually commands the highest price in the London market. The "Red Spanish" is a favourite in the W. Indies and is noted for its sweetness. Other leading varieties are "Sugar-loaf," "Ruby," "Ripley Queen", "Black Antigua," "Pernambuco," "Bracomorensis," "Abbaka," and "Egyptian Queen." In Ceylon the "Mauritius" (Ripley Queen) occurs in two types, (a) reddish-yellow, and (b) yellow when ripe. This appears to be identical with what is known as "Ceylon" in the West Indies. "Rock Pineapple" (Gal-annasi, *S*) is a semi-wild variety in Ceylon, bearing small, yellow, inferior fruits.



Anona squamosa. SUGAR APPLE.

Anona squamosa. Sugar-apple ; Sweet-sop ; Anoda, *S.* & *T.* (*Anonaceae*).—A small tree, native of tropical America, commonly cultivated throughout the tropics for its fruit. The latter is of the size of a large apple, and has a peculiar rind, which appears to be formed of scales; when ripe, these break away separately, exposing the white granular, sweet, custard-like pulp. The principal seasons in Ceylon are April and October, when the fruits are commonly sold in the markets. The tree thrives in ordinary, well-drained soil, up to about 3,500 ft. elevation. In India the fruit is said to be grown to perfection in the neighbourhood of Cawnpore, " thriving in the most barren and sterile places." A purple-fruited variety is sometimes met with in the West Indies. §

Bertholletia excelsa. Brazil-nut, Savoury-nut, Para-nut. (*Lecythideae*).—A tall handsome tree, with long, wavy leaves, 14 to 16 inches long and about 3 inches broad, native of Guiana, Venezuela, and Brazil, being found chiefly in the State of Para. In its native home, especially on the banks of the Amazon and Orinoco, it attains a height of considerably over 100 ft. Introduced at Peradeniya in 1880, it fruited for the first time in 1906. The same tree is now about 70 feet high, and produces at the ends of the upper branches each year, in the dry season, large erect panicles of white flowers, followed by a number of large, brown, round or ovoid fruits, which take about 8 or 9 months to ripen. Ridley records similar progress of a Brazil-nut tree at Singapore, where it was introduced in 1881. Normally the tree takes 15 years or more to bear fruit. The latter is a hard, woody, brown shell, from 4 to 6 inches in diameter, enclosing from 12 to 15 or more large, angular, closely packed nuts (seeds), each with a brown horny testa ; these are the "Brazil-nuts" of commerce, which form an important article of export from Brazil. At the top end of the fruit is a small aperture (fitted with a thin, woody peg), too narrow to allow access to the "nuts," which are therefore secure from animals ; consequently the shell has to be sawn, or broken with an axe, in order to obtain the nuts. Propagated by seed or gootee, and thrives best on a rich, deep, alluvial soil, in a hot and moist climate. $



Bertholletia excelsa. Brazil Nut.
1, flowering branch (flowers dropped); 2, whole fruit ; 3, fruit sawn open showing nuts, 4, woody plug.

Carica Papaya. Papaw ; Papaya ; Papeta ; Tree-melon ; Pepol, *S* ; Pappali.—*T.* (*Passifloraceae* ; Passion-fruit family).—A fast-growing, small, herbaceous, branchless and usually dioecious tree, attaining a height of about 15 to 20 feet, indigenous to Central America and the West

Indies, cultivated throughout the tropics. It bears a crown of very large, handsome, palmate leaves, at the base of which the large green fruits are produced. The latter vary from round to ovoid or oblong in shape, being usually 8 to 14 inches long by 4 to 6 inches in diameter, not unlike green melons in appearance and texture, each weighing from 5-8 lbs. or more. They are in season all the year round. §

The fruit has a central cavity, to the walls of which the olive-coloured seeds are attached, usually in great abundance, but sometimes entirely absent. The succulent flesh is of a pinkish or orange tint, very refreshing and agreeable to the taste, especially on first acquaintance. It is generally esteemed as a table fruit, and is considered an aid to digestion. Some people prefer to eat it with a little sugar and fresh lemon or lime-juice. It may also be made into jam or sauce, and in the unripe state may be pickled, or boiled and used as a vegetable. The seeds have a flavour like that of water-cress.

Papaine, * a digestive enzyme, valued in medicine and in the preparation of chewing gums, etc., is obtained from the white, thin latex or juice. The latter is extracted by making shallow incisions with a bone knife or wooden splinter in the mature but unripe fruit ; the juice rapidly exudes from the cuts and is collected in a cup held beneath, then spread on glass to dry in the sun or, if the weather be wet, over a stove or in a hot-air chamber. Drying should be effected without delay, but should not be too rapid, a temperature of about 100°. F. being the best. The process should be completed in about 24 hours. When the material is crisp-dry, it is reduced to a fine powder, or made into a granular form ; like vermicelli. It should then be of a white or grey colour, and has an unpleasant odour. This should be packed in hermetically-sealed tins or bottles for export. About 5 to 8 oz. dried papaine may be obtained per tree in a year, or an average of about 150 lbs. per acre. The fruits may be tapped at intervals of 2 or 3 days, and are not removed from the tree until they cease to yield. Fair to good quality papaine may fetch from 5*s*. to 8*s*. per lb., but the demand is limited and irregular. Papaine is used in medicine, in invalids' and children's foods, and in chewing gums, etc. The property of Papaw leaves in rendering meat tender is well known and is commonly made use of by cooks, who wrap the leaves round fresh meat, or place a piece of the green fruit in the water in which the meat is boiled. 38,252 lbs. of papaine, valued at £ 14,727, were exported from Ceylon in 1923.



Carica Papaya. PAPAW.

* *Malayan Agricultural Journ.*, Vol. XII, No. 5, May, 1924.

The Papaw tree likes deep, humous or loamy soil, and flat or gently sloping land, which should be well manured. Planting distances may be about 6 or 7 ft. each way. Seeds may be sown at stake, allowing 5-6 to each hole, leaving afterwards one good seedling to each hole; or seedlings may be raised in bamboo-pots and planted out when a few inches high. The plant thrives from sea-level to about 3,000 ft. in moist districts; bears fruit continuously from the time it is about 10 or 12 months old, but deteriorates and becomes unprofitable at the age of about 3-4 years.

The flowers being usually unisexual, the tree is dependent on cross-fertilisation for its reproduction by seed. Therefore the varieties become much mixed, the fruit varying from globose to long and narrow, with many, few, or no seeds. Roundish fruits with few seeds are often the best flavoured. Occasionally, bisexual (hermaphrodite) flowers are produced by either male or female trees. Thus "male" trees sometimes bear fruit, which, however, are usually small and rather unpalatable. When "male" trees are too numerous, they should be thinned out and replaced with fruit-bearing trees. The seed, which take 2-4 weeks to germinate, are of the size of small peas; about 230 when fresh go to an ounce, or 500 when partly dried. Different names are sometimes employed to distinguish the different forms of the fruit, as "Ceylon," "Madagascar," "West Indian," etc.; these, however, are misleading, for the tree is nowhere indigenous in the Eastern Tropics, and the fruit is variable, as already stated. See also *Mountain Papaw*, p. 275.



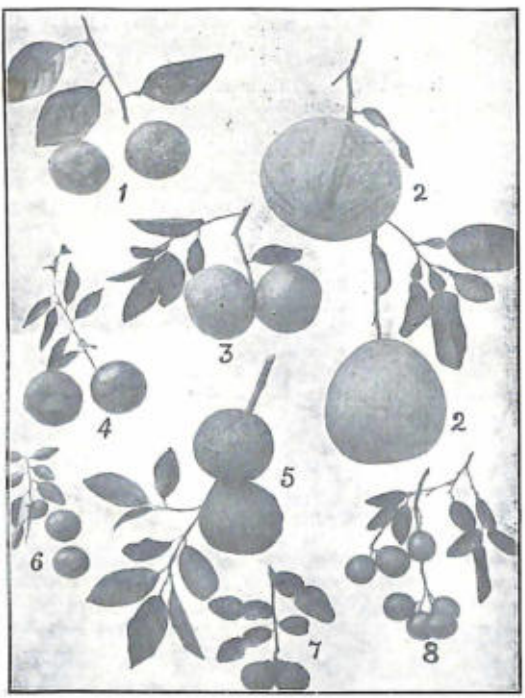
Caryocar nuciferum. SOUARI NUT.
1, flower-buds; 2, open flower; 3, nuts; 4, nut split open.

Caryocar nuciferum. Butternut; Souari-nut. (*Ternstroemiaceae*). A handsome, lofty tree, attaining a height of 80—100 ft., with large lanceolate, trifoliate leaves, native of the Guianas. It bears a large roundish, woody fruit, about the size of a child's head, containing when ripe 3-5 large, kidney-shaped seeds, which have a very hard, woody, warty and reddish shell. The kernels have a pleasant nutty taste, and are esteemed for confectionery and fruitarian dishes. They yield by pressure a valuable oil. Souari-nuts are imported into England, and may sometimes be seen in Covent Garden, being retailed at about 4*d.* each. Their chief drawback may be said to be the extremely hard shell enclosing the nut; this is best opened by prising the halves apart along the central suture. The tree flourishes in the moist low-country of Ceylon, and prefers rich, deep loam or alluvial soil. The two trees in Peradeniya and Henaratgoda Gardens, introduced in 1891, grow well but have not yet fruited. The tree in the former garden has flowered freely since 1910, while that in the latter garden flowered in 1922 for the first time. S.

Caryocar tomentosum, a tree similar to the above, native of British Guiana, where, it is said to have fruited in six years from planting.

Citrullus vulgaris. Water Melon; Komadu or Peni-komadu, *S.* (*Cucurbitaceae*).—A smooth, ovoid gourd, usually about 8-10 inches long, sometimes round, produced by a quick-growing, creeping vine, commonly cultivated in the dry region of Ceylon and in warm countries generally. The fruit is dark-green, often streaked with white, with a reddish juicy flesh, which is cool and refreshing, though rather insipid. It is reported in India as growing sometimes to 3-4 ft. in length and from 15 to 20 inches in diameter. The smaller-sized varieties are, however, the best. The plant thrives in ordinary soil, provided sufficient moisture is afforded at the root, and is best suited to dry districts. In India it is commonly grown on the banks of rivers, where the natives often bury the fruit under dry sand to ripen slowly. Largely cultivated in temperate countries as a summer fruit. Easily propagated from seed.

Citrus Aurantium, var. (C. sinensis). Sweet orange; Peni-dodan, *S*; Naran-kai, *T.* (*Rutaceae*).—A small tree or shrub, 8-12 ft. high, supposed to be indigenous to Northern India. The orange has long been cultivated in all warm climates, and is especially adapted to regions where the trees are subject to light wintering, or to a short period of rest. It thrives in the tropics, and is grown at low and medium elevations in numerous varieties. In the moist low-country of Ceylon, especially when not cultivated with some care, the fruit is often coarse and thick-skinned, and invariably green when ripe. These defects, due doubtless in part to the tropical climate, could to a large extent be eliminated by attention to the selection of varieties by vegetative methods of propagation, instead of by seed, and by good cultivation. At the higher elevations imported grafted plants flourish for a few years, producing attractive yellow fruits of fair quality, but the excessive rains and strong winds often prove detrimental both to the crop and the tree, the latter being consequently short-lived.



COLLECTION OF CITRUS FRUITS IN CEYLON

1, Sweet-orange; 2, Pomelo; 3, Grape-fruit; 4, Mandarin-orange (Jamanaran); 5, Wild orange (*Citrus medica var.*) or "Patharan" (used only in medicine); 6, Tangerin or Nasnaran; 7, Kaffir-lime or "Kudala-dehi" (used only in medicine); 8, Limes.

The nearest approach to the proper conditions for successful orange culture in Ceylon would appear to be found in the drier parts of the Uva Province, between 2,000 and 3,500 ft. elevation. The tree is especially suited to a gentle slope with free natural drainage, light rich soil on a marly or limestone formation, a rather dry climate (with intermittent irrigation), and requires shelter from strong winds. A strong sea-breeze is injurious to the crop. A "resting period" is imitated annually in India by stopping the water supply, removing much of the soil from around the tree and exposing the roots, which has the effect of making the trees drop the greater part of their leaves. When the roots have thus been exposed for about a month or six weeks, the soil is again filled in with a liberal application of manure. In dry districts, oranges do well under irrigation. The tree suffers from no serious pest in Ceylon. See *Insect Pests*, p. 488; and *Fungus Diseases*, pp. 498, 499, 501.

Propagation of the orange is best by budding upon the more hardy and vigorous growing kinds of Citrus, as Sour-orange, Pomelo, and Lemon. Only budded plants can be relied upon to produce fruits of a uniform type and quality. The flowers being naturally subject to cross-fertilisation, plants raised from seed are obviously liable to produce fruits of a variable character. Seedling trees are, however, usually the healthiest and longest-lived and, provided due care is exercised in their selection, may yield very good fruit, suitable at any rate for home consumption. In raising seedlings, care should be taken to choose the best fruits, selecting from these only full and plump pips or seeds. Sow the latter in well-prepared soil, covering them with about ½ inch of finely sifted earth. The seeds, if fresh, germinate in about 3 weeks; when the seedlings are 2 or 3 inches high, transplant them into small plant-baskets or bamboo pots. These should be ready for planting out or, if desired, for budding or grafting in 10 or 12 months; budded or grafted plants should be fit for planting out about six months later.

Planting and Yield. The spacing may be 14 by 14 ft. in indifferent soil (say 220 trees to the acre), 18 × 18ft. (34 to the acre) in ordinarily good soil, and 20 × 20 ft. or about 108 trees to the acre in rich soil. The trees should commence to bear when about 4 or 5 years old, and are considered to be in their prime at the age of fifteen years. When in full bearing, a good tree should yield 2,000 to 3,000 fruits a year.

Manuring and Mulching. The chief requirements of the Orange tree are generally considered to be lime, phos. acid, and potash. Phosphatic manures are especially recommended. A successful grower in Australia applies 2½ lb. each of bone-dust and phosphate of lime per tree once a year, while in Florida burnt shell-lime is applied at the rate of ½ ton to the acre. The ground around the tree should be frequently forked lightly on the surface and never allowed to harden. Mulching is of special benefit, and a dressing of any well decomposed organic manure may be given with advantage. Good natural drainage is essential, as otherwise the roots become affected and the trees cease to be productive.

Pruning. Good orange trees require but little pruning, beyond the removal of superfluous, dead, or broken branches. The plants should be topped at a height of about 2½ ft., so as to induce a spreading and evenly balanced form. The fruits, it should be remembered, are borne on one-year old wood. Excessive woodiness may sometimes have to be checked by cutting the tap-root below 15 inches from the surface, or by applying the resting method above described.

Packing and Export. For export purposes, the fruits are carefully washed, sorted, and individually wrapped round with soft tissue-paper, then packed carefully in crates of regulation sizes. Different countries have their own standard sizes of cases. In Jamaica, which has in recent years developed an export industry in oranges, the standard size is 2 ft. in length, 1 ft. in breadth, and 1 ft. deep.

By-products. By-products are obtained from different species or varieties of Citrus, as candied peel (from the rind), citric, lactic, and acetic acids (from the fruit juice), essential oil (from the peel), the perfume bergamot (from the flowers as well as rind), also orange wine, etc., from the pulp. Marmalade is made chiefly from the sour varieties, especially the "Seville orange," see below.

Varieties.—The following are well-known :—

Jaffa. A large ovoid fruit of first-rate quality; pulp rich and juicy, seeds few or none.

Jama-naran, S. See *Mandarin.*

King Orange. A fine, large variety of the *Mandarin* type.

Kumquat. A famous Japanese variety.

Maltese Blood-Orange. Fruit medium-size, flesh deep crimson ; seeds few ; tree spineless.

Mandarin. Jama-naran, *S.* (*Citrus nobilis*). Large fruits of deep colour, loose-skinned, segments easily separated ; usually compressed at both ends ; seeds small, few. Largely grown in India, Florida, &c. There are many varieties of this type.

Mediterranean Sweet. Thornless tree ; fruit medium to large size, seeds few.

Nagpur Suntra. An Indian orange of the *Mandarin* type, famous for its sweetness.

Navel Orange. Fruit large, with a navel-like mark at apex end ; very juicy and melting pulp, almost or quite seedless; tree almost thornless, bears fruit early. Considered the finest of all oranges.

Satsuma (="*Unchus*" of Japan). Large fruits, of the *Mandarin* type, produced in large bunches; almost seedless.

Seville Orange. (*Citrus Bigaradia,=C. vulgaris*). Large, juicy, bitter fruit, bright orange yellow. The tree thrives and bears freely at Hakgala Gardens, in Ceylon, where its large well coloured fruits make it a striking object when in full crop. Bears two crops a year, and the fruits make the finest marmalade. See also pages 276, 398, 509.

St. Michael. Large, thin-skinned, blood-red, fine flavour.

Tangerine. A variety of *Citrus nobilis*, with small or medium-sized fruit ; has a distinct aromatic flavour. Known in Ceylon as "Nas-naran".

Valencia. A "late" variety, fruiting season extending over a long period.

C.—acida (=*C. aurantifolia*). Lime ; Dehi, *S* ; Dhaisi-kai, *T*. A small spiny tree, cultivated in all tropical countries for its acid, juicy fruit. The latter varies in size, acidity, juiciness, oil content, &c., also in shape from almost round to ovoid. It is used by all races for flavouring and other culinary purposes, and the juice is largely employed for making lime-juice cordial and other cooling drinks. It also enters much into native medicine. Applied externally, it is sometimes considered a cure for snake-bite.

Limes are grown as a commercial product in some West Indian Islands, and the preparation and export of raw or concentrated lime-juice, citrate of lime, and lime essential-oil forms an important industry in Dominica, Montserrat, &c. Lime oil (distilled) fetches from 6*s*. to 9*s*., and hand-pressed oil up to 20*s*. per lb. In Ceylon, limes are in season practically all the year round, except in prolonged periods of dry or wet weather, and are sold in the boutiques and markets. The tree thrives up to 3,500 ft. elevation, preferring a light marly soil with good natural drainage. It is propagated by seed (pips), or preferably by budding on stocks of a strong growing kind, or on the Sour-orange or Pomelo (*Citrus decumana*).

The plants are spaced at about 15 by 15 ft. on poor or steep land, up to about 20 by 25 ft. on rich soil. They begin to bear in the 3rd or 4th year from planting. When in full bearing, 125 barrels of fruits per acre a year is a fair average yield, though it may be as much as 180 barrels, or 300 lbs. of fruit per tree. A barrel of limes gives 7½–8 galls. of lime juice, the latter yielding an average of 12–14

oz. of citric acid per gallon. A barrel of limes gives from 3½–4 oz. of hand-pressed, or 3–5 oz. of distilled, oil, and a gallon of the latter weighs 9 lbs.

Varieties.—Among the principal varieties recognised in India are: *Patee*, a small round fruit, much esteemed; *Kaghuzee*, of the size of a hen's egg, in most general cultivation; *Gora*, a small ovoid fruit, much cultivated; *Kamuralee*, a large handsome fruit, of pale lemon colour, "about the size of a small coconut"; *Rungpore*, a round, smooth-skinned fruit; *Taba*, a large globose, spongy fruit. The *Kaffir Lime* in Ceylon is almost the size of a lemon, with a warty, coarse skin, and is used only in medicine.

Spineless Lime.—A sport of the ordinary lime, said to have first originated in Dominica in 1891, the stems and branches being without spines, while the fruit is rich in citric acid.

Seedless Lime.—In recent years several varieties of limes have been raised whose fruits are almost, if not quite, free from seed. The *Persian Seedless* (= *Tahiti Lime*) is the chief variety grown in Cuba; it is a prolific bearer, and contains a high percentage of citric acid.

West Indian Lime.—A medium-sized, spreading tree, in Hakgala Gardens, known by this name, bears heavy crops of pale yellow, smooth round fruits of the size of small oranges, which are juicy, sweet-acid, and make a pleasant refreshing drink. It is similar to, if not identical with, the "Sweet-Lime," which see.

C.—Limetta. Sweet-lime. A large distinct Lime of the form of a moderate-sized orange, with smooth pale-green rind. It has a sweetish acid taste, and makes an excellent refreshing drink. The tree is used largely in parts of India for budding the Orange on.



Citrus grandis. GRAPE-FRUIT.

Citrus grandis (*C.—decumana*, var.). Grape-fruit, said to be so-called from the fruit being produced in clusters. These resemble large oranges or small pomeloes, being usually globular, but sometimes ovoid, with a smooth skin of medium thickness. The pulp is pale yellow or greenish-white, sometimes pink or crimson, acid-sweet and composed of large and distinct "sacs"; it varies in degree of juiciness and acidity according to variety. $.

Cultivated commercially in Florida, California, Cuba and Jamaica, being especially popular in the United States as an early morning fruit. It is also imported into England, where it is usually esteemed by those who know it, and finds a ready sale in Covent Garden Market at 6d. to 8d. each. According to the *British Medical Journal*, it has "the physiological action of stimulating the appetite and promoting salivary and gastric digestion." The Grape-fruit has not yet become well-known in the East, though it is sometimes met with in gardens. It thrives best at medium elevations, but is best suited to sub-tropical conditions.

Propagation is by budding or from seed. In Jamaica, good varieties are considered to come true from seed, but some of the best varieties are seedless. The following are among the best: Marsh's Seedless, Conner's Prolific, Triumph, Pernambuco, Royal, Ellen, and Walters.

C.—Limonum. Lemon; see *Sub-tropical Fruits*, p. 276.

C.—medica. Citron; see *Sub-tropical Fruits*, p. 276.

Cucumis Melo. Musk Melon; Cantaloupe; Pitti-kekiri, *S.* (*Cucurbitaceae*).—A round or ovoid fruit, about 4-5 in. in diameter, with "netted" or smooth skin, red or greenish-white flesh, produced by a creeping annual gourd with large angular leaves. The fruit has a strong pleasant odour, the interior being of a somewhat floury consistency. The best varieties, as grown in hot-houses in temperate countries, are highly prized on account of their luscious flavour. The plant is suited to a hot, dry climate and rich porous soil. It requires moisture at the root, but the vines are susceptible to a damp atmosphere, and in cultivation the precaution has usually to be taken of forming a collar of earth round the base of the stem, to keep the latter dry.

Varieties.—There are many varieties in cultivation. Firminger referred to a fine variety in India called the "Surdah," the fruit of which has large seeds and is "sometimes brought from Cabul to Punjab for the wealthy classes, who are said to pay as high as Rs. 6 each for them." An inferior variety is sometimes cultivated in the dry region, in Ceylon. Propagation is by seed, like other gourds.

Durio zibethinus. Durian; "Civet Fruit". (*Malvaceae*).—A very large, handsome, upright tree, indigenous to the Malay Archipelago, but seldom found in a wild state; commonly cultivated in the Straits, Burma, Java, etc., for the sake of its celebrated fruit. The latter, produced on strong, mature branches, varies somewhat in shape from round to ovoid, is yellow when ripe and usually weighs from 5–8 lbs., though sometimes as much as 10 lbs. It is armed with thickly set, sharp-pointed prickles about ½ inch long, and possesses when mature a very offensive odour, more especially so on first acquaintance. The white custard-like pulp surrounding the seed is generally highly prized by Malays and others, being also much relished by some Europeans when a taste for it is acquired. Firminger described it as "resembling blanc-



Durio zibethinus. DURIAN.

mange, delicious as the finest cream," whilst according to Russel Wallace the sensation of eating durians " is worth a voyage to the East." Others, however, have compared it to "French custard passed through a gas-pipe." The large seeds may be roasted and eaten like chestnuts. An acid is obtained from the fruit used by Chinese for washing the hair. The tree thrives in the moist low-country of Ceylon up to 2,000 ft. elevation, and luxuriates in deep, alluvial or loamy soil. In Peradeniya Gardens there are magnificent specimens about 100 ft. in height. They usually flower here in March or April, and the fruit is ripe in July or August, but sometimes the flowering and fruiting periods change with an abnormal season. The fruits vary to some extent in size, shape, flavour and quality of pulp, according to variety, whilst the trees also vary in productiveness, some being almost barren, especially when fairly old. The best varieties should, therefore, be selected for propagation. The tree is readily propagated by seed, which should be sown fresh. The large, fleshy seed is of short vitality, and germinates in about 8 days. §



Garcinia Mangostana. MANGOSTEEN.

Garcinia Mangostana. Mangosteen; Mangus, *S*; Mangus-kai, *T*. (*Guttiferae*).—A small or moderate-sized conical tree, with large, leathery leaves, indigenous to Malaya, introduced into Ceylon about 1800. Its globular, purplish-brown smooth fruit, about the size of an apple, is famed as one of the most delicious fruits of the tropics, and considered by some to " partake of the flavour of the strawberry and the grape." The delicate white, melting, juicy pulp surrounding and adhering to the seed is the part eaten. In striking contrast to this is the dense, thick, reddish-purple rind, which contains tannic acid and a dye. The fruit is in season in the low-country of Ceylon from May to July, and at higher elevations from July to August, or September-October. It is sold in the markets at about 75cts. (1*s*.) to Re. 1 (1*s*. 4*d*) per dozen. The tree is of very slow growth, and does not usually come into bearing till at least nine or ten years old, but takes several more years to attain full size. The essential conditions are a hot, moist climate; deep, rich, and well-drained soil, and a sheltered locality. Light shade is beneficial; in the young state it is essential. The tree responds to manuring, and thrives up to about 2,000 feet elevation in the moist region. Propagation is usually by seed,

but may with difficulty be effected also by " gootee " or layering. Sow seeds in pots or boxes under cover. The plants are of very slow growth, taking two years or more to become large enough for planting out, being then only about 12 inches high.

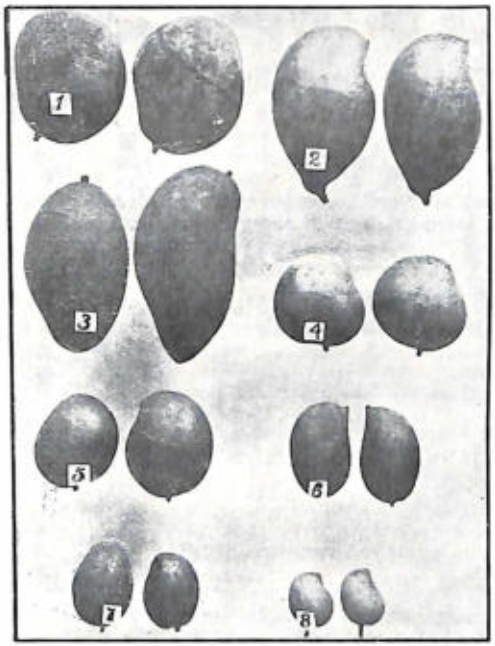
Lecythis Zabucajo. Sapucaia-nut ; Monkey-pot. (*Lecythideae*).—A large forest tree of Brazil and Guiana, closely allied, but superior, to the Brazil-nut. The oblong, wrinkled nuts (seeds), about 2 in. long, enclosed in a very large, brown, woody shell, are of a delicate flavour and considered by some to be the finest nut known. As distinct from the Brazil-nut, the shell is furnished with a large lid, which when ripe becomes detached and allows the seeds to fall out. Owing, therefore, to the difficulty of collecting these, they are less common and command a higher price than the Brazil-nuts. The empty shell, deprived of the lid and baited with sugar, &c., is used as a trap for catching monkeys, the latter being unable to withdraw their paw when inserted. Introduced at Peradeniya in 1897, but not yet fruited there. $.

Mangifera indica. Mango ; Amba, *S* ; Manga, *T*. (*Anacardiaceae*).—A medium or large-sized, spreading and quick-growing tree, indigenous to tropical Asia. It bears large panicles of greenish-white, scented flowers, usually in January to March, followed about 2½-3 months later by the fruit. A second crop is sometimes obtained in Aug-September. The round or ovoid fruit is somewhat flattened, generally with a more or less pronounced beak near the apex. It may weigh from 6 oz. to 2 lb. or more; has a tough, thin, skin and, when ripe, is yellow, reddish, or green. The flesh is usually of a reddish tint, with a distinct, pleasant, aromatic flavour ; in inferior varieties it is turpentiney, somewhat resinous and fibrous. In the centre is the large fibrous, ovoid, flat seed. $.



Lecythis Zabucajo. SAPUCAIA-NUT. Showing oblong wrinkled nuts and large plug by side of enormous woody shell.

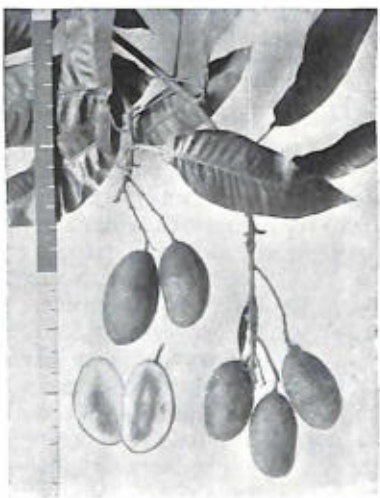
The mango is the fruit *par excellence* of India, where it has been cultivated from time immemorial. Here it may be considered an article of food as well as dessert, whilst it also enters largely in the preparation of chutneys and preserves. The tree thrives from sea-level to about 3,000 ft. or higher. A hot and rather dry climate, and a rich, deep, well-drained soil suit it best. The ground should be irrigated during prolonged drought, especially if the trees are setting fruit, also manured once a year, and mulched in dry weather. Pruning consists in thinning out



TYPES OF MANGOES GROWN IN CEYLON. 1, Rupee mango; 2, Jaffna mango; 3, Alphonso; 4, Baiti or "Bombay"; 5, Mee-amba; 6, Gira or "Parrot"; 7, Cotta-amba; 8, Et-amba.

superfluous or sickly branches; root-pruning is sometimes applied with advantage to trees which become unfruitful, owing to their running too much into wood and leaf, the operation being performed by cutting a deep trench round the tree at a few feet from the stem, cutting clean all roots met with. Shade is not necessary, except when the plants are young. Propagation is best by grafting on seedling stocks of a hardy vigorous variety, or by inarching or layering. The gootee method of layering is commonly adopted in India. (See page 39). Bud-grafting (plak-budding) may also be successfully effected.

Plants are easily raised from seeds, and if care be exercised in selecting the best fruits from choice varieties, these may become good fruiting trees. The seed is often polyembryonic (see under *Seeds*, page 13), producing several seedlings which, owing to their asexual origin, should be practically equivalent to budded or grafted plants. Some varieties come more true from seed than others. Frequently, however, seedling trees are liable to be disappointing in the quailty of their fruit, and take longer to come into bearing than trees from layered or grafted plants. The latter should commence to bear in their fourth or fifth year. Before planting out, large holes, not less than 3 ft. × 3 ft. by 3 ft. deep, should be dug, mixing a good proportion of well-rotted manure with the soil when filling



ALPHONSO MANGO.

in. Spacing should be not less than 30 feet each way; in rich soil it should be at least 40 feet. §

Varieties.—Numerous varieties are in cultivation, the fruit varying in shape, size, flavour, juiciness, succulency, etc. Certain small-fruited varieties are almost seedless (see below). Varietal names are numerous, and often different names are given to the same varieties, in the same or different countries. In Ceylon, there commonly occur the following distinct types, and of these there are many sub-varieties.

Rupee or *pol-amba.* Fruit very large, more or less round and compressed; pulp luscious and free from fibre; similar to *Cowasje Patel* or *Inerma* of India.

Jaffna. Large, ovoid fruits, of excellent quality when well-grown; similar to *Alphonso.*

Parrot-mango (*Gira-amba*). Medium-sized, oblong fruit, with a distinct beak, piquant and pleasant flavour.

Bombay or *Baiti-amba, S.* Round and rather flat, very juicy, yellow when ripe.

Dhampara. Fruit rather small and flat, very sweet.

Honey-mango (*Mi-amba, S*). Small roundish fruit, of a sweet flavour.

Seed-mango or (*Et-amba, S*). Very small, ovoid fruit, juicy but scanty pulp, distinct piquant flavour.

Maha-mudaliyar (*Puhu-amba, S.*). Very small, seedless fruit, with sweet, juicy pulp.

The following are a few, out of a large number, of the principal Indian Mangoes :—

Alphonso. Fruit large, ovoid, about 8 in. by 3¼ in., pulp of the finest piquant and delicate flavour. Considered one of the best.

Banchore of Dhairey. Yellow fruit, 3 in. by 2½ in., very sweet.

Bangalora. A favourite variety of S. India.

Borsha. Oblong, bright green, with yellow spots when ripe : up to 10 oz., delicious.

Custodio. Very large, yellowish-green, free from fibre.

Mulgoa. Fairly large, yellow and green blotched, no fibre, piquant flavour.

Pairi. Broadly ovoid, with a marked beak ; one of the best.

Pakria. Medium-sized, rich crimson, pulp deep yellow.

Ryotya. Bright crimson, extra fine flavour, no fibre.

Salgadina. Medium-sized, rich crimson, flesh deep yellow.

Roos. One of the best of the round or " Bombay " varieties.

Totapari. Medium-sized, slightly fibrous, excellent flavour.

Well-known mangoes in other countries are :

Philippines :—*Caraboa,* bright yellow ; *Pico,* next to latter in quality ; *Pahutan,* highly flavoured, vigorous grower. Cuba :—*Biscochuelo,* one of the best varieties known. West Indies : *Julie, Peters, Minnie, Martin, Pere Louis.* Florida : *Sundersha,* large clear yellow, distinct beak, juicy and free from fibre. Mauritius : *Fijette, Baissac.* S. Africa : *Gundoo* (*= Fijette*), excellent variety, grown for local markets and export.

Musa sapientum. Plantain or Banana ; Kehel, *S* ; Vala, *T.* (*Scitamineae* ; Ginger family). A small quick-growing, very handsome tree, 10 to 20 ft. high, with a herbaceous stem composed of the succulent leaf-stalks, naturally propagated by suckers and forming a cluster of stems. For utility combined with magnificence, this is probably the most remarkable of tropical products. When the plant is about 15 months old, the enormous flower-stalk, 3 to 5 feet or more in length, issues from the centre of the crown of large leaves, and curves over with its weight. The flowers are in clusters, alternating with large reddish succulent scales, which drop off as the fruit stalk develops. The ovaries of the flowers rapidly grow into large finger-like fruits, which are borne in " combs " or clusters. The banana fruit, or plantain as it is generally called in the Eastern Tropics, is a nutritious and easily digested food, and is to the inhabitants of the torrid zone what the potato is to those of the north temperate zone. According to *The Lancet,* the starch of the banana is much more digestible than the cereal starches.



Musa sapientum PLANTAIN OR BANANA.

1, stem; 2, bud end of flower stalk, used as a vegetable; 3 & 4, a single flower; 5, comb of fruit; 6, section of unripe fruit; 7, ripe fruit.

The fruit may be dried and made into meal, sometimes valued in London at £30 or more per ton. Mixed with wheat flour, this may be made into bread, porridge, &c. The tree is not particular as to soil, provided the latter is fairly heavy, moist and naturally drained; it is essentially suited to a hot and moist climate, and will thrive up to about 4,000 ft. in sheltered valleys. A windy situation and a rocky or sandy calcareous soil are unsuited to it. Propagation is by suckers, which may be planted out direct at distances of about 14 by 14ft., in large deep holes filled with good soil and manure. Fertile seed is rarely produced by cultivated varieties. The plant will throw out several suckers, forming a clump, which should not be allowed to exceed about ½ dozen stems. The clumps should from time to time be moulded up with surface soil and any mulch of dead leaves, etc., available.

The first bunches of fruit may be obtained about a year from the time of planting, while the subsidiary suckers (ratoons) produce fruit when from 12 to 15 months old. Each stem dies after fruiting and is replaced by others, the clump thus continuing productive for several years. Under good tillage, an acre is considered to produce 350 to 400 or more bunches annually. The plant is a gross feeder and responds well to manuring and deep tillage. Farm-yard manure is the best, but if a stimulant is required an application of the following mixture is recommended, the quantities being for an acre, viz: sulphate of potash, 200 lb.; sulphate of ammonia, 250 lbs.; and superphosphate, 450 lb. All leaves and trash should be returned to the soil in the form of mulch around the plants, and covered with earth. While in the Eastern tropics all bananas are generally known as plantains, in the West Indies the latter name is applied only to cooking varieties. See page 511.

Varieties.—A great number of varieties occur in cultivation. Of those grown in Ceylon the two best are doubtless *Suwandel* and *Koli-kuttu*. Less superior varieties are, however, the most cultivated, because the most prolific and easiest of cultivation, such as *Embul-hondarawala*, *Anamalu*, and *Rath kehel*, or forms of these.

The following are the principal varieties met with in Ceylon :—

Anamalu, fingers stout, rather angular, sub-acid, large bunches; *Bin-kehel* or dwarf plaintain, similar to *Anamalu*, fingers thickly set, smooth yellow skin; *Embul-hondarawala* or *Sour plantain*, most common kind met with in markets and bazaars, fingers straight, fragrant, sub-acid; *Koli-kuttu*, fingers large and stout, loose-skinned, sweet, mealy, produced in large bunches; *Puwalu*, fingers thin and rather angular, somewhat acid; *Ranel* or *Red-plantain*, large red fingers, borne in huge clusters, coarse, thick-skinned, mealy, chiefly grown in the North of Ceylon, taking 15 months or longer to mature, as against 12 months for most other kinds; *Rata-hondarawala*, thickly set combs, angular, stout fingers, rather sweet; *Rath-kehel*, short, smooth, round fingers, rather acid but pleasant; *Suwandel*, thin-skinned, usually short fingers, tender and sweet, considered the best in Ceylon; not commonly grown for market.

While almost all the above may be cooked in an unripe state and used as a vegetable, the following are used chiefly for that purpose only, although some may also be eaten raw when ripe :—

Alu-kehel or *Ash Plantain*, slender stems, stout and angular fingers, covered with a greyish bloom; *Kochi-kehel*, large, stout, brownish-red fruit; *Marthamalu*, short, stout, thick fingers, resembling *Anamalu* in taste; *Nawari* or *Wanduru-anamalu*, long, thin, greenish-yellow fingers; dark slender stems; *Puspakadali*, short, stout fingers, thin-skinned, suited also for dessert; *Suramondan*, large, green, angular fruit, borne in huge clusters.

Gros Michel, introduced into Jamaica about 1836, is now the most important variety grown in that country and is largely exported. It is a heavy yielder, bears transport well, and is of good size and flavour. Similar to *Koli-kuttu*.

Musa Cavendishii. Dwarf- or Chinese-Banana; Nan-kehel, *S.* Native of South China, largely cultivated in the Canary Islands and exported to England, etc.; also commonly grown in Barbados and other West Indian islands, and occasionally in Ceylon. It is distinguished by thin-skinned, rather small, sweet fruit, and short, stout stems; suited chiefly to medium elevations or a sub-tropical climate.



Nephelium Litchi. LITCHI FRUIT. *Nephelium lappaceum*. RAMBUTAN.

Nephelium lappaceum. Rambutan ; Ramtum, *S.* (*Sapindaceae*). A large, handsome, spreading tree, native of Malaya, producing (chiefly in July to August) large clusters of bright red or orange-yellow fruits, suspended from the ends of the branches. Each fruit is of the form of a large gooseberry, covered with long, soft, coloured, fleshy spines, the interior being occupied by a large seed, surrounded by a layer of white, opaque pulp (aril), which has an acidulous agreeable taste. Birds and bats are, unfortunately, particularly partial to it. It is strange that this fruit, which is so common in the low-country of Ceylon and Malaya, should be so little known in India, Mauritius, Madagascar, etc. The tree is readily propagated from seed, but the best varieties should be raised by grafts or gootees. Thrives up to 2,000 ft. elevation. See p. 246. §

N.—chryseum (= **N. mutabile**). Pulassan.—A Malayan tree, similar to the Rambutan in appearance. It differs from it, however, in that the leaves are grey beneath, the fruit being larger, purplish-brown, with short blunt processes. According to Ridley, the flavour is decidedly superior to that of the Rambutan. Not yet become well known in Ceylon.

N.—Litchi. Litchi or Litchee.—A small bushy tree, with handsome, dense foliage, native of China. It blossoms usually in the dry season, producing sprays of pale-green flowers, and ripens fruit at Peradeniya from August to September. The fruit, borne in large clusters, is of the size and form of a large plum, with a rough, thin, warty rind, which on ripening assumes a beautiful pinkish-crimson tint, turning to a dull brown colour. The jelly-like aril which covers the seed is of a translucent whiteness and of an agreeable sweet-acid flavour. See p. 246. §

The Litchi is grown to great perfection in Mauritius and parts of India, being commonly sold in the bazaars when in season. It thrives up to 3,500 ft. in South India, giving two crops a year, in May and December. In Ceylon, however, it is rarely met with, though introduced as early as 1802. The tree flourishes and produces fruit at Peradeniya, but does not appear to be in its element here, the climate being probably too wet for the fruit to attain perfection. Several varieties are in cultivation, these being distinguished by size, shape, and quality of fruit.

Passiflora edulis. Passion-fruit. See Sub-tropical Fruits, p. 279.

Persea gratissima. Avocado- or Alligator-pear ; Soldier's Butter ; Et-pera, *S* ; Anakoya-pallam, *T.* (*Lauraceae*).—A small tree, 25-30 ft. high, native of Trop. America, producing a large pear-shaped fruit, which is much relished by some people but not by others. It contains in its hollow centre a large, round, fleshy seed, between which and the thin skin is a thick layer of greenish-yellow pulp, of the consistency of firm butter and somewhat resembling walnut in flavour ; this may be scooped out with a spoon and eaten either plain or flavoured with salt, pepper, and vinegar. The green, tender-skinned fruit assumes a yellowish tint (pinkish crimson in some varieties) on ripening. Esteemed by many people and considered wholesome. It should be picked before it is quite ripe, and kept for a few days to become slightly soft.

The tree is commonly grown in the Eastern tropics, as well as in Florida, Mexico, Queensland, Madeira, Natal, etc. The fruit is very popular in the Southern United States, and is sometimes imported into London from the Canary Islands. It is very susceptible to injury by bruising, and therefore rather difficult of transport. The tree thrives best at medium elevations or under sub-tropical conditions, bearing fruit abund-

antly, chiefly in July-August in Ceylon. There are several more or less distinct varieties, the fruit varying in shape, size (5-7 in. long by 3-4 in. in diam.), colour, thickness of flesh, &c. A good tree will bear from 600 to 800 or more fruits a year, and each fruit may weigh from about 1 lb. to nearly 2 lb. Propagated by grafting or from seed, which is of short vitality and should be selected and sown as fresh as possible. S.



Persea gratissima. AVOCADO PEAR. 1, section of fruit; 2, seed.

Phoenix dactylifera. Date Palm. (*Palmae*. A sub-tropical, dioecious palm, attaining a height of 60 to 80 ft. or more, with rather stiff, feathery leaves, extensively cultivated for its fruit (the dates of commerce) in Northern Africa, North Western Asia, and the Mediterranean region. All parts of the palm are, like the coconut palm, used for different domestic purposes. Dates are a standard article of food with the inhabitants of the countries above named, being also used as food for animals. Their cultivation forms a large and important industry, the fruit being dried or preserved and largely exported. The chief requirements of the date-palm are : great heat for a certain period of the year, a dry atmosphere, and deep, sandy soil. In regions where it is indigenous or cultivated, the temperature in summer is frequently well over 100° Fah., whilst in winter it may go well below freezing point. An annual rainfall of 5 to 10 inches is sufficient for the tree, but no rain should fall during the fruiting period. The roots, however, must have access to a constant supply of moisture, which may be of a brackish but not stagnant nature. The trees are planted about 25 ft. apart each way, or 70 trees to the acre. Before planting, deep pits are prepared, as in coconut planting ; these are (at first only partially) filled with light, rich soil, the plants, after planting, being shaded and kept moist, by watering if necessary, until they are established and have put on fresh leaves. The best time for planting is at the commencement of the rainy season.

The Date-palm has of late been largely planted in the Southern United States and Queensland. Its cultivation in Northern India is reported to be only partially successful, whilst in Ceylon and the Straits it has so far proved a failure. A specimen in the Royal Botanic Gardens, Peradeniya, is now about 70 years old and about as many feet in height, but has never flowered. Propagation is by off-shoots produced at the base ; seeds are seldom employed, as seedlings cannot be relied upon for crop or quality of fruit, nor can the male in these be distinguished from the female plants until they have flowered. Only female trees are productive, and their flowers must be fertilised by those of a male tree. The trees bear off-shoots, as a rule, only between the ages of 6 and 16 years.

Off-shoots are not removed from their parents until 3 to 5 years old. When planting these out, one "male" off-shoot is allowed for every 50 or 100 "females," this proportion being considered sufficient to secure the pollination of the latter. The process of fertilization is sometimes assisted by hanging a portion of the male inflorescence above that of the female tree for a few days; the dates are ripe and ready to gather about 4 months after pollination of the flowers. The palms come into bearing in 5 to 7 years, but are not in their prime until about 20 years old. A good tree will produce from 150 to 200 lb. of fruit per annum, and may continue productive until it has reached the age of 80 or 100 years. After attaining this age the palms are used only for extracting toddy (fermented juice), which is obtained by incisions made in the crown of the tree. The toddy, being fermented and distilled, yields an intoxicating beverage, arrack. (See *Palm Sugar*, p. 360). There is a large number of varieties of dates in cultivation, amongst the best being *Deglet Noor*, *Khadrawee*, *Hallawee*, *Sayer*, *Zahdee*, and *Deree*.

Photinia (Eriobotrya) japonica. Loquat; Japanese-medlar. (*Rosaceae*; Apple family).—A tree of medium size and symmetrical habit, with large handsome leaves, which are woolly-white underneath, native of China and Japan. It is cultivated in the Riviera and in most warm countries, being suited to medium elevations in the tropics. The small ovoid or pear-shaped, yellow fruits, which are of the size of crab-apples, have a sweetish acid flavour, and may be used for dessert or for stewing, &c. The quality of the fruit, however, varies considerably, according to variety and cultivation. The dingy white flowers are delightfully fragrant. The tree thrives best in light, rich soil with good drainage, at medium elevations. Plants may be raised from seeds, but superior varieties should be propagated by budding or grafting. S.



Anacardium occidentale. CASHEW-NUT.



Photinia japonica. LOQUAT.

(See page 252.)

Vitis vinifera. Grapes, or Grape-vine. (*Ampelidae*).—The Grape-vine is extensively cultivated in Southern Europe (in parts of which it is indigenous), Australia, South Africa, and Southern United States; also in England and other cool countries in glass-houses (vineries), the finest dessert grapes being produced under the latter condition. In Northern India, grapes of very fair quality are grown, both from exotic and indigenous sorts, while in the dry northern part of Ceylon certain varieties have long been cultivated with some degree of success. Here, the want of a winter's rest, which is so essential to the plant, is partially supplied by periodically baring the roots and exposing them to the sun for a few weeks. This operation is resorted to once a year, at the time of the principal pruning, viz. in July.

A practical experiment made a few years ago at Colombo, under the supervision of an expert viticulturist, proved conclusively the unsuitability of the uniformly steamy and hot climate here to the grape-vine. Efforts made at Hakgala Gardens, Ceylon (elevation about 5,500 ft.) to make vines bear fruit in a glass-house, also ended in failure. Essential conditions for the grape-vine are: a dry warm temperature when the fruit is setting and ripening, and a cold period for resting or wintering. The climate most approaching these conditions in Ceylon is probably that of Bandarawela, elevation about 4,000 feet. A wet climate is unsuitable, but moisture at the roots is essential, and this is best supplied by occasional irrigation, which may be given until the bunches commence to ripen, when it should cease. In vineyards, the canes are usually planted in rows, tied to stout stakes and grown on the bush system, being pruned back each year to a height of about 4 feet. In glass-houses, however, they are grown as climbers and supported by means of strands of wire stretched horizontally about a foot from the glass roof. In Jaffna, the vines are usually trained over a trellis-work or pandal.

Propagation. The Grape-vine is readily propagated by cuttings, which should be inserted slanting-wise in the soil to about ⅓ their length, leaving about 3 buds above the surface, the earth being pressed around them. The length of cutting used should be about 12-15 inches.

Pruning and *Thinning.* The usual pruning is carried out after the crop is over, all lateral shoots being pruned back once a year to within two or three buds of the main stem. Strong-growing shoots should be cut back, and excessive growth thinned out as may be necessary when the vines are in bearing. The berries should, when young, be thinned out by means of a pair of fine scissors, and the bunches also, if too numerous, reduced in number, in order to produce larger bunches and better berries.

Manuring. The plants require liberal treatment. A mixture of loamy soil and well decomposed cattle-manure forked into the soil around the vines is very beneficial, and may be applied twice a year. In India, as well as in Jaffna, fish manure is considered the best fertiliser, and salt in small quantities is also applied. The following ingredients form an excellent stimulant: 2 lbs. muriate of potash, 2 lbs. superphosphate, and 2 lbs. bone-dust; mix well together, and apply at the rate of about 4 oz. each for young plants, or 2-3 lbs. each for mature vines.

Varieties.—All the numerous cultivated varieties of the Grape-vine are considered to belong to *Vitis vinifera.* Several species of *Vitis* are indigenous to Ceylon; but none of them can be considered to be edible, except, perhaps, *V. indica.* The fruit of the latter somewhat resembles *Vitis vinifera*, but has a bitter flavour. The "Black Hambro" (dark purplish fruit) and "Muscat of Alexandria" (pale green berries) are grown in the northern part of Ceylon. "Gordo Blanco," closely resembling white "Muscat of Alexandria," has been found to bear fairly well at Bandarawela (about 4,000 ft.). In the Deccan, "Fladi," "Pandhari-sahebi," and "Bokhari" are

among the best, the last named being the most prolific. Grapes are grown with some success in some of the West Indian Islands, the most successful varieties including "Barbarossa," "Muscat Hamburg," and "Gros Colman."

Yield. In Jaffna, Ceylon, two crops a year are obtained, the principal one in March, and the second in September. The fruit takes 3 to 4 months to ripen, from the time of flowering, the vines (which grow to a large size) each producing an annual crop of from 50-80 lb. or more; the crop is sold at prices varying from 30 to 50 cents (=6*d.* to 8*d.*) per lb.

(B.)—OTHER EDIBLE FRUITS.

Exception may be taken to the inclusion of some of the following species as edible fruits, but since the collection without these would be even more incomplete than it necessarily is, it is deemed advisable not to omit them. Certain fruits may be considered edible by some people and not by others ; whilst other kinds may be relished in some countries, but considered inedible in others, *e.g.* "Akee."

Aberia Gardneri. Ket-embilla, *S. & T.*; Ceylon Gooseberry. (*Bixaceae*).—A small shrubby tree, peculiar to Ceylon, bearing velvety round berries of the size of large marbles, brownish purple when ripe. These make good jam or preserve. Worth cultivating, and doubtless capable of improvement by cultivation and selection. Season, August and September. Thrives in sandy loam and requires good drainage. Sow the small seeds in boxes under cover.



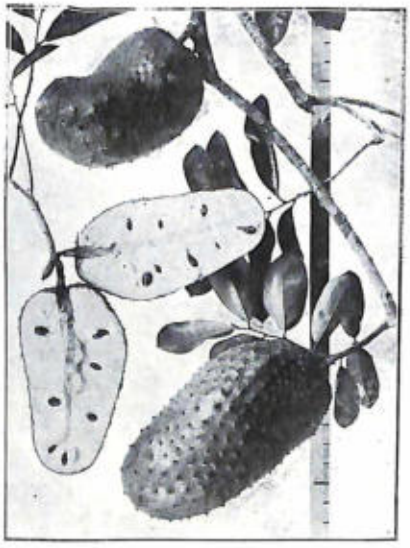
Aegle Marmelos. BAEL FRUIT. *Feronia elephantum.* WOOD-APPLE.

Aegle Marmelos. Bael-fruit; Bengal Quince ; Baeli, *S*; Vilvam, *T.* (*Rutaceae*, Orange-family).—A small or medium-sized, spiny tree with small trifoliate leaves, native of India, commonly grown in Ceylon and other tropical countries for the fruit, which is globular, with a hard, woody, smooth, green shell, 3 to 4 inches in diameter. Intermingled with the doughy, aromatic pulp is a limpid glutinous substance, which is esteemed for its well-known medicinal properties. When not fully ripe the fruit is astringent, whilst the ripe fruit has a special tonic and laxative, effect and is a well-known specific for dysentery, diarrhoea, &c. Principal season, March to May, but is available throughout the year. Propagated by seed ; thrives in ordinarily good soil. See page 377. S.

Anacardium occidentale. Cashew-nut; Caju-gaha, *S;* Mundiri-maram, *T*. (*Anacardiaceae*, Mango family.) A spreading tree, 30 to 40 ft. high, considered to be a native of Trop. America, naturalised in Africa, Ceylon, India, etc. Fruit consists of two distinct parts, viz. (*a*) the large swollen pear-shaped stalk (cashew-apple), 2 to 4 inches long, which is juicy, astringently acid, sometimes used in preserves; (*b*) the small kidney-shaped, grey or brown nut (about 1 inch long) at the extremity. The latter has an edible kernel (seed), which when roasted has a very agreeable nutty taste and is much relished for dessert. It is in demand in Europe, and is exported to some extent from S. India, Africa, &c., for confectionery and table dessert. In London the nuts are usually worth about 55*s.* to 60*s.* per cwt. In the local markets they are generally sold for about Re. 1 per hundred, shelled. The shell of the nut is acrid and poisonous. All parts of the fruit are of various uses in medicine. An intoxicating beverage ("kaju"), largely consumed by the Natives in East Tropical Africa, is made from the fleshy receptacle. A gum obtained from the tree is obnoxious to insects and is recommended for book-binding. The juice from incisions made in the bark forms an indelible ink. The tree is especially adapted to moderately dry districts, near the sea, but also thrives up to 3,000 ft. Propagated by seed. $.

Anona diversifolia. Ilama; "Anona Blanca". (*Anonaceae*, Custard-apple family). A small tree bearing conical, glaucous, green or pinkish fruit, native of Mexico, where it is commonly cultivated. Climatic and cultural requirements similar to those of the Sugar-apple. The fruit is pleasantly acid-sweet, and, according to Popenoe, may be termed "the Cherimoya of the lowlands." Suited to low or medium elevations. Not established in Ceylon.

A.—muricata. Soursop; Katu-anoda, *S*; Seetha, *T*. A small, quick-growing shrubby tree, 15-20 ft. high, with fragrant laurel-like leaves, native of the West Indies and commonly grown in the tropics generally. The large fruit, weighing from 4-6 lb. or more, varies in form from kidney-shaped to ovoid, and is covered with soft green prickles. The white and rather woolly pulp, amongst which the large black seeds are scattered, is sweet-acid and juicy, suggesting the flavour of pineapple; it is sometimes used for flavouring ices and in the preparation of a pleasant cooling drink. Propagated from seed or cuttings. Thrives up to 3,000 ft. $.



Anona muricata. SOURSOP.

A.—palustris. Monkey-, Alligator-, or Pond-apple; Cork-wood. A small tree of S. America and the West Indies, generally inhabiting swamps. Fruit not edible; wood soft and spongy, used as stoppers for bottles, &c.

A.—reticulata. Custard-apple; Bullock's Heart; Anoda, *S*; Ramsita, *T*.—A small bushy tree of tropical America and the West Indies, commonly grown in gardens throughout the tropics. The large heart-shaped or round fruit, brownish-red in colour, contains several large dark-brown seeds interspersed among the sweet custard-like, granular, edible pulp. There is a superstition among some people in Ceylon that the fruit causes leprosy. Thrives at low and medium elevations. $.



Anona reticulata BULLOCK'S HEART.

Artocarpus incisa. Bread-fruit ; Rata-del, *S* ; Erapillakai, *T*. (*Urticaceae*, Fig family).—One of the most handsome of tropical trees, native of the Pacific Islands, Java, etc.; introduced into Ceylon before 1796. A quick grower, attaining a height of 40 to 60 ft., with very large, shining, deeply-cut leaves. The fruit is roundish or ovoid, 5-7 in. long by about 4 in. in diameter, pea-green in colour, and produced in twos or threes at the ends of the branches. The best varieties seldom have any seed; seeding varieties contain large fleshy seeds embedded in the pulp, both seeds and pulp being cooked and eaten. In the W. Indies, a seeding variety is known as the "Bread-nut Tree," as distinct from the seedless Bread-fruit. The pulp in either case consists of a solid, white, fleshy mass which, when sliced and roasted, is not unlike the crumb of a new loaf. It is esteemed as a vegetable, being used for curries, roasted and ground into flour, or prepared in various other ways. Bread-fruit forms an important article of diet with the natives of the South Sea Islands. Firminger, after partaking of the fruit in Ceylon, considered it to be "hardly distinguishable from an excellent batter pudding." The tree thrives up to to 1,500 ft. in the moist districts of Ceylon. Propagated by root-suckers, gootee, or layering, or from seed when obtainable. See page 97. §.

A.—incisa, var. Bread-nut. See above.

A.—integrifolia. Jak-fruit ; Kos, *S* ; Pilla-kai, *T*.—A very large tree, native of South India and Malaya, commonly cultivated and naturalised in Ceylon. The enormous fruits, one of which may weigh up to 100 lbs. or more, are borne on the trunk and older branches, sometimes down to the base of the trunk. Each fruit (botanically a multiple



Artocarpus incisa. BREAD-FRUIT.

fruit formed of achenes surrounded by fleshy perianths on a common receptacle) is usually oblong and irregular in shape (sometimes almost round), the green rind consisting of fleshy knobs. The fruit forms a very important article of food with the poorer people in the Eastern Tropics, while some of the better classes also relish it, more especially the large, albuminous, white seeds when cooked and served in curries. When ripe, the fruit has an over-powering odour, but this does not appear to be considered a drawback. The cream-coloured or yellowish, soft, flakey pulp is eaten either raw, boiled, or fried, and used as a vegetable for curries, etc. §.

The tree affords an excellent timber, much used for cabinet work, building, etc., in Ceylon; lemon-yellow at first, it turns with age to a very dark tint like mahogany, to which it is but little inferior. It is suited to moist or semi-dry districts, up to 2,000 ft. In planting, the seed should be sown *in situ*, or in baskets or bamboo-pots, as seedlings from nursery beds will not bear transplanting well. Large holes should be dug and filled with good soil and manure; sow 3 seeds in the centre, and remove the weaker seedlings afterwards, leaving the strongest one.



Artocarpus integrifolia. JAK FRUIT.

Varieties.—The Jak-fruit occurs in several varieties, the two most distinct in Ceylon being "Waraka," distinguished by a firm fruit which is recognised by the sound when flicked with the fingers, and "Vela," characterised by its softer pulp, through which the finger may be thrust when approaching ripeness, the pulp being less sweet than that of the former variety. "Kuru-waraka" has small and almost round fruit, and "Peni-waraka" (honey-jak) has a distinct sweetish pulp.

A.—Lakoocha. Kana-gona, *S*; Tampang-manis, *Mal.*—A large deciduous tree of India, Ceylon, Malaya, &c., with tomentose branchlets, and oblong leaves, 8-12 in. long. The flat, broad seeds are edible.

A.—nobilis. Wild Bread-fruit; Bedi- or Wal-del, *S*; Asini-pillakai, *T*. A noble tree, usually attaining a height of about 60 ft. or more, sometimes with a very large trunk, characterised by large leathery, crinkled or wavy, undivided leaves, peculiar to the moist low-country of Ceylon. The fruit is cone-like, 6 to 8 inches in length by 1½ to 2 inches in diameter; it is similar in texture, though inferior, to the Bread-fruit proper, and is eaten by the poorer classes, being cooked and used as a vegetable with curries. It contains several round, white seeds, of the form of large peas, which are roasted and eaten. The tree thrives in a wild state up to about 2,000 ft. in Ceylon, where it is endemic. See pages 97, 255. §.

A.—odoratissima. Sometimes known as Johore Jak. The leaves are hairy or pubescent, and the oblong or ovoid fruit, much smaller than the Jak, has a powerful odour. The pulp is sweet and esteemed by those who eat the fruit.

A.—rigida. Tampumunei; or Buah-perian (*Mal*).—A medium-sized tree of Malaya, with small oval leaves, producing a round or ovoid fruit, about 4-6 in. or

more in diameter, furnished with prominent sharp spikes, yellow when ripe. The orange-yellow fleshy sac surrounding each of the round seeds is sweet, juicy, and edible. Introduced at Peradeniya in 1910.

Averrhoa Bilimbi. Cucumber-tree ; Bilimbing; Biling, *S*; Bilimbikai, *T*. (*Geraniaceae*).—A small fine-foliaged tree, native of the Moluccas, commonly cultivated in the tropics, especially in the East, for its fruit, which is about 3-4 inches long, resembling a small green cucumber, produced in clusters on the trunk and oldest branches, and is esteemed in pickles and preserves, being sometimes used for making jam and cooling drinks. It is also much relished in curries. The tree thrives up to medium elevations.

A.—Carambola. Carambola ; Kamaranga, *S* ; Tamarta, *T*.—A small tree, similar to the preceding species, native of the Moluccas and long cultivated in the East. The curious, ovoid, angular and fleshy fruit, 3 to 5 inches long and borne in great profusion, is, when ripe, of a rich amber colour, semi-transparent, very juicy, and of a sweet-acid taste. It is sometimes used for making jelly, preserves, &c., and a pleasant drink is made from it. The juice removes stains from linen and, like that of the preceding species, is also commonly used for burnishing brass. Some varieties bear agreeably sweet fruits; these should be propagated by gootee or budding, though usually the tree is raised from seed. See p. 509.



Artocarpus nobilis
WILD BREAD-FRUIT.

Baccaurea (Pierardia) Motleyana. Rambeh or Rambai of Malaya. (*Euphorbiaceae*). A handsome tree of Sumatra, with large oval leaves, bearing long pendulous clusters of large smooth berries (yellow when ripe) along the older branches. The sweet-acid juicy fruit is relished by some people. Season, August-September. Sometimes cultivated in Malaya. Introduced into Ceylon in 1883. §.



Baccaurea Motleyana.
RAMBEH OR RAMBAI.

Averrhoa Carambola.
CARAMBOLA. (A, CROSS SECTION OF FRUIT.)

Bactris (Guilielma) utilis. Peach-nut ; Pewa ; Pejibaye. A pinnate-leaved, slender, spiny palm, cultivated in Costa Rica, Ecuador, &c., for its fruit, which is used as an article of food. The fruit is borne in clusters (racemes), not unlike large dates, each cluster weighing up to 25 lbs. or more, and each palm producing 4 or 5 clusters a year. The best varieties are seedless, or contain only a small seed. Boiled in salted water, the mealy flesh of the fruit is eaten and relished, being very nutritious and of a pleasant chestnut-like flavour. Suited to low and medium elevations.



Blighia sapida. AKEE.

Blighia sapida (=**Cupania edulis**). Akee. (*Sapindaceae*). A medium-sized tree, native of West Tropical Africa, introduced and cultivated in the West Indies for the sake of its edible fruit. The latter is bluntly triangular, about 2½ to 3 in. long, bright red when ripe. The seeds, of which two or three are in a fruit, are shiny-black and of the size of large peas. The edible portion is the firm, cream-coloured, fat-like substance (aril) developed in a succulent socket around the base of the seed. This may be eaten raw, but is generally cooked, and considered delicious when par-boiled, flavoured with salt, etc., and fried with butter. The fruit when ripe splits open, and must then be picked, as on long exposure to the air the aril becomes discoloured and dangerous to eat ; if not fully mature, or if over-ripe, it is equally unfit for food. Between the lobes of aril there is a pink integument which must be removed when preparing for eating, as it is poisonous. The fruit must be picked in the morning, and fallen fruits should not be used. The tree is suited to moist or semi-dry districts, up to about 2,000 ft. elevation. It is commonly grown in Jamaica, where the fruit is much relished. A specimen in the garden at " Temple Trees, " Colombo, bears fruit freely twice a year, chiefly in April-June and September-October. The Akee is also sometimes cultivated in Indian gardens, but the fruit does not appear to be eaten anywhere in the East. S.

Bouea macrophylla. Kundangan. (*Anacardiaceae*).—A medium-sized tree of Malaya, producing a profusion of small, mango-like, edible fruits, of the size of a hen's egg, with thin skin and juicy flesh.

Calocarpum mamosum, see *Lucuma mammosa.*

Canarium commune. Java Almond ; Keanee (Papua) ; Kanari-nut; Pili-nuts of the Philippines, &c. ; Rata-kekuna, *S.* (*Combretaceae*).—A large, handsome, Malayan tree, characterised by a remarkable but-

tressed trunk or laterally compressed surface roots; the latter develop into enormous erect flanges of nearly uniform thickness, so that solid circular sections may occasionally be cut out from them to form ready-made cart wheels. The tree is much cultivated for shade or ornament in Java. It bears in great abundance large pendulous clusters of fruits, of the size of small plums, dark-purple when ripe; these are produced almost all the year round, but chiefly in June-August. The kernel is edible, resembling sweet almonds; it yields by expression an oil used for burning in lamps and for cooking purposes. A considerable quantity of the "nuts," collected from wild-trees, is said to be exported from the Philippines. A striking tree for planting in a row or in an avenue; thrives in hot and moist districts up to about 2,000 ft. elevation, and prefers deep, well drained soil. See p. 106. S.



Chrysophyllum Cainito. STAR-APPLE.



Canarium commune. JAVA ALMOND.

Carissa Carandas. Maha-karanda, *S*; Perunkila, *T.* (*Apocynaceae*). A small tree or large shrub, with sharp, rigid, forked thorns and small oval leaves, native of the dry region of Ceylon, also of India and Malay. The fruit is dark purple when ripe, resembling a damson, and contains a number of small seeds. In India it is made into a pickle, also used for making excellent tarts and puddings, being considered to resemble gooseberries in flavour. When ripe, it makes a good jelly. Season, August-September. The plant is commonly employed for barrier hedges. Propagated from seed. Suited to dry localities.

Casimiroa edulis. "Sapote": see p. 275.

C.—grandiflora. Natal Plum; Amatingula.—A large spiny shrub, similar to its above relative, much used for hedges in Natal, the fruit being relished and used in tarts, &c.

Chrysophyllum Cainito. Caimito; Star-apple; Rata-lawulu, *S*; Seemaipala-pallam, *T.* (*Sapotaceae*). A large or medium-sized, handsome tree of Trop. America and W. Indies, with striking, dark-green, oval leaves, which are cop-

pery yellow underneath. The purplish, smooth, round fruit is 2 to 3 in. in diameter, usually 4-to 6-seeded, the brown shiny seeds being ½ inch long. In an unripe state the fruit contains a sticky white latex, but when fully matured the white, transparent, jelly-like substance surrounding the seed is sweet and agreeable. The fruit when cut across presents a stellate form, the cells with their white edible pulp radiating from the centre ; hence the name "Star-apple." There are several varieties, differing in the size of the fruit, &c. The tree is well worth growing for ornament or shade, and is commonly cultivated in the Western Tropics ; thrives at Peradeniya, where it was first introduced in 1802. Propagated from seed. §.

C.—monopyrenum. Date-plum ; Kos-eta-lawulu, *S* ; Seemai-palapallam, *T*.—A West Indian tree, of more slender and upright habit than the preceding species, but resembling it in foliage ; introduced at Peradeniya in 1814. As the vernacular names signify, the small, milky, sweetish fruit is of the form of a date or a jak seed, purplish-black when ripe. Season, February-April.

Chrysobalanus Icaco. Coco-plum ; Icaco ; Spanish Nectarine. (*Rosaceae*).—A large straggling shrub or small tree of Trop. America and West Indies. Bears large, round, reddish-purple, plum-like fruits at the ends of the branches, each fruit having a large kernel covered with white, soft sweetish pulp. Introduced into Ceylon. It has little to recommend it as a dessert fruit, though it is sometimes made into a preserve.

Citrus decumana. Shaddock ; Pomelo ; "Forbidden Fruit" ; Jambola, *S* ; Jamblica or Bambalinas, *T*. (*Rutaceae*). A small tree, 25 to 30 ft. high, native of Tropical Asia, commonly cultivated throughout the tropics for its large round or ovoid fruits. There are numerous varieties, varying in the shape and size of the fruit, as well as in the colour and flavour of the pulp ; in some varieties the latter is green and acid, in others it is crimson, juicy, and sweet. Some varieties have few or no seeds. The fruit is sometimes made into jam. The tree grows luxuriantly in the moist low country, producing fruit from 6 to 8 in. in diameter : thrives up to about 4,000 ft. elevation either in moist or semi-dry districts. Seedlings of Pomelo are recommended as grafting stock for oranges.



Cynometra cauliflora. NAM-NAM.

Clausena Wampi (=*Cookia punctata*). Wampee ; Rata-karapincha, *S*. (*Rutaceae*). A small ornamental and aromatic tree, native of China. The pale yellow berries have a strong aromatic taste and are sometimes made into a preserve, also used for flavouring meat curries. Suited to low and medium elevations. Propagated by seed.

Cynometra cauliflora. Nam-nam. (*Leguminosae*). A shrubby, much-branched tree with small binate leaves, native of India and Malaya. The fruit is a large, wrinkled, thick, fleshy 1-seeded pod, rather semi-circular in shape, produced in large numbers on the trunk near the ground or on the lowermost portions of the branches, chiefly in May and June. The succulent green or greenish yellow shell is about ½ inch thick, and is of a pleasant, sweet, sub-acid taste, suggesting an indifferent apple, and is suited for stewing or pickling. The large flat seed yields a medicinal oil. Thrives in moist low-country of Ceylon up to 2,000 ft., and prefers deep rich soil. Though indigenous to parts of India, it does not seem to be commonly cultivated there, for neither Firminger nor Cameron mentions it. §.

Davidsonia pruriens. Davidson's plum. (*Saxifrageae*). Queensland. A medium-sized tree with handsome serrate leaves. The fruits are of the size of plums, bright pink when ripe, with a reddish flesh, sometimes made into jam and preserves. Introduced at Peradeniya in 1892 ; not yet flowered or fruited there (1924).

Detarium senegalense. (*Leguminosae*). A medium-sized handsome tree of Tropical Africa, with small one-seeded pods. The thick farinaceous pulp, inter-mixed with fibre around the bony shell of the seed, is sweet and edible. A variety with acid pulp is, however, considered poisonous. Introduced at Peradeniya in 1885.



Dialium ovoideum. VELVET TAMARIND.

Dialium ovoideum. Velvet Tamarind ; Gal-siyambala, *S* ; Kallu-pullium, *T* ; Kanji, of Malaya. (*Leguminosae*). A tall tree with pinnate leaves, indigenous to the semi-dry region of Ceylon. The dark-brown, small, velvety fruits are produced in large clusters, each fruit being about the size of a small filbert. The thin, brittle shell encloses one or two seeds surrounded by a sweet-acid farinaceous pulp, which is edible and used in the preparation of chutneys, etc. When in season, chiefly in April-May, the fruits are collected from uncultivated trees and commonly sold in the markets and boutiques. The tree affords a handsome dark red timber. §.

D.—guineense. West African Velvet-tamarind. Similar to the preceding species, but distinguished by its larger leaves. The genus is characterised by the flowers having only two stamens, most Leguminous plants having ten or more. Introduced at Peradeniya in 1893.

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Dillenia indica. Honda-para, *S* ; (*Dilleniaceae*).—A medium-sized handsome tree, with large leaves and very large white flowers, native of Ceylon and tropical Asia generally. Produces a profusion of large, round, green fruits (formed by the much enlarged, closely imbricate, fleshy sepals), each about 4 inches in diameter, being juicy and acid ; these are used for making jelly and a cooling drink, also sometimes as a vegetable in curries. The tree is worth cultivating for ornament. Propagated by seed. §.



Dillenia indica.
1, flower; 2 & 3, fruit.



Diospyros discolor. VELVET APPLE.

Diospyros discolor. Velvet-apple ; Mabola. (*Ebenaceae*).—A medium-sized, slow-growing tree of the Ebony and Persimmon family, native of S. India and the Philippines. The beautiful, dull pink, velvety, round fruit is of the size of a large apple. The white fragrant pulp surrounding the large seeds is considered edible, though not very tempting. §.

Elaeocarpus edulis. (*Tiliaceae*). A small ornamental tree, native of New Guinea, producing bright red fruit, 3 to 5 sharp-angled, ovoid in shape, one-seeded and about 2 inches long. The outer scanty rind (pericarp) is of a sweetish bitter taste, and may be made into a savoury jelly or used for pickling. The tree is worth growing for ornament, but not as a fruit tree. Thrives in shady places with loose rich soil, up to about 2,000 ft. Propagated by seed.

E.—serratus. Ceylon Olive ; Veralu, *S*; Verali-pallam, *T*.—A handsome medium-sized tree, indigenous to Ceylon, producing smooth ovoid green fruits, of the size of olives, which they rather resemble. The fleshy portion surrounding the stone (seed) is sub-acid and palatable. In an unripe state it is suited for pickling, like olives. Principal season, May-June. The tree thrives in the moist low-country up to about 2,000 ft., and is propagated by seed. §.

Eugenia Jambos. Rose-apple ; Veli Jambu, *S*; Seeni-jambu, *T*. (*Myrtaceae*).—A medium-sized handsome tree, native of India and Malaya, introduced into Ceylon probably in the time of the Portuguese. The fragrant, pinkish-white fruit, about the size of a hen's egg, is of a sweetish rose-water taste, and is said to be sometimes used in preserves. As a fruit, however, it has little to recommend it, being usually woolly and almost juiceless ; but it varies somewhat with different trees and locality. Thrives best in moist districts, at medium elevations up to about 4,000 ft., preferring a deep, rich soil. See page 217.

E.—Jambolana. Java-plum; Mahadan, *S*; Naval, *T.*—Large tree with grey bark, native of Ceylon, India, Malaya, etc., bearing a very small but edible fruit. There are varieties in India with larger fruits.

E.—javanica. Wax Jambu; Pini Jambu, *S.* — A small, ornamental, Malayan tree, producing clusters of pretty, glossy, rose-pink or pinkish-white, waxy-looking fruits. Each fruit is about the size of a large strawberry, with the base laterally compressed; it is sweetish-acid, but usually too fragrant and pithy to be agreeable. Propagated by seed. Thrives at low and medium elevations. Season, March to May. S

E.—malaccensis. Malay Apple: Jambu, *S*; Peria Jambu, *T.*—A handsome tree, 30 to 50 ft. high, with large leathery, oval leaves, indigenous to Malaya. Produces a great profusion of beautiful crimson flowers, the bright crimson stamens of which make a thick carpet under the tree as they drop. The pear-shaped, waxy-white or red fruits are in season chiefly during May and June. The snowy white, woolly pulp is edible, but not of much account. Thrives at low and medium elevations. S.



Elaeocarpus serratus. CEYLON OLIVE.



Eugenia malaccensis.
MALAY APPLE.

Eugenia javanica.
WAX-JAMBU.

E.—Michelii. (*E—uniflora*). Brazil- or Surinam-Cherry; Goraka-jambu, *S*; Pitanga.—A small shrubby tree of Brazil, bearing small round and ribbed fruit, about 1 inch in diameter, rather flattened at the ends, of a bright red waxy appearance. They are sweetish-acid and edible, but to most people are too aromatic to be agreeable; said to make good jelly, being also stewed or used in preserves. Thrives best at medium elevations, under subtropical conditions. §.

Feronia elephantum. Wood-apple; Elephant-apple; Diwul, *S*; Vila or Villati, *T*. (*Rutaceae*).—A small spiny tree, 30 to 40 feet high, with small, pinnate, glabrous, trifoliate leaves, native of India and Ceylon. The globular or ovoid fruit is of the size of a large cricket ball, similar to the Bael-fruit, but distinguished from it by the rough woody, hard, white shell. It contains a mass of soft, bitter-sweet, mealy substance, which is used for making a pleasant cooling drink and a preserve, also in native medicine. The tree is common in Ceylon throughout the dry region, being often cultivated. The fruit is collected under licence as a forest produce, and commonly sold in the markets. See pages 378, 511.



Eugenia Michelii. BRAZIL CHERRY.



Flacourtia inermis. LOVI-LOVI.

Flacourtia cataphracta. Rata-uguressa, *S*. (*Bixaceae*). A small thorny tree, native of India and Malaya, producing round berries of the size of large cherries, purplish or deep-red in colour and of a rather pleasant tart flavour. Firminger thought it "suggestive of something better than a sloe, but worse than an indifferent plum." There are, however, several varieties in cultivation, and some would seem to merit a better description than this. The fruit can be made into a very agreeable jam or preserve. Propagated from seed, but a good variety should be budded or grafted.

F.—Ramontchi. Governor Plum (W. Indies); Uguressa, *S*; Katukali, *T*. A tree similar to the above, native of Ceylon, India, China, etc., bearing round dark purple fruits, which contain numerous seeds. An excellent jelly is made from the fruit, and the tree makes a good hedge. §.

F.—inermis. Lovi-lovi; Tomi-tomi; Louvi, *S*. An ornamental, thornless, Malayan tree, growing to about 25 or 30ft. high,

bearing in great profusion bright red, cherry-like berries, which are attractive-looking but deceptive, being exceedingly sour; they make good jelly or preserves, but require much sugar. Chief seasons in Ceylon, March-April and August-September. Propagated by seed; thrives in any moderately good soil at low elevations. Sow the small seed in boxes, under cover; prick out the seedlings into baskets or bamboo pots when large enough. Seedlings take about eighteen months to become ready for planting out. S.

Garcinia Cambogia. Goraka, *S*; Korrakkai-pulli, *T.* (*Guttiferae*).—A moderate-sized handsome tree, with a round head and drooping branches, native of the moist low-country of Ceylon and Western India. The large roundish fruit is of the size of an orange, with several (usually 6-8) deep vertical grooves, forming blunt lobes; it is smooth on the surface, red or orange-yellow in colour and sweetish-acid in taste. When ripe (June-July), it is commonly collected in the low-country of Ceylon, the thick succulent shell being cut in sections, dried in the sun, and preserved for use as required. It is largely employed for preserving fish, being made into a brine with salt; also used as a substitute for limes in curries. Thrives up to about 2,000 ft. Propagated by seed. S.



Garcinia Cambogia. GORAKA.

G.—dulcis. Mundu. A jam is made of the fruit in Malaya.

G.—Xanthochymus. Egg-tree (from its ovoid or conical shape); Cochin-goraka or Rata-goraka, *S*; Seemai-goraka, *T.*—A symmetrical, bushy tree, growing to 25 or 30ft. high, native of South India and Malaya, with large leathery leaves, 10 to 15 in. long and $2\frac{1}{2}$ to $3\frac{1}{2}$ in. broad. The handsome, yellow, smooth fruit, produced in great abundance, usually in December to February, is of the form and size of a small orange, with a pointed (stigmatic) projection at the end or on one side. The yellow juicy pulp has an acid but refreshing taste. The tree is propagated from the large seeds, and thrives best at medium elevations.



Garcinia Xanthochymus. COCHIN-GORAKA.

Genipa americana. Genip or Genipap; Mamoncilla; Marmalade-box. (*Rubiaceae*).—A medium-sized tree with large glossy leaves, producing a succulent, russet-brown fruit, of the size of an orange, which is edible but must be kept after picking till it softens. Native of the Guianas, often cultivated in Brazil, &c. Introduced at Peradeniya in 1904.

Gnetum Gnemon. (*Gnetaceae*). A small tree of Malaya, sometimes cultivated for the edible fruit. Flowers and leaves also eaten. Introduced at Peradeniya in 1904; flowers freely, but has not yet fruited there.

Grias cauliflora. Anchovy Pear (*Myrtaceae*). A small, slender, unbranched, West Indian tree, with a crown of very large drooping leaves, each measuring up to 3 ft. in length by about 6 to 8 inches across. The brown ovoid fruits, produced on the stem, are each of the size of a hen's egg and considered edible, resembling the mango in taste; said to be used for dessert or pickling. Judged by the fruit produced at Peradeniya, however, it is hardly worthy of being classed as edible.

Hibiscus Sabdariffa. Jamaica- or Red Sorrel; Rozelle; Rata-bilincha, *S*; Pulincha-kira, *T*. (*Malvaceae*).—An annual shrub, 6 to 8 ft. high, with reddish stems, leaves, and fruits; native of the West Indies. Cultivated in most warm countries (sometimes as an intercrop with other products), for the sake of its large fleshy sepals, which remain after the flowers fall away and become enlarged and succulent (accrescent), enclosing the fruit capsule; these make excellent jelly,



Hibiscus Sabdariffa. ROZELLE.

considered to be almost equal to red-currant jelly. In an unripe state the fruit is adapted for pickles, and a refreshing beverage called "sorrel-drink" is also prepared from it. The young, tender, acid leaves are sometimes used as a vegetable in curries. Thrives at all elevations up to about 4,000 ft. Seeds may be sown at the commencement of the monsoon rains, and the seedlings, when ready, planted out about 4 ft × 3 ft. The crop should be fit for picking in 5 - 6 months from planting, and continues for about 2 months. There is also a green form, known as "White Sorrel," with greenish-white fruits, but the former variety is considered to be more acid and is generally preferred. See *Fibres*, page 430. §.



Lansium domesticum. LANGSAT.

Inocarpus edulis. Tahiti Chestnut. (*Leguminosae*). A moderate-sized tree with large, shiny leaves, indigenous to the Pacific Isles, where the large fleshy seeds (1 to 2 in each stout pod) form an article of food with the Natives. When boiled and roasted the seeds are considered palatable, though "not suited to weak stomachs." The tree thrives and produces flowers and fruit at Peradeniya, where it was introduced in 1861, but the fruit is not eaten there.

Lansium domesticum. Langsat; Langseh; Duku. (*Meliaceae*). A modera'e-sized, ornamental tree, native of Malaya; bears long, hanging clusters of closely packed berries, which have a thin tough skin, pale yellow when ripe, enclosing opaque, aromatic, juicy pulp, said to be much relished in its native country, being "eaten fresh or variously prepared." It has been described as one of the finest fruits of the Malayan Peninsula, but the fruit produced in Peradeniya Gardens may be considered barely edible, though this may be only a poor variety. The tree seems to be little known in India. Thrives up to 2,000 ft. in moist districts. Introduced at Peradeniya in 1869. Season, August-September. S.

Lucuma (Pouteria) Cainito. Abiu. (*Sapotaceae*).—A small tree of Brazil, resembling the Canistal in general habit of growth, and the Sapodilla in the fruit, the latter being ovoid or almost round, 2-4 in. long, bright yellow when ripe, said to be "melting and sweet." Cultivated in Peru and Brazil; suited to medium elevations.

L.—(Calocarpum) mammosa. Mammey Sapote; Grosse Sapote; Marmalade Fruit. (*Sapotaceae*). A tree 30 to 40 ft. high, with fulvous grey branches and long, obovate, pointed leaves, native of Central America, cultivated in the latter country and in some West Indian islands for its fruit, which are borne in clusters on the stem. The fruit is ovoid, 3 to 5 inches long, russet-brown, containing one or more polished seeds embedded in the pulp, the latter being of a reddish tint, sweet when fully ripe, like that of its ally the Sapodilla. It is made into a marmalade, which is said to be not unlike an apple preserve. Seeds said to be used in America with cocoa for making chocolate. The common names of this tree are often confused with those of the tree *Mammea americana*,—see p. 266.

L.—nervosa. Canistal. A small tree, 15 to 25 ft. high, native of Cuba and tropical S. America. The fruit is round to ovoid, 2–4 in. long, and orange-yellow; it is popular with some people, but too sweet and musky for others. Propagated by the dark-brown, ovoid, shiny seeds. Suited to medium elevations or warm sub-tropical conditions.

L.—Palmeri. "Mexican Sapodilla." A medium-sized tree with long, narrow and closely set leaves, native of Trop. S. America. The large round or ovoid, smooth-skinned fruit, yellow when ripe, consists of a mass of yellow pulp with one or more large brown ovoid seeds; it is relished in its native country, but is of indifferent quality in Ceylon, where it is sometimes grown in low-country gardens. S.



Lucuma Palmeri.
"MEXICAN SAPODILLA."

L.—(Colocarpum) viride. Green Sapote; Injerto; Yash-tel. A tree of the Guatemalan high-lands, similar to the preceding species, but with fruit claimed to be superior to it. Suited to high or medium elevations.

Macadamia ternifolia. Queensland-nut. (*Proteaceae*).—A moderate-sized tree, about 30 to 40 ft. high, with dense, dark-green foliage narrow leaves, native of North Eastern Australia, producing hard, round nuts, of the size of marbles; these have an agreeable flavour and are much relished in Australia, being sometimes retailed in Sydney at from 8d. to 1s. per lb. The hard, smooth shell is difficult to break, which is a drawback. The tree is propagated from seed; thrives and bears fruit at Peradeniya, where it was introduced in 1868. Suited to medium elevations.



Mammea americana. MAMMEY-APPLE.

Mantingia Calabura. "Calabura." Jam-fruit. (*Tiliaceae*)—A small or medium-sized, rather ornamental spreading tree with pinnate, pubescent, glandular leaves and small white flowers, native of Trop. America. The small yellow berries make good tarts or jam. An infusion of the leaves is used as tea in Caraccas. Introduced into Ceylon about 1912.

Melicocca bijuga. Honey Berry; Spanish Lime; Ginep; Mamoncillo of Cuba. (*Sapindaceae*).—A handsome medium-sized tree of South America, with pinnate leaves, introduced and cultivated in several West Indian Islands. The small green ovoid fruits, about 1 in. long, have a sweet aromatic taste, but are hardly worth eating; said to be popular in Cuba, Porto Rico, &c. Best suited to medium elevations. Introduced at Peradeniya in 1907.

Mimusops Bojeri. (*Sapotaceae*).—A slow-growing tree with small ovate or obovate, leathery leaves, shiny above and satiny grey beneath. The fruits, produced in November and December, are of the size of small plums, borne in clusters at the ends of the branches. Each fruit contains from 2 to 4 oblong brown seeds; the pulp has a sweetish taste, not unlike that of the Sapodilla. Suited to low and medium elevations.

Mammea americana. Mammey apple; St. Domingo-apricot. (*Guttiferae*, Mangosteen family).—A small or moderate-sized, slow-growing tree, with large, rigid, leathery, shining leaves, and white, scented flowers, native of tropical America and the West Indies. The fruit is nearly spherical, 3 to 5 inches in diameter, with thick brown, bark-like skin, and a distinct pointed nipple developed towards the apex. It contains one large seed (sometimes more), which is covered with a layer of fibre and surrounded by dense, orange-coloured, sweetish and slightly aromatic pulp, which may be stewed, preserved with sugar, or eaten raw. The small cream-coloured, scented flowers yield by distillation a spirit used in flavouring the liqueur known as Eau-de-Creole. The fruit has been described as rivalling the mangosteen, for which there is no justification. It would seem, however, to be a promising fruit for improvement by selection and cultivation. The tree has been grown at Peradeniya since about 1810, and bears a few fruits annually. $.



Monstera deliciosa.
"CERIMAN."

Monstera deliciosa. (*Aroideae*, Arum family).—A noble epiphytic creeper with very large, scalloped and perforated leaves, native of Mexico. It produces, in the axils of the uppermost leaves, a cone-like fruit (spadix) 7 to 9 inches long, which is edible though juiceless, and has a pleasant pineapple-like odour when ripe. It is characterised by the presence in the pulp of needles or spicules of calcium oxalate which, if eaten, cause an uncomfortable itching in the throat, and consequently render the fruit hardly worth eating. It is, however, relished by some people, and is said to be sold in the markets in Java, &c. The plant grows best on stout tree trunks or rough-barked trees, and may be propagated by seed or cuttings, the latter being placed in a mixture of old bark, leaf-mould, &c., at the base of the tree on which it is to grow. See p. 131.

Myrica cauliflora. Jaboticaba. (*Myricaceae*). A small or medium-sized tree of Brazil, commonly cultivated in parts of that country for its fruit as well as for its beauty of form and foliage. The small round fruit, produced in abundance on stem and branches, is ½ to 1½ in. in diameter, maroon-purple in colour, and crowned with a disk. The translucent juicy pulp is of an agreeable vinous flavour and makes good jelly. Seeds 3 to 4. Fruit esteemed in Brazil and commonly sold in the markets.* Suited to medium elevations or sub-tropical conditions.

Nephelium (Euphoria) longana. Mora, or Rasa-mora, *S*; Nurai, *T*. (*Sapindaceae*).—A large spreading tree with smooth grey bark, native of the low-country of Ceylon, also of S. India, Bengal, Burma, and S. China. The aril surrounding the seeds is edible and sweet, but inferior to that of the Litchi and Rambutan. Not cultivated in Ceylon. Season, September-October.

Noronhia emarginata. (*Oleaceae*, Olive family).—A small upright tree of Madagascar and Mauritius, the small, olive-like fruit of which are edible. Introduced at Peradeniya in 1882.

Oncoba spinosa. Onkob. (*Bixaceae*). A small deciduous tree of Arabia and Tropical Africa, the fruit of which is sometimes eaten. Introduced at Peradeniya in 1883. Season, August-September

Opuntia Dillenii. Prickly Pear. Several other species. See pages 74, 454, 475. Fruit edible, but the tufts of small spines covering it are an objection.

Pangium edule. See *Fine Foliage Trees*, pp. 102, 463.



Passiflora quadrangularis.
GRANADILLA.

Passiflora laurifolia. Water-lemon ; Jamaica Honeysuckle ; Pomme d'or ; Bell-apple. (*Passifloraceae*, Passion-fruit family).—A handsome West Indian climber, with entire, oval leaves, cultivated for the fruit or for ornament. The smooth, ovoid fruit is of the size and shape of a hen's egg, orange-yellow when ripe, containing sweet watery pulp, much esteemed for dessert or for making a sweet-cup. Readily propagated by cuttings, and especially adapted for growing as a screen against plant-houses. The plant appears to have been introduced at Peradeniya before 1824, but, although it grows and flowers freely there, it has not yet set fruit, neither does it appear to be fruitful elsewhere in the East. See pp. 78, 130.

P.—quadrangularis. Granadilla ; Garandilla, or Rata-puhul, *S*; Seemai-sorakai, *T*.—A strong, quick-growing-

* Popenoe's Manual of Tropical and Sub-tropical Fruits.

climber, with large oval leaves and square stems, native of Tropical America. The large oblong green or greenish-yellow fruit is not unlike a water melon, and contains in its hollow centre a mass of purplish, sweet-acid pulp mixed with the flat seeds. In the unripe state the succulent shell may be boiled and used as a vegetable. The root is usually swollen and fleshy, and is sometimes cooked and eaten like a yam. The flowers are generally pollinated by insects, but these should be aided by artificial pollination in order to ensure a good crop of fruit. When the crop is over, the shoots should be cut well back, retaining only the stem and main branches. The plant is propagated by either seed or cuttings, and thrives up to about 3,000 ft. or higher. It should be trained over a fence or trellis-work, or allowed to climb against trees with low spreading branches.

Phyllanthus distichus. Otaheite-gooseberry; Star-gooseberry; Rata-nelli or Siri nelli, *S.* (*Euphorbiaceae*).—A shrub or small tree, with long graceful branches and feathery foliage, native of India and Malaya, often cultivated in low-country gardens in Ceylon. The pale green, round, faintly ribbed, acid fruit, has a hard kernel, and is commonly used for pickling and making a delicious preserve. A crop is produced twice a year, in April and August. Propagated by seed. Suited chiefly to the moist low-country.

P.—Emblica. Nel i, *S.*—A small tree or shrub, with graceful, feathery foliage, native of Ceylon, India, Malaya, China, etc.; commonly found wild in open patana land in Ceylon, up to about 3 000 ft., being also sometimes grown in gardens for ornament. The round green fruits, of the size of marbles, have a comparatively large kernel and are made into a much-esteemed preserve (see page 510). The fruit is collected from plants in the wild state when in season, chiefly from November to February, and usually sold at from 5 to 8 cts. per hundred.

Pouteria Cainito, see *Lucuma Cainito.*

Prosopis dulcis. Algaroba-, Cashaw-, or Mesquit-bean. (*Leguminosae*).—A deciduous thorny shrub or tree, 25-30 ft. high, with small bipinnate leaves, native of Central and South America. The sweetish succulent pods are edible, but used chiefly for feeding cattle. Suited only to arid districts. Propagated by seed. The tree has not yet become generally established in Ceylon. It has been successfully introduced into the Hawaiian Islands, where the wood is now a valuable source of fuel.

P.—pubescens (Tornilla or Screw-bean), and **P.—juliflora,** are small thorny trees of Mexico, &c., similar to the foregoing species. The latter is also known as "Mesquit Bean."

P.—spicigera A small tree resembling P. dulcis, native of Northern India, where the sweetish farinaceous pods form an article of food in time of scarcity, being eaten either raw, or boiled and flavoured with salt and onions, etc; they are also used as cattle food. Suited only to dry districts; not yet established in Ceylon. See *Fodder Plants*, p. 454.

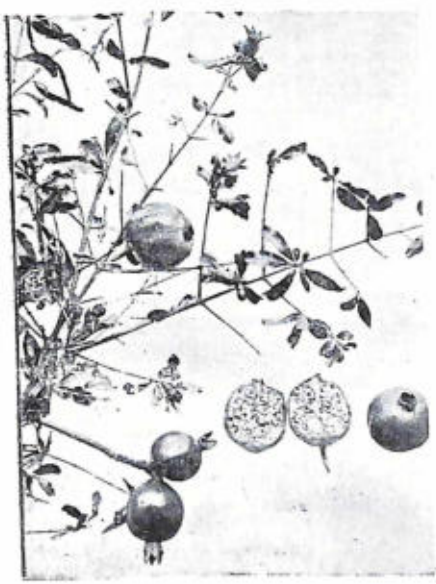
Psidium Guyava. Guava; Pera, *S*; Koiya-pallam, *T.* (*Myrtaceae*). A large spreading shrub or small tree, 10-15 ft. high, native of Trop. America. A wild form of Guava occurs in Ceylon as a common weed in waste ground, bearing small round berries, chiefly from November to January; these are pale yellow when ripe, and are sold in the



Psidium Guyava. GUAVA.

markets under the name of "Embul-pera" (sour guava), at about 6 to 10 cts. per hundred, being used for stewing and for making tarts or jelly. The best cultivated varieties have large juicy fruits, round or ovoid in shape, becoming lemon-yellow when ripe, with a reddish or yellowish pulp mixed with numerous small seeds, and are usually of a sharp tart flavour. The chief use of the fruit is for making the well-known guava jelly. Propagation is easily effected by seed or suckers, but budding or grafting should be resorted to for the best varieties. The tree thrives at all elevations up to 5,000 ft. or higher, and flourishes in ordinarily good soil.

Varieties.—Several varieties or species are known in cultivation. The "Pear-guava" bears a large, ovoid, succulent fruit, of the form of a lemon, with a smooth yellow rind and pale-green, scented pulp. "Kaffir-guava" is distinguished by a large warted and furrowed fruit, not unlike a citron in appearance. "Apple-guava" (*P. pomiferum*) is similar to the Pear guava, but differs in having a round fruit with reddish pulp. "Strawberry-guava" (*P. cattleianum*) has small, round, reddish-purple fruits, of a sweet tart flavour, suitable for dessert (see p. 282). "Guinea-guava" (*P. guineensis*), a native of Guinea, is described as a "fulvous berry, with red flesh, about the size of a nutmeg, of a pleasant flavour."



Punica granatum. POMEGRANATE.

Punica granatum. Pomegranate; Delun, *S*; Madalan-kai, *T.*—(*Lythraceae*). A small ornamental tree, with large scarlet flowers, native of Northern Africa and South Europe, commonly met with in gardens throughout the East, thriving especially near the sea, but also to some extent up to about 4,000 ft. elevation in dry districts. The fruit is of the size of a large apple, with a tough rind, of a bright red or orange-yellow colour when ripe, and crowned with the persistent calyx lobes. The succulent, juicy coating of the numerous seeds is of a sweet acid taste, sometimes very tart and astringent. In the tropics, the Pomegranate is seldom equal to what it is in its native home, and often contains merely a quantity of closely packed seed with a scanty, astringent juicy covering. Superior varieties are described as "almost seedless, very sweet, deliciously perfumed, and as large as an infant's head." The best fruits I have seen in Ceylon were grown near the sea-coast, in dry districts. Propagation is best by budding or grafting, though plants are easily raised from seed. "Flowering pomegranate" is a variety with large, double, scarlet flowers, cultivated only for ornament. See pages 73, 208. $.

Rheedia lateriflora. Wild Mammey. (*Guttiferae*).—A medium-sized tree of Trop. America and the West Indies, with large, leathery leaves, bearing round or

ovoid, yellow fruits of the size of small mangosteens. The whitish pulp around the seeds is sweetish-acid and edible. Introduced at Peradeniya in 1896. Season, July-August.

Sandoricum indicum. Santol. (*Sapindaceae*). A handsome lofty tree of Malaya, with large trifoliate leaves, producing in June and July large clusters of yellow globular fruits, not unlike small oranges at a distance. Like the Rambutan, the soft white aril covering the seeds (usually 5) is edible and of a sweetish-acid taste. Fermented and mixed with rice, an intoxicating drink is prepared from it in Malaya. Suited to hot and moist districts up to about 3,000 ft. §.

Sarcocephalus esculentus. Negro-peach; Rata-bakmi, *S.* (*Rubiaceae*). A robust semi-climbing or spreading shrub, native of West Trop. Africa, introduced at Peradeniya in 1883. The round, brownish, warty fruit, produced chiefly in July and August, is about the size of an apple; the soft, reddish, watery pulp is said to be edible, but is not eaten in Ceylon. See p. 463.



Sandoricum indicum. SANDORICUM.



Spondias mangifera. AMBARELLA.

Sideroxylon dulcificum Miraculous Fruit. (*Sapotaceae*). A tree of West Trop. Africa, with sweet-acid fruits of the size of large olives, said to have the effect of changing an acid taste to sweet.

Sorindeia madagascariensis. Manguiera-a-grappes. (*Anacardiaceae*).—A large tree of the mango family, with pinnate leaves, native of Madagascar, Zanzibar, and East Trop. Africa, sometimes cultivated for the sake of the fruit, which is ovoid in shape, about one inch long, and of a sweetish taste with a trace of turpentine flavour. Introduced at Peradeniya in 1911.

Spondias mangifera. Otaheite-apple; Hog Plum; Ambarella, *S.* (*Anacardiaceae*).—A small tree with handsome pinnate leaves, native of the Pacific Islands, etc., commonly grown in Ceylon, India, etc. The round or ovoid fruit is of the size of a small mango amber-coloured when ripe; it has a large

stone (seed), surrounded by coarse fibre and a scanty acid pulp, "with a flavour like that of an exceedingly bad mango." But it makes an excellent preserve, and some varieties are better than others. §

S.—tuberosa. "Imbu." A small tree, found in abundance on the dry plains of North Eastern Brazil. The roots are swollen or tuberous, hence the specific name. The ovoid fruit, about 1½ in. long, is eaten fresh, or made into jelly.

Telfairea pedata. Telfaria-nuts; "Mkewme." (*Cucurbitaceae*).—A climbing gourd with a slender woody stem, reaching a height of 50 to 60 ft., native of Zanzibar and East Trop. Africa. The fruit attains a size of 1½ to 2 ft. or more in length, and 8 to 10 inches in thickness, containing a large number of flat, nearly circular seeds, each about 1½ inches across. The latter are eaten, either fresh or roasted, and are said to be palatable. They contain about 36 per cent. of oil, said to be almost equal to olive oil. Propagation is by seed, which germinate within a week.

Terminalia Catappa. Country Almond; Kotamba, *S*; Kottai, *T.* (*Combretaceae*).—A handsome spreading tree, 40 to 50 feet high, with large leathery leaves, native of Malaya, commonly grown in Ceylon and most tropical countries. The fruit is of the size of a plum, slightly compressed on two sides, and contains a 1-seeded kernel (drupe), which is edible and not unlike an almond. Firminger considered this to be "beyond comparison the most delicious nut of any kind India affords." The tree is deciduous twice a year, and bears two crops of fruit annually before dropping its leaves, *i.e.* in June and November. Thrives from sea-level to about 3,000 ft. Propagated by seed. See page 105.

T,—Okari. Okari-nut.—A large handsome tree of Papua and New Britain, with large, fulvous, obovate leaves, bearing ovoid or obovoid fruit, about 7 in. long by 3 in. in diam., deep reddish purple when ripe. The large seed, surrounded by a fibrous shell, is about 3 in. long by ¾ in. in diam., and has a dark brown testa. In its native home the nut is * much relished by all classes, being eaten raw or cooked, and prepared in different ways. "Probably one of the finest of tropical nuts." Introduced at Peradeniya in 1922, through Mr. C. F. Hutchinson.

Trapa bicornis. Water Chestnut; Ikiliya, *S.* (*Onagraceae*). A low, aquatic, floating plant, common in the tanks of the dry region of Ceylon, also in Bengal, Malaya, Trop. Africa, etc. Firminger stated: "Much cultivated in many parts of India for its nuts." It does not seem, however, to be in any way cultivated in Ceylon, though the nuts are commonly collected and eaten by the poorer classes. The "nut" consists of the hard, two-horned, dark-brown or black fruit, resembling a miniature bull's head. The interior is said to be palatable when fried.

Triphasia Aurantiola. Chinese Lime; "Macanchi." (*Rutaceae*). A small spiny shrub, native of South China, semi-naturalised in parts of India. The small, red, berry-like fruit can hardly be considered edible, though in China it is made into a preserve. Makes a good barrier hedge.

Urceola esculenta. (*Apocynaceae*). A woody climber of Burma, producing an edible fruit, also a blue dye; introduced at Peradeniya in 1881.

Vangueria edulis. Voa-vanga. (*Rubiaceae*). A small shrubby, deciduous tree, native of Madagascar, producing an abundance of smooth, round, green fruits, of the size of a small apple, yellowish when ripe and of a sweetish-acid taste. Coolies and children relish the fruit when approaching ripeness. The large, shining, light-green



Vangueria edulis. VOA-VANGA.

* C.T. White, Government Botanist, Queensland.

leaves are said be to used in medicine in Madagascar. Suited to the moist low-country up to 3,000 ft. Propagated by seed or cuttings. $.

Zizyphus Jujuba. Jujube ; Masan, *S* (Portuguese) ; Ilantai, *T.* (*Rhamnaceae*). A small, thorny, spreading tree, native of Ceylon, India, Malaya, &c.; found chiefly in dry districts. The fruit, which is borne in great profusion, chiefly about November–January, is of the size of a large cherry, yellowish in colour, with a hard horny kernel. The pulp surrounding the latter is rather pleasantly acid in flavour, and in India is said to afford "a very nice dish when cooked with sugar." In Ceylon, however, the fruit is usually eaten only by children. When dry, the pulp becomes farinaceous and is used in China and parts of Africa for making meal and bread. Suited to rather arid districts. Several varieties are cultivated in India and China. Propagated by seed. See p. 417.

Z.—vulgaris. A small thorny tree, native of Syria and Levant, said to be "commonly grown about Calcutta and in most parts of India." The fruit is similar to the Jujube just described and, though edible, has little to recommend it.

ZOOLOGICAL GARDENS CALCUTTA.

CHAPTER XX.

SUB-TROPICAL OR TEMPERATE FRUITS

SUITED TO HIGH OR INTERMEDIATE ELEVATIONS.

See also Pages 509-512, *Recipes for Jams, Preserves, &c.*

Aberia caffra. (*Bixaceae*). Kei Apple.—A small thorny tree or tall shrub, native of the Cape and Natal. The fruit is of the form of a small apple, yellow when ripe, and very acid. It is made into a preserve and in an unripe state is used as a pickle. Established at Hakgala Gardens, Ceylon, since about 1880, but has only been known to fruit once, the climate being doubtless too wet for it.



Anona Cherimolia. CHERIMOYER.
1, section of fruit showing seed;
2, showing fruit.

Anona Cherimolia. (*Anonaceae*). Cherimoyer.—A small tree of Peru, &c., introduced into Ceylon about 1880. The large, green, round, oblong, or heart-shaped fruit, which has a pitted rind, is 3 to 5 inches in diameter, and weighs from 2 to 4 lb. It is a delicious fruit, somewhat resembling the Custard-apple of the same family, and is known in Covent Gardens Market, London, under that name, but it is far superior to the latter fruit. The Cherimoyer has been described as one of the three finest fruits in the world, the other two rivals being the Mangosteen and Pineapple. Dr. Lindley, however, considered that "one good Pear is worth all the Cherimoyers of Peru." §.

The tree is now cultivated in many up-country gardens in Ceylon, especially in the Uda-pussellawa district, where the fruit ripens chiefly in June-July and Oct.-December. In Madeira, the tree is grown on commercial lines, being propagated by grafting. It may also be raised from seed, but the best varieties have almost seedless

fruits. Cherimoyers are regularly imported from the Canary Is.ands into London, where they are often retailed at 1*s.* to 2*s.* each. The tree is best suited to the hill districts, preferring a rather dry climate, and thrives best on deep, rich, marly soil. "Quotemoyer" and "Atemoyer" are varieties which differ chiefly in the shape of the fruit, being oblong or ovoid.

Buchanania latifolia. "Cheronjee." (*Anacardiaceae*).A small tree about 30 ft. high, bearing simple, leathery leaves, native of the mountainous parts of Coromandel, Malabar, Mysore, etc. The pear-shaped kernels of the fruit are sometimes used as a substitute for almonds, being considered superior to the cashew-nut, and a fine oil is expressed from them. They are sometimes sold in the bazaars in India at 4 to 6 annas per lb. The tree is not



Carica candamarcensis. MOUNTAIN PAPAW.
1, fruit cluster ; 2, section of fruit.



Carica candamarcensis.
GROWING IN A WILD STATE AT HAKGALA, CEYLON.

known in Ceylon ; but a close ally, *B. angustifolia*, is indigenous here, though its fruit does not appear to be eaten.

Carica candamarcensis. (*Passifloraceae*). Mountain Papaw.—A small semi-herbaceous tree with a crown of large, coarse, palmate leaves, native of Colombia and Ecuador, similar to the Papaw of the low-country, but with fruit only a fraction the size of the latter ; introduced at Hakgala Gardens, Ceylon, in 1880, and now commonly grown in hill gardens, being often found in a semi-naturalised state near up-country bungalows. The ovoid green fruit is characterized by longitudinal ridges, and is in season all the year round. Though too acid to be used for dessert, it is very agreeable when stewed, and can also be made into jam and preserves. When ripe, the fruit has a pleasant apple-like odour. Propagated by seed. See also pp. 235, 274. §.

Carya oliviformis. (*Juglandaceae*). Hickory; Pecan- or Pican-nut.—A handsome, erect tree, attaining a height of about 70 feet, native of Texas, etc. The delicious nuts are much esteemed and form an article of trade in the Southern United States.

There are several varieties in cultivation. The tree, which is also noted for its tough elastic timber, has not as yet been established at Hakgala Gardens, nor apparently in Indian hill gardens, with the exception possibly of " one or two varieties under trial at Saharanpur Botanic Gardens. " It requires a rather dry, temperate or sub-tropical climate.

Casimiroa edulis. (*Aurantiaceae*, Orange family). Sapote, or White Sapote ; Mexican Apple.—A medium-sized tree of Mexico and the highlands of Guatemala, characterized by large palmate leaves (each divided into 5 leaflets), and greenish flowers borne in racemes. The fruit of the best varieties is edible, being of the form of a medium-sized apple, and is considered by some to have an agreeable flavour. The seeds are comparatively large and are considered poisonous; these as well as the bark and leaves are used medicinally in Mexico, &c. The tree was introduced at Peradeniya in 1889, but has not yet fruited here. Its requirements are sub-tropical.

Castanea chinensis. (*Cupuliferae*). Chinese Chestnut.—This tree bears a superior nut, but has not been found suited to the hill districts of Ceylon, and is reported to have failed similarly in India. The most likely conditions for it in Ceylon are found in the drier climate of Uva, at 3,000 to 4,000 feet elevation. Plants could be obtained through the Yokohama Nursery Coy., Yokohama, Japan.

C.—vesca. Spanish Chestnut.—A handsome tree, lately introduced, though not yet well established, at Hakgala and certain other hill gardens in Ceylon. It is commonly grown on the hills of Northern India, where it produces in March and April panicles of lavender-coloured blossom, the fruit following in May and June. It does not appear to have yet fruited in Ceylon.

Cerasus (Prunus) vulgaris. (*Rosaceae*). Cherry.—A species of Cherry (*Prunus puddum*) grows freely at Nuwara Eliya, Ceylon, and flowers abundantly in January and February, but does not fruit. Every attempt to cultivate the Cherry on the Plains has proved a failure. According to Cameron, however, it can be grown successfully on the hills, though this probably refers to flowering-cherries. Certain species of Cherry indigenous to Northern India yield fruit suitable for making tarts.

Ceratonia Siliqua. (*Leguminosae*). Locust-or Carob-bean ; St. John's Bread ; Algaroba of Spain—A small tree, native of South Europe, extensively cultivated in the Mediterranean region for its sweet, sugary, flat pods ; the latter are from 6-10 inches long, nearly 1 inch broad, dark brown in colour, and form a considerable article of export in the countries named. Being rich in sugar, they are a valuable, fattening and nutritious food for cattle, but are also eaten and relished by human beings. The tree is a slow grower and of great longevity, continuing " productive for over 100 years." It is in its prime between 18 and 40 years old, when a single tree may produce as much as 2 or 3 cwt. of fruit a year.

Efforts have been made to establish the tree in Ceylon ; but although specimens have for several years been growing at Anuradhapura and in some up-country gardens, none has yet borne fruit worth speaking of. It is commonly grown or semi-naturalised in parts of Northern India, and is being established in Queensland, S. United States, S. Africa, &c. The tree is frequently unisexual, so that plants raised from seed are often unproductive. Therefore the usual method of propagation is by cuttings.

Citrus Aurantium. (*Rutaceae*). Orange.—See page 236.

C.—Limonum. Lemon ; Natran, *S* ; Kidanar-attankai, *T*.—This small-sized tree, native of Northern India, is extensively cultivated in Southern Europe, especially in Sicily and Spain, and more recently in California, for its well-known, acid, juicy fruit, which is usually ovoid in shape and pale-yellow when ripe.

The tree grows freely at medium and high elevations in Ceylon, but the fruit produced here is invariably coarse and pithy, with a thick warty rind, and can seldom compare with the lemons of temperate countries. The long straggling branches which the tree is liable to throw out should be cut back, in order to encourage the production of fruit-producing lateral shoots. Lemon fruits are very largely used for flavouring in confectionery and in the preparation of beverages, etc. The rind yields a valuable essential oil, and is also argely used for making candied lemon peel. The tree requires similar conditions of climate and soil to the Orange (see page 236). Propagation is by budding or layering, but plants are easily raised from seed. Well known varieties are *Eureka* and *Spanish*.

C.—medica, var. Citron; Cidran, *S*.—A small tree, much cultivated in Southern Europe and the Mediterranean region for its large, spherical fruit, which is usually about 4 to 6 inches in diameter (sometimes nearly double that size), being round or ovoid in shape, according to variety. The "Fingered Citron" resembles a man's hand, with the fingers bent up as with cramp. The thick rind is the part used, this being prepared in brine, preserved in sugar, and largely employed in confectionery, preserves, marmalade, etc. Citrons are not commonly cultivated in the tropics, though good fruits may occasionally be met with in hill gardens. The leaves of Citron are distinguished from those of other species of Citrus by not having the petiole distinctly winged. Propagated by seed, budding, or layering.

C.—Bigaradia (C. vulgaris). Seville-, Bitter-, or Marmalade-orange. A hardy, prolific orange with large, well-formed fruits, bright orange-yellow when ripe. Thrives and bears well from 4,000 to 5,500 feet in Ceylon, the cropping period extending from August to March. See pp. 238, 398.

Crataegus stipulosa. (*Rosaceae*). Manzanilla.—A small tree of Guatemala, bearing small, apple-like fruits, yellow when ripe, used for making tarts and preserves, also for decorative purposes.

Cyphomandra betacea. (*Solanaceae*). Tree Tomato ; Vegetable Mercury ; Gas-Takkali, *S*. —An evergreen, semi-woody shrub or small tree, native of Peru, introduced into Ceylon in 1882. It has become thoroughly established in many hill gardens, and is commonly grown about Nuwara Eliya for market purposes. The egg-shaped and smooth-skinned fruit, produced in great abundance, in hanging clusters towards the ends of the branches, is in season almost throughout the year, but chiefly from March to May. At first greenish purple, it changes in ripening to reddish yellow. In the purple-fruited variety the fruit becomes a deep purple when ripe. The sub-acid succulent fruits are refreshing and agreeable when eaten raw, but their chief use is for stewing ; they may also be made into jam, &c. The tree is a quick-grower, and commences

to bear fruit when 1½ to 2 years old, continuing productive for several years. Thrives best on deep soil, and is propagated by seed or cuttings. S.



Cyphomandra betacea. TREE TOMATO.

Diospyros Kaki. (*Ebenaceae*). Persimmon; Kaki or Date-plum.—A medium-sized, slow-growing tree with large, handsome, ovate or cordate leaves, native of China and Japan. The attractive, shining, smooth fruit is usually a bright orange-yellow when ripe, sometimes pink or dark-purple. It is globular or pear-shaped, usually about 3 inches or more in diameter, containing two almond-like seeds in the centre, but some varieties are seedless. When perfectly ripe, or even slightly over-ripe, it has an agreeable flavour, being compared to an apricot with a suspicion of the medlar, or to an over-ripe apple. In a less ripened state it is, in its native country, made into a well-known preserve. Dried kaki fruits are said to be almost equal to dried figs. The tree thrives in the Riviera, whence excellent fruits are imported into London, these being sold in Covent Garden market at fancy prices. It also thrives and sometimes bears abundantly in parts of India, as at Calcutta, Saharanpur, etc., but has not yet done well in Ceylon. It was first introduced at Hakgala Gardens in 1888, and occasionally bears fruit there, but the wet climate is apparently against it. The Persimmon is usually dioecious, so that it is necessary to have a male tree in the neighbourhood of a pistillate tree to ensure fertilization of the flowers of the latter.

Feijoa sellowiana. (*Myrtaceae*). Feijoa (Fay-zho-a) or "Pineapple Guava."—A shrub or small bushy tree, 10-15 ft. high, native of sub-tropical South America, recently introduced into cultivation. It is closely allied to the common guava, and resembles the latter in the fruit.

In California it is considered a valuable addition to the fruits of that country, being described as "delicious in flavour, not unlike that of the strawberry." The fruit is ovoid in shape, 2-2½ inches long, rather fragrant, and is in season chiefly in November. "It can be used either raw, stewed, crystallized, or made into jam or jelly." The seeds are very small, like those of guava.

Ficus Carica. (*Urticaceae*). Fig.—A small spreading, deciduous, shrubby tree with large leaves, native of Turkey and the Mediterranean region, where it is extensively grown for the fruits. Fig trees often grow moderately well and set fruit in up-country gardens in Ceylon, but owing to the South-west monsoon rains setting in when the trees are in bearing, the fruit seldom ripens well;

in fine weather, however, a few fruits occasionally ripen, though these are generally lacking in flavour. FIRMINGER said : " In most parts of India, Fig trees are to be met with thriving vigorously and bearing fruit abundantly," but this needs qualification and probably refers to the plains, for CAMERON says he has " not seen the Fig under cultivation in the hills of India."

The Fig thrives in dry, arid localities, requiring no shade and but little moisture, the essential conditions being good drainage, a rich porous soil, and a hot dry season for ripening the fruit. Thus in the drier parts of Uva, in Ceylon, Fig trees have been found to ripen fairly good fruits. The trees should be sheltered from strong wind. In their native country, they usually thrive best in an enclosed yard, with their roots confined to a limited space. In Greece, the average yield of a Fig orchard is said to be about 2,000 lb. of fruit per acre.

The " Smyrna-fig." which is dependent for its pollination on a small wasp (see p. 471), which carries pollen to it from the *Capri* fig, is the best kind. Other varieties in cultivation are : *Golden fig*, *Purple fig*, *White Adriatic*, *Black Ischia*, etc. The last two named have been found the most approaching to success at Nuwara Eliya. The Fig is easily propagated by cuttings, which travel well by post.

Fragaria vesca. (*Rosaceae*). Strawberry—A low, herbaceous, creeping perennial, producing "runners," by which the plant is readily propagated. A species of wild Strawberry (*F. nilgerrensis*) is indigenous to the hills of South India. This is probably identical with the Wild Strawberry found occasionally in patches at the higher elevations in Ceylon, especially about Hakgala and Nuwara Eliya, though in the opinion of TRIMEN the latter is an escape from cultivation. Cultivated strawberries are grown in many up-country gardens, sometimes producing a crop of very fair quality, though the fruit is generally lacking in flavour. At Bangalore, and other hill stations in India with a fairly dry climate, excellent crops of large strawberries are grown. The plants, planted in rows about 18 inches apart, with 12 inches between the plants in the row. should be renewed once in two years and given a change of soil, The latter must be well-drained, rich, and porous. *Crescent Seedling*, *Royal Sovereign*, *Veitch's Perfection*, *Sunbeam*, *President*, and *Melba* are among the best varieties.

Juglans regia. (*Juglandaceae*). Walnut.—The Walnut tree, a native of Europe and Northern Asia, is commonly cultivated on the hills of Northern India, where it produces abundant crops. It is not, however, a success on the Plains, nor on the hills of Southern India. It has been tried without success at Nuwara Eliya and in Hakgala Gardens, Ceylon. Walnuts are grown commercially in California.

Morus indica. (*Urticaceae*). Indian Mulberry.—A small quick-growing tree, native of Northern India, where it is commonly cultivated. The fruit resembles a small, red pepper-corn, cylindrical in shape, rather deficient in flavour, and quite inferior to the European mulberry.

The Indian mulberry is commonly grown in Ceylon at medium and high elevations, but birds usually take most of the crop. The fruit, when obtainable, makes pleasant stews and tarts. Its cultivation in Ceylon villages was encouraged some years ago for the purpose of affording food, by means of its leaves, to the mulberry silk-worm. Easily propagated by cuttings. See *Sericulture*, p. 434.

M.—nigra. European Mulberry.—A native of Persia, introduced and established at Hakgala and some othe up-country gardens, though seldom fruitful here. Occasionally, however, specimens bear well in the drier parts of Uva, about

5,000 ft. The same remarks apply to the White Mulberry. According to FIRMINGER, "the mulberry fruit, such as it is, ripens in February in Bengal, but it is fit for little but to be left to the birds."

Loganberry.—A Bramble-like plant, supposed to be a natural hybrid between the Blackberry and Raspberry, bearing large, dark red, raspberry-like fruits, which are juicy and sweet. It does not appear to have yet been established in the tropics, being apparently suited only to cool temperate conditions.

Nephelium Litchi, see page 247.

Olea Europea. (*Oleaceae*). Olive.—A small tree, native of North-western Asia, naturalised and extensively cultivated in the Mediterranean region; also largely grown in Northern Africa, California, etc., both for the fruit, which is largely used in preserves and pickles, as well as for the extraction of the valuable and well-known olive oil. Plants have been introduced into Ceylon, and grown for many years without producing a crop, except an odd fruit occasionally. Olives have not been found suited to the hills of S. India, and even in the dry climate of Bangalore trees 30-40 years old have remained unproductive, but in California, Australia, S. Africa, and N. India they have been successfully established. A good crop should produce an average of about 2,000 lb. of fruit per acre, yielding 600 gallons of oil.

The tree is susceptible to either a very hot or very cold climate, and thrives best under dry, sub-tropical conditions, in light soil of a limestone formation. Where found to thrive, it makes a good hedge plant. There are numerous varieties in cultivation, differing in the lateness or earliness of the crop, and in the shape, size, and quality of the fruit; the latter varies from round to ovoid, and from ¾ to 1 inch in diameter. Propagated from seed, cuttings, layers, or suckers. The spacing usually recommended for planting is about 20 ft. each way. The trees normally take about 7 to 8 years to come well into bearing.

Passiflora edulis. (*Passiflor-aceae*). Passion-fruit; Sweet-cup.—A perennial climber, native of Southern Brazil, introduced into Ceylon and commonly cultivated up-country for the fruit. As an escape from cultivation, it may often be met with in a wild state at elevations of 3,000 to 5,000 feet. It bears in great abundance a smooth, ovoid fruit of the size of a hen's egg, purple when ripe, the rind afterwards shrinking and becoming much wrinkled. Two crops a year are sometimes produced, the principal season being from May to July. The fruit contains in its hollow centre a quantity of fragrant, sweet, juicy pulp, inseparable from which are the small seeds; this, when emptied out of the shell and beaten up in



Passiflora edulis PASSION-FRUIT.

a glass with a pinch of bicarbonate of soda and sugar, makes a delicious drink; resembling the sweet-cup of the West Indies.

The fruit is sold locally at about Re. 1 (1*s.* 4*d.*) per hundred. Consignments of the fruit are occasionally exported from Australia and elsewhere to London, and these usually secure fancy prices, but the shrivelled appearance which the fruit assumes on ripening is against it for market purposes. The Passion-fruit may be cultivated successfully from 2,000 ft. upwards, and should be trained over a fence or trellis-work, or allowed to climb over trees, etc. Rich humous soil and a moist, sheltered situation suit it best. Propagated by seed. See p. 189. $.

Persica vulgaris. Peach. See p. 249.

Photinia (Eriobotrya) japonica. Loquat. See p. 249.



Physalis peruviana. CAPE GOOSEBERRY.

Physalis peruviana. (*Solanaceae*). Cape Gooseberry; Peruvian Cherry; Tippari.—A low, straggling or creeping herbaceous perennial, native of Peru, naturalised at the Cape and to some extent in the hill districts of Ceylon, India, &c. The fruit is of the size and form of a small cherry, concealed in the dry, leafy, persistent calyx. When quite ripe it is yellow and of an agreeable and refreshing flavour, being used for dessert or for making jam or preserves. In South Africa it is largely made into a delicious jam, which forms an article of export there. See *Recipes for Jams*, p. 509. The plant is easily raised from seed, and will thrive in any ordinarily good soil, but is most productive on rich sandy loam. Sow seed on a sheltered bed, and plant out seedlings in rows 3 feet apart, with about 18 inches between the plants in the row. Stakes or trellis-work shouldbe provided for support, or the plants may be allowed to run over rocks, &c. Suited to elevations of 2,000, 5,000 ft. or higher.

Pistacia vera. (*Anacardiaceae*). Pistachio-nut.—A small tree, reaching about 30 feet in height, considered to be indigenous to Syria, cultivated in Northern India, Florida, etc., for its delicious nut, which is eaten as a dessert, or prepared and used in various ways. During the cold weather in India these nuts, being brought from Cabul by Afghan traders, are said to be obtainable in great abundance in the bazaars, so that travellers often take them to be a product of the country. In Ceylon, however, the nuts appear to be an unknown commodity. The tree might thrive to some extent at moderate elevations in the drier parts of the Uva Province, and at corresponding elevations in other countries.

Prunus Armeniaca. (*Rosaceae*). Apricot.—The cultivation of this delicious fruit in Ceylon has so far been nowhere successful, nor does it seem to have been attended with much better results elsewhere in the tropics. The tree, however, grows with vigour in the hills in India, where it is sometimes propagated by budding or grafting, which is done in April or May.

P.—domestica. Plum.—A small deciduous tree, whose native country is uncertain. In Ceylon, as in other parts of the tropics, the plum has so far not been found to bear well. Certain varieties occasionally produce light crops about Nuwara Eliya ; but the fruit seldom ripens satisfactorily, as the monsoon rains usually commence when it is approaching maturity. In India, however, on the hills and in the Northern Provinces, plums are grown with a greater measure of success, though the fruit is "hardly palatable, except when cooked or preserved." CAMERON says : "Of many kinds tried at Bangalore, *Kirk's Blue*, *Greengage*, and *Golden Drop* have been reported to thrive best." At Nuwara Eiya, Mr. COTTON found *Red-heart* (a cooking variety), *Alucha*, and *Greengage* to give the best results, while at Hakgala and Albion the *Hedge-plum* has been found to do fairly well (elevation about 5,000 ft.). Cultivation similar to that of the Peach.

P.—Bokhariensis. Bokhara Plum.—A species of Plum indigenous to Northern India. According to FIRMINGER, "quantities of the fruit in a dried state are annually brought down from Cabul. The tree grows vigorously in the Upper Provinces and is very common in gardens in the Punjab, where it bears abundantly." CAMERON adds that it is also successfully cultivated on the hills in S. India, the fruit being made into a good preserve, or stewed.

P.—Capollin and **P.—salicifolia.** Small slender, erect trees of Trop. S. America, the fruits of which, known as Capulin, resemble cherries and are relished in their native habitat.

P.—Persica (Persica vulgaris). Peach.—A small slender tree, supposed to be indigenous to China. The Peach in the tropics is, at best, very different to the large, luscious, melting fruit it is in Europe and other temperate countries. Acclimatized varieties are, however, grown with appreciable success in certain localities in Ceylon at elevations of 4,000 to 5,000 feet. In a rather dry climate, as in the district of Wilson Bungalow, moderately good fruits, at any rate for stewing and making jam, are obtained. Here inferior peaches are often grown for the local market. No systematic cultivation, however, is followed, the trees being propagated by cuttings, with but little regard for selection, manuring, etc. Peaches will not thrive at low elevations in the tropics.

At Bangalore, CAMERON mentions "an excellent variety" called *Indore*, and states : "It is a great point in the cultivation of the Peach tree to keep the roots as little below the surface of the soil as possible. This is sometimes effected by placing tiles underneath where the trees are planted." The tree may be propagated by sowing the stones (kernels) of the fruit, but is best raised by cuttings (from fruiting branches), budding, or grafting. Seedling plants take three or four years to come into bearing. A good plan is to raise seedlings, and bud or graft the best sorts on these when about a year old. Among the best varieties are : *Royal George*, *Estella*, *Florida Gem*, *Imperial*, *Peen-to* ("*Flat Peach*" of China), *Shackleford*, &c.

Psidium cattleianum. (*Myrtaceae*). China-, Purple-, Strawberry-, or Calcutta-guava.—A small, shrubby, ornamental tree, 20 to 25 feet high, with smooth, grey bark and small, leathery, shining, obovate leaves, native of Trop. America. The date of its introduction into Ceylon is not recorded, but that of its first discovery is given as 1818. It has been grown at Peradeniya and Hakgala Gardens since about 1870, and is now sometimes met with in up-country gardens. CAMERON does not mention it for South India, which is remarkable considering its good qualities.

The fruit is probably the most palatable of all the guavas, and deserves to be more widely known. It is of the size of a large greengage, deep claret-coloured when ripe, with soft, juicy, purplish red pulp, which has an agreeable flavour, somewhat suggesting that of a strawberry. It is excellent for making tarts, jam, or jelly, and may also be relished raw. The tree thrives and bears fruit freely at elevations of 2,000 to 5,000 feet, producing two crops a year. With good cultivation, the size and quality of the fruit is considerably improved. Usually propagated by seed, but the best trees should be increased by layering or budding. S.



Psidium cattleianum. PURPLE GUAVA.

Pyrus communis. (*Rosaceae*). Pear.—Certain varieties of Pear grow and bear well in many parts of the tropics, at medium elevations and on the hills, but the fruit produced is usually hard, woody, and lacking in flavour. In many hill gardens in Ceylon, a variety of cooking pear has become well established, thriving with but scanty attention and producing, during February-April, fairly heavy crops of large, coarse fruits, which can only be eaten when stewed with a liberal addition of sugar. Cameron, however, states: "At Simla and other hill stations in India, the Pear can be brought to great perfection under cultivation," and advises pruning the trees in February, just before they burst into leaf. In Ceylon the trees are practically evergreen; they are propagated by cuttings, layering, or grafting, and like rich loamy soil.

P.—Malus. Apple.—The cultivation of the Apple has at different times been tried in Ceylon, more especially in the vicinity of Nuwara Eliya, Hakgala, and Bandarawela, but so far has met with little success, the climate being apparently quite unsuited to the tree. On the hills in India, according to CAMERON, "apples can be cultivated to perfection," though all the samples the writer has seen from Bangalore and other parts of S. India have been hard and lacking in flavour. In Cashmere and other parts of Northern India, however, apples of the finest quality are grown, including *Worcester Permain, Ribston Pippin, Kentish Fillbasket, Golden Russet, Blenheim,* &c.

The tree is propagated by cuttings, layering, or grafting, and a rich, sandy loam suits it best. In India, it flowers in February and March, and the fruit ripens in May and June. The roots are laid bare in January, and after an interval of a fortnight, are again covered with a mixture of cow-manure and good soil. Copious watering is given at the root when the fruit is swelling.

Rhodomyrtus tomentosus. (*Myrtaceae*). Hill-gooseberry; Hill-guava.—A handsome shrub with small, thick, oval leaves, indigenous to the mountain regions of Ceylon, South India, and Malaya. It produces a profusion of pale pink flowers, followed by small round berries of pale yellow colour; from these a jelly is made, which in flavour somewhat resembles apple-jelly. Propagated from seed. Not suited to low elevations, but an acclimatized variety thrives at Peradeniya (1,500 ft.), where, as an ornamental shrub, it is much admired; this seldom, however, bears fruit here. See p. 116.

Ribes grossularia. (*Saxifrageae*). Gooseberry.—Plants of this small, spiny bush have been imported both from England and Australia, and planted under the most favourable conditions available in the Experiment Garden at Nuwara Eliya, as well as at Hakgala Gardens, Ceylon. They grew for a time, but failed in each case to become properly established. The climate of the tropics in general is, apparently, equally unsuited to the plant.

R.—nigrum. Black Currant.—The same remarks as under Gooseberry may be applied.

Rubus lasiocarpus. (*Rosaceae*). Ceylon-, or Wild-Raspberry.—A large, straggling bramble, characterised by a white down which entirely covers the stems, indigenous to the hills of Ceylon, India, and Java. The fruit rather resembles the Raspberry proper, but unless well-grown it has very little flavour. Its hoary, woolly appearance is, however, against it. In India it is said to be frequently collected and made into delicious tarts, and is in great demand at Simla and other hill stations for making jam. The plant likes deep, rich soil, and should be trained on a fence. Propagated by seed or by suckers dug up during the rains.

R.—macrocarpus. "Ceylon Blackberry." A very hairy, prickly bramble, commom at medium and high elevations in Ceylon. The large, dull purplish-red or bright-red fruits are juicy and when quite ripe have a good flavour.

R.—rosaefolius. "Mauritius Raspberry."—A shrub, considered to have been introduced from Mauritius, said to be commonly grown in gardens about Calcutta. The fruit produced in February, is similar in appearance to the Raspberry, but, being filled with hard seeds, has, according to FIRMINGER, no better flavour than a bad blackberry. HOOKER gives this as an indigenous species for India.

R.—Idaeus. Raspberry.—This has been tried at Hakgala and Nuwara Eliya Gardens, but found quite unsuited to the climate. The same remarks as under Gooseberry may be applied.

R.—trivialis. American Dewberry.—I am not aware that this has been tried in Ceylon; it has been reported to grow vigorously and bear fruit well at Saharanpur, India.

Vaccinium meridionale. (*Vacciniaceae*, Cranberry order). "Jamaica Mulberry."—This is of the size of a Black-currant and is used in Jamaica for making tarts, jam, and jelly. Other species which yield edible fruits are the "Cowberry" (*V.—Vitis-idaea*) and Whortleberry (*V.—myrtillus*). The "Cranberry" is produced by *Oxycoccus palustris* and *O.—macrocarpus*, the latter being a Canadian species.

Vitis vinifera. Grape Vine. See page 250.

CHAPTER XXI.

TROPICAL VEGETABLES AND FOOD PRODUCTS

SUITABLE FOR LOW OR MEDIUM ELEVATIONS.

Vegetables of one kind or another can, with a little trouble, be grown in all parts of the tropics where any other cultivation is possible. While certain temperate vegetables, such as Beetroot, Celery, Leeks, Carrots, Parsnips, Cabbages, Globe-artichokes, etc., thrive to perfection in the cool moist climate of the higher elevations, several of these may also be grown at lower altitudes, or even at sea-level, with some degree of success, if sown at suitable seasons and supplied with the proper amount of moisture and shade. Tropical vegetables are, of course, suited chiefly to low or intermediate elevations, and many of these are well worth cultivating, as may be seen from the following selections and descriptive notes.

A deep alluvial soil, such as is sometimes found on flat low-lying land or near river banks, is the best for vegetables generally. Where this does not exist, a condition approaching it may usually be attained by the application of humus, organic manure, sand, and lime. See p. 20. A loose, sandy soil is essential for deep-rooting vegetables, such as carrots, parsnips, etc. Frequent stirring of the soil, weeding, watering, and earthing up when necessary, are indispensable to the successful cultivation of vegetables generally. At low elevations, light shade from the noon sun, especially for temperate kinds, is usually beneficial; whilst shelter from strong winds is indispensable.

An application of suitable fertilisers (see pages 17-24) is usually amply repaid, not only by a larger yield but also by a better quality of crop, whilst liming the ground (see pp. 20, 495) periodically is essential. Root-crops generally are benefited by a potash fertiliser, and the following mixture may be generally recommended: kainit, 3 parts; superphosphate, 3 parts; sulphate of ammonia, 3 parts; mix well together just before use and apply about 3-4 oz. of the mixture per square yard.

For convenience of reference the following are grouped thus:

(1)—*BEANS, GRAMS, AND PULSES.* (LEGUMINOSAE.)

(2)—*GOURDS, PUMPKINS, &c.* (CUCURBITACEAE).

(3)—*ROOT-OR TUBEROUS VEGETABLES.*

(4)—*MISCELLANEOUS VEGETABLES AND FOOD CROPS.*

(5)—*CEREALS OR DRY GRAINS COMMONLY CULTIVATED IN THE TROPICS.*

(6)—*COMPOSITION OF PULSES, DRY GRAINS, &c.*

(7)—*EDIBLE FLOWERS OF THE TROPICS.*

(8)—*EDIBLE HERBS, &c., COMMONLY USED AS FOOD IN CEYLON.*

(1).—BEANS, GRAMS, AND PULSES.

(*LEGUMINOSAE*).

Cajanus indicus. Pigeon Pea ; Congo-bean ; Red-gram ; Dhal or Dhol ; Rata-tora, *S* ; Thovaroy or Paripu, *T*.—A perennial shrub, 6 to 8 feet high, with thin wiry branches and narrow trifoliate leaves, native of India ; commonly cultivated in most tropical countries, more especially in India, where the dark grey or yellow seeds, of the size of small peas, are almost a universal article of food. The latter, dried and split, are largely imported into Ceylon and much used in curries, vegetable soups, etc., being everywhere sold in the boutiques as "paripu." The plant resists drought well, and is recommended as a restorative crop in rotations. In India, it is grown either mixed with other crops, or as a pure crop, being planted in rows, about 5 ft. × 4 ft. About 6 lbs. of seed is required to sow an acre, and the crop is ready for picking in about 6-7 months from the time of sowing. It may be had in bearing almost throughout the year, but the bushes should be cut back periodically and well manured. Grown alone, the average crop may be about 500 to 600 lb. of seed per acre, or mixed with other crops 200-300 lb. Not largely cultivated in Ceylon. A variety recently introduced from India has large pods, 3 to 4 in. long, with comparatively large, yellow seeds. The plant is cultivated in parts of India as food for the Lac insect. See pages 310, 417.



SWORD BEAN.
Canavalia ensiformis.

DWARF LIMA BEAN.
Phaseolus lunatus, var.

Canavalia ensiformis. Sword-, Jack-, or Horse-bean ; Awara, *S* ; Awarakai, *T*.—A robust, woody, perennial, climbing bean, bearing large

coarse, rather flat, sword-shaped pods, 10-12 in. long or more, by about 1¼ to 1½ in. broad, containing large, white seeds. In the young and tender state the pods may be sliced, boiled, and used as a vegetable. The tender seeds may be peeled and used as broad-beans. The plant requires strong and durable supports, such as a fence or a low spreading tree. S.

C.—ensiformis, var. nana. Gotani-bean of E. Africa.—A bush variety, 2 to 2½ ft. high, bearing numerous pods similar to those of the climbing form. Seeds may be sown in rows 2½ ft. × 2½ ft. apart, say at the rate of about 25 lb. per acre. A crop is produced in 3 to 5 months, yielding at least 20 to 25 bushels (500-600 lbs.) of seed per acre.

Cicer arietinum. Chick Pea ; Bengal- or Common Gram ; Kondakadala, *S.*—An annual, about 1 ft. high, much cultivated in India as a food crop. The small, pea-like, angular seeds are largely imported into Ceylon and sold in the boutiques, being used either fried and roasted or boiled in curries, and are considered very nutritious. Roasted and ground, they are sometimes used as a substitute for coffee. The crop is sown broadcast or in drills, the former at the rate of about 30 lbs. to the acre. A yield of 500-650 lbs. per acre is usually obtained.



CLUSTER BEAN.
Cyamopsis psoralioides.

Cyamopsis psoralioides. Guar- or Cluster-bean; Kotaranga, *S.* or *T.* —A bushy plant, 2 to 3 ft. high, commonly cultivated in India, and sometimes in Ceylon and elsewhere, as a food-crop. The small, straight, hairy pods, about 3 inches long, produced in clusters, are popular as a vegetable in curries , etc; but they are rather fibrous and must be used in a young state. The ripe seeds, which are black, white, or grey, are also eaten. Some tall varieties are cultivated for fodder or for green manuring. See p. 310 S.

Dolichos bracteata. El-dhambala, *S.*—A climbing bean, bearing purplish flowers and narrow, well-filled pods, about 3 inches long, which when tender are boiled and eaten.

Dolichos Lablab, var. Bonavist-bean ; Ho-dhambala or Irivija, *S* ; Motchai, *T.*—A strong-growing climbing bean, producing flat, broad pods with warted or wavy margins, 4 to 5 inches long, which when young and tender are boiled and eaten, as are also the seeds when immature. The plant is often seen cultivated in cooly gardens in Ceylon. It occurs in several varieties with white, pink, or purplish flowers and white or reddish seeds. "Sudu-dhambala" of Ceylon has white flowers and short, broad pods, containing 2 to 3 white seeds each. A bush form, about 2-3 feet high, is best suited for cultivation. See p. 310.

Dolichos biflorus. Madras-gram ; Horse-gram; Kollu, *S.* and *T.*—A semi-erect annual, about 2 to 3 ft. high, with small trifoliate leaves, bearing narrow, curved pods, 2 to 3 in. long. It is grown somewhat extensively in India, either as a food or fodder crop, or as a green-manure for ploughing into the soil. The plant is suited to a dry climate, and is commonly grown in Ceylon in dry localities. See pp. 26, 310.

Glycine hispida. Soya-bean.—An erect annual, varying in height, according to variety and soil, usually from about 1½ to 2 ft., though sometimes reaching 4 to 5 feet or more ; native of China and Japan, where it has been cultivated for food from time immemorial. It is also extensively grown in Manchuria, Eastern Bengal, Burma, &c. The short, hairy pods contain 2 to 4 seeds each; the latter are a nutritious food and a standard article of diet in the home of the plant, being next in importance to rice. The smooth pea-like seeds (" beans ") vary from white to yellow and black, and are cooked and prepared for food in numerous ways, being boiled, roasted, or ground into flour. They contain little or no starch, and are recommended as a diet for diabetic patients. In America and on the Continent, they are sometimes used for adulterating coffee. In India, they are used in the same way as " dhal." The famous soya-sauce, said to be the basis of many popular sauces made in Europe, etc., is made from the seeds. A useful domestic oil is also obtained from them, and the residual cake resulting from the expression of the oil forms a nutritious cattle-food. See pp. 310, 397. §.



SOYA BEAN. *Glycine hispida.*

The seed is largely exported from Manchuria, more especially to England, for the sake of the oil used for soap-making, &c. Cultivation is simple. A loose rich soil is preferable. Seeds may be sown thinly in rows about 1½ to 2 ft. apart, or wider according to variety; or they may be sown thinly broadcast, about 2 bushels being thus required to sow an acre. The seed should germinate in 4 to 5 days, and the crop may be ready for picking in 6 weeks to 2 months from the time of sowing. The yield varies according to variety, soil, climate, etc., about 22 bushels seed per acre being considered a good average return. The crop has been grown at different times at Peradeniya on a small scale ; but it does not appear to be suited to the tropics, being more adapted to warm temperate or sub-tropical conditions. There are several varieties, these varying in size of plant and colour of seed. The yellow-seeded kinds

are considered the best suited to a hot climate. Tall-growing varieties are cultivated for fodder, yielding 8 to 10 tons of the latter per acre. $.

Ground-nuts. See page 302, &c.

Lens esculenta (=*Ervum lens*). Lentils; Misurupur, *T.*—A low, bushy annual, 14 to 18 in. high, cultivated for food from time immemorial. Lentils are to this day an important article of diet to the inhabitants of Egypt, Palestine, and the Mediterranean region, and are grown as a winter crop in many parts of India, more especially in the Central Provinces and Madras. It thrives best on a clay soil, the seed being usually sown broadcast at the rate of about 30 lbs. per acre. If sown in drills, half that quantity will suffice. The seed is eaten as "dhal," and considered the most nutritious of pulses. The dried leaves and stems are esteemed as cattle-food, and the green plants form a valuable green-manure. The crop is ripe about 3 months from sowing, and the yield as a pure crop is about 6-8 maunds per acre.



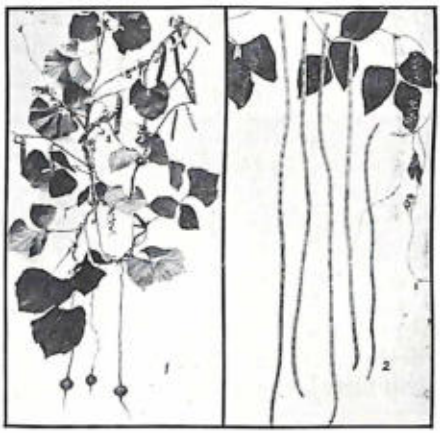
VELVET BEAN (LYON BEAN).
Stizolobium deeringianum (=*Mucuna utilis*).
1, FLOWERS; 2, PODS.

Mucuna nivea (= *Stizolobium pachylobium.*). Velvet Bean; Wanduru-me, *S.*—Cultivated varieties of this or of a closely allied species (*M. utilis*=*Stizolobium deeringianum*) have in recent years come into prominence, chiefly in America and the Philippines, being known by such names as Velvet-, Florida-, Georgia-, Lyon-, Yokohama-bean, &c. They are strong-growing, perennial creepers, bearing stout pods, which are covered with soft, short hairs when young, being about 3 to 5 in. long, containing black or mottled, round seeds, which may be boiled and eaten after removal of the outer skin. The pods also are edible when young and tender. Roxburgh (India) considered the latter, after removing the velvety skin, "a most excellent vegetable, being scarcely inferior to the garden-beans of Europe." These beans are, however, seldom cultivated America as a forage crop or for in Ceylon, and are chiefly valued in green-manuring. See p. 452. $.

Pachyrhizus tuberosus. Yam Bean; Potato Bean; "Sincamas."—A strong-growing climbing bean, native of Trop. America, naturalised and cultivated in the Philippines, introduced at Peradeniya in 1887. It produces an edible tuber as well as pods, the latter being about 6 to 8 in. long, and used when young. It takes two years for the tubers to

reach full size. The plant is commonly cultivated in its native country, but is as yet scarcely known in Ceylon. Cultivation the same as for other climbing beans. Sow seeds thinly in rows about 4 ft. apart, with about 15 in. between the seeds in the row, and support the vines with stout sticks. There are blue- and white-flowered varieties. §

Phaseolus lunatus. Lima-, Tonga-, Burma-, Rangoon-, or Madagascar-bean; Pothu-dhambala, *S*; Pithanga, *T*.—This climbing bean, which occurs in several varieties, is held in high estimation in America, its original home, and is extensively cultivated in Madagascar and other countries for local consumption and export. It is best suited to the higher elevations, and is commonly grown in up-country gardens in Ceylon. The short, flattish, and rather curved pods are not generally eaten, but the large, flat seeds, when boiled and shelled, make an excellent dish and have an agreeable flavour. These may be white, cream, red-dish-brown, or speckled, according to variety. The white seeds are preferred, being free from traces of hydrocyanic acid, which the coloured varieties contain. The plants are of a robust habit and bear racemes of small, white or pink flowers and rather dense foliage. Sow in rows about 4 ft. apart with about 12 inches between the seeds in the rows. Place strong stakes along both sides of the rows for supporting the vines.



1, YAM-BEAN. *Pachyrhizus tuberosus.* 2, COW PEA. *Vigna Catiang* var.

Varieties.—There are dwarf or non-creeping varieties, which are best adapted for cultivation. The dwarf or "Bush Lima" grows to a height of about 2ft., is a heavy cropper, and may be sown in rows about 2 ft. apart each way, about 10 lb. of seeds being required to sow an acre. Cropping should begin at 5 to 6 weeks from sowing, and continues for a month to 6 weeks later. "Henderson's Bush Lima" and "Burpee's Dwarf Lima" are heavy cropping varieties.

Phaseolus Mungo, var.(=**P.—Max**). Green-gram; Mung; Muneta, *S*; Pasipyru, *T*.—A small, erect, hairy annual, about 16 in. high, with narrow, cylindrical, straight, radiating pods, about 3 in. long, and trifoliate leaves; native of India, where it has been cultivated as a food-crop from time immemorial. It is also grown to some extent in the dry zone of Ceylon, either as a pure or inter-crop. The young pods may be used as a vegetable, but it is the ripe seed (pulse) that is chiefly valued, this being cooked and used in various forms like dhal. The straw is useful as fodder. Suited to dry districts; thrives in the plains of India and up to 6,000 ft. elevation. When grown alone, under average conditions, a yield of 5 maunds (400 lb.) or about 20 bushels of pulse per acre may be obtained.

Phaseolus Mungo, var. radiatus. Black-gram; Kalai.—This variety, known in India as "Urd," differs from Green-gram in having longer

stems and a more trailing habit, also in the plant being more hairy, and the seed fewer, larger, and usually dark-brown in colour. According to Watt, it is the most highly esteemed of all pulses in India and fetches the highest price. It is eaten either in the form of bread, boiled whole, or as spiced balls, and is the chief constituent of the wafer biscuits known as "papad" or "papadam." Sown alone, the seed-rate is about 20 lb. per acre, from which the average yield is about 4-5 maunds, or 320-400 lbs.

Phaseolus vulgaris, var.—Climbing or Runner-beans; Bonchi, *S*; Bonchi-kai, *T*.—One of the most useful climbing beans for low and medium elevations. With a few successional sowings, it can be had in bearing almost throughout the year. The young tender pods are boiled and served in different ways. Sow the seeds thinly in rows about 3 ft. apart, in well-tilled and manured soil. The seeds germinate in from 4 to 6 days. Earth up the seedlings when about 12 in. high, and fix stakes along both sides of the rows to support the vines.

Varieties.—The dwarf or non-creeping varieties include the French-, Haricot-, or Kidney-bean (see page 315). The "Rodriguez Bean" is a dwarf variety, 12" to 14" high, which bears profusely and yields a crop in about 6 weeks or 2 months from sowing. Pods almost cylindrical, often streaked with red, 4-6 inches long.



WINGED BEAN.
Psophocarpus tetragonolobus.
1, flowers; 2, pods.

Psophocarpus tetragonolobus. Winged-, Goa-, Manila-, or Princess-bean; Dara-dhambala, *S*.—A strong-growing climbing bean, native of Mauritius, with large pale blue (sometimes white) flowers, bearing peculiar four-angled pods. The latter are 6 to 8 inches long, and have a leafy fringe running along the length of each of their four ridges. In the tender state they are sliced, cooked, and usually much relished. In Burma, where the plant is largely cultivated, its fleshy tuberous roots are also used as an article of food, the yield of tubers being said to be from 1½ to 2 tons per acre. Sow seeds in drills 4 ft. apart, or along a fence or other support, and provide stout stakes for the vines. S.

Vigna Catiang. Cow-, Tonkin-, Jerusalem-, Blackeye-, Catiang- or Marble-pea; Yard-long Bean; Me-karal, Diya-mekaral, Hawari- or Polon-me, *S*.—An annual, climbing bean, bearing long, narrow, pliant pods, which reach from 1½ to 4 ft. or more in length, according to variety. These are used like French-beans, or the ripe seeds are

used. The plant is especially suited to the low-country, but thrives also at medium elevations. There are many varieties, which vary in length of bean and are known by different names as the foregoing. *Vigna unguiculata* and *V. sesquipedalis* are regarded as varieties of *V. Catiang*. §.

(2).—GOURDS, PUMPKINS, SQUASHES, AND MELONS. (*CUCURBITACEAE*).

These comprise a group of climbing plants, many of which yield excellent vegetables. A few yield dessert fruits. The plants are generally monoecious (the sexes in separate flowers on the same plant), in some cases dioecious (the sexes on separate plants). They are of rapid growth, and generally require rich soil and abundant moisture at the root. As a rule they yield larger and better crops in a rather dry climate, with irrigation. The mature fruits (gourds) are generally remarkable for their keeping qualities, in some cases lasting several months in a condition fit for consumption, *e.g.* Pumpkin. Propagation is by seed or cuttings.

Benincasa cerifera. Ash-Pumpkin, or White Gourd; Alu-puhul, *S*; Puchchini or Pusanikai, *T*.—A large, handsome, ovoid gourd, grown throughout the tropics, as well as in sub-tropical countries. The fruit is covered with a whitish waxen bloom (hence its popular names), and is used as a vegetable, sometimes candied as a sweetmeat. The plant is an annual, with large angular leaves, and may often be seen growing over the roofs of peasants' houses. In India, it is said, the fruit is not so liable to be stolen as those of other gourds, owing to certain religious superstitions. Seed may be sown in the rainy season, and the vegetable should be fit for use about 3 months later. The plant will thrive in sheltered valleys up to about 3,000 or 4,000 feet. §.

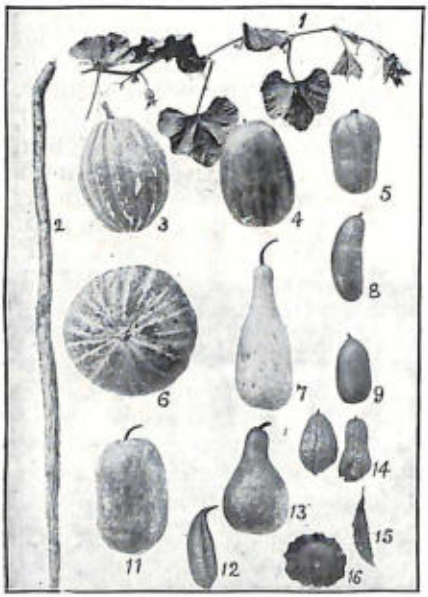


WHITE GOURD OR ASH-PUMPKIN. *Benincasa cerifera.*

Cucumis sativus, var. Native Cucumber; Pipingha, *S*; Pipingkai, *T*.—A thick, cylindrical, smooth fruit, 10 to 15 inches long and about 3 to 4 inches in transverse diameter, usually brownish-yellow when full-grown and ripe. The yellow flowers are about 2 in. across. The fruit is either cooked and used as a vegetable or, peeled and sliced, in salads, being a good substitute for the Cucumber proper, of which it is but a variety. It is cultivated chiefly in semi-dry districts for supplying local markets or boutiques. Sow seed in ridges or mounds of rich soil and manure. The vines may be supported on trellis-work, or allowed to trail over the ground in dry localities. §.

Varieties.—There are several varieties, with fruits of different sizes and forms. "Tee-amabara" is similar to "Pipingha," bearing fruits about 6-8 in. long and about 2 in. in diameter, rather tough in texture, only used as a vegetable when cooked. "Haen" or "Kanda-kekiri" bears small, ovoid, smooth-skinned, brownish-yellow, ornamental gourds, 3 to 4 in. long; specially suited to dry districts, often cultivated in Ceylon as a dry-ground or chena crop.

Cucurbita maxima. Pumpkin; Wattaka or Rata-labu, *S.*—A large, globular, bluntly-ribbed, brownish-yellow gourd with yellowish flesh, commonly grown throughout the tropics. The plant is an annual and is suited to rather dry and hot districts, as Kurunegala, Dumbara, Jaffna, &c. in Ceylon. The gourds keep good for a long period if stored in a dry airy room. They are commonly sold in markets and boutiques, either whole or in portions. Though rather insipid, it is one of the best of tropical vegetables. Seeds may be sown at any time during the rains, in deep holes filled with rich soil and manure, the vines being allowed to run over the ground without supports. The fruits sometimes grow to an enormous size, instances being recorded of specimens having attained 200 to 300 lbs. or more in weight, and 7-8 ft. in circumference. The shells when dried become very hard, and are often made into light and durable vessels and ornaments. There are several varieties, which vary in size, form, and colour of fruit. $



COLLECTION OF GOURDS.

2, Snake-gourd, *Tricosanthes anguina.* 3, Polong-wattaka, *Cucurbita moschata.* 4, Water-melon, *Citrullus vulgaris.* 5, Vegetable-marrow, *Cucurbito Pepo.* 6, Pumpkin, *Cucurbita maxima.* 7 and 13, Bottle-gourd, *Lagenaria vulgaris.* 8, Native cucumber, *Cucumis sativus var.* 9, Tee-ambara, *Cucumis sativus var.* 11, Ash Pumpkin, *Benincasa cerifera.* 12, Loofah, *Luffa aegyptiaca.* 14, Cho-cho, *Sechium edule.* 15, Carilla-fruit, *Momordica Charantia.* 16, Squash, *Cucurbita Melo-pepo.*

Cucurbita Melo-pepo. Squash.—The name Squash is given in America to numerous varieties of gourd which bear variously-shaped fruits, these ranging from ovoid to almost flat or shell-like forms. Squashes are extensively grown in sub-tropical America, where they are much relished, but are not suited to a wet, tropical climate. In the drier districts, however, at medium or high elevations, they thrive and bear moderately well. Sow seeds in boxes, and transplant the seedlings, when large enough to handle, into mounds of well-prepared earth. The plants may be left to trail over the ground like Vegetable-marrow. During wet weather a piece of flat stone or tile should be placed under each fruit to prevent it from rotting. Squashes are boiled green, like vegetable-marrow, or mashed like turnips, and served

with milk, pepper and salt. When ripe, they are made into pies. In France they are sometimes gathered when of the size of an egg, boiled in salt and water, laid upon toast, and eaten as asparagus. §.

Cucurbita moschata. Polong-wattaka, *S.*—A large, ovoid or round gourd, with yellow spots or dark-green patches or streaks. Cultivation, etc., the same as for Pumpkin. §.

Cucurbita Pepo. Vegetable Marrow (see page 327).

Lagenaria vulgaris. Bottle Gourd; Diya-labu, *S*; Sorakai, *T.* One of the most popular of native vegetables, commonly cultivated in the tropics, suited chiefly to semi-dry districts, as Kurunegala, Dumbara, etc., in Ceylon. The fruit varies in length from 16 to 24 inches or more and is variously shaped, often resembling a large decanter or water-bottle. The unripe fruits when boiled are a wholesome though insipid vegetable. When ripe and seasoned, the shell becomes very hard and durable and, being emptied of the pulp, is commonly made into vessels used for carrying water, or for collecting palm-toddy, etc. The plant is an annual, with usually white flowers (about 2½ inches across), and may be grown on the ground, but is best supported on trellises, etc. §

Luffa acutangula. Veta-kola or Dara-vetakola, *S*; Pekan-kai, or Pey-pichukku, *T.*—A distinct gourd, 8 to 10 inches long, with several sharp longitudinal ridges, commonly used in a tender state as a curry-vegetable, the outer part being peeled off before cooking. The plant is an annual and commonly grown in India, Ceylon, &c., being raised from seed and supported on trellis-work, fences, or low trees.

Luffa aegyptiaca. Loofah; Sponge-gourd; Niyan-vetakola, *S*; Pikku or Pichukku, *T.*—A large, annual, climbing gourd with angular stems, indigenous to Trop. Asia, commonly grown throughout the tropics. The cylindrical fruit is from 8 to 14 inches long, and is used when tender as a vegetable. See page 431. §

Momordica Charantia. Carilla Fruit; Karawila, *S*; Pakal or Pavakai, *T.*—A rather slender vine, bearing an ovoid, warty gourd, 6 to 8 inches long, bright orange-yellow when ripe; commonly cultivated in the tropics as a vegetable, sometimes for ornament. The fruit is very bitter, and is adapted for pickling, being one of the most common ingredients in Indian pickles. There are several varieties, one of which has white fruits. §

Momordica dioica. Tumba-karawila, *S*; Tumpai or Palupakkai, *T.*—A small, oblong, green, warty-looking gourd, about 2 to 3 inches long, commonly used and much esteemed by the peasants as a curry-vegetable. The tender shoots and leaves also are edible. The plant is indigenous to Trop. Asia, being common in the dry districts of Ceylon, &c. Sow seeds during the rains, and provide supports for the vines.

Sicana odorifera. Melocoton; Casabanana.—A Mexican climbing plant, bearing stout Cucumber-like fruits, 10 to 15 inches long and about 3 inches in diameter. In the green and unripe state these afford an excellent vegetable, and in a ripe state are suitable for preserves. When approaching maturity, the fruit assumes a brownish-red tint and a pleasant fragrance. The plant is a rapid grower, and attains a height of about 50 feet; thrives best in rich soil, fully exposed to the sun, and should be allowed to ramble over an arbour or trellis. It is best suited to a rather dry climate.

Trichosanthes anguina. Snake-gourd; Club-gourd; Patola, *S*; Podivilangu or Podalangai, *T*.—A quick-growing, annual gourd, native of China and Malaya, bearing long, cylindrical, green or greenish-white fruits, 4 to 5 ft. or more in length. In an unripe state these are sliced and cooked, being commonly used and much relished as a curry-vegetable. Seeds are sown at the beginning of the rains, against a trellis-work of bamboos or other supports. A crop should be obtained in 3 months from planting. It is customary to fasten a small stone to the end of each fruit whilst growing, so as to weight the latter down and induce it to grow straighter, and perhaps longer, than it would otherwise do. §.

Vegetable Marrow. See p. 327.



SNAKE-GOURD. *Tricosanthes anguina.*

(3).—ROOT OR TUBEROUS-VEGETABLES AND FOOD-CROPS.



TOPI-NAMBOUR. *Calathea Allouya.*

Calathea Allouya. (*Scitamineae*). Lleren; Topi-nambour (corrupted to Topee-tambu or Tokee-tambu).—A perennial, about 2 feet high, with large, oval, Canna-like leaves, native of tropical South America and parts of the W. Indies, common in Grenada, &c., introduced at Peradeniya in 1893. It produces numerous fibrous tubers which resemble small potatoes and, though of poor quality as a vegetable, are relished in the plant's native country and sometimes cultivated. The tubers are of a hard, somewhat gritty nature, require a considerable amount of boiling, and have but little flavour. People who have acquired a taste for them, however, pronounce them "delicious." They are said to be sold in the streets of some of the larger towns of S. America, "ranking with ground-nuts in popularity." The plant has been

grown at Peradeniya since 1893, but the tubers are not eaten there. Propagated by suckers (the tubers have no "eyes" or buds), and planted about $2 \times 1\frac{1}{2}$ ft. apart, in rows. About 10 months are required to produce a crop.

Canna edulis. (*Scitamineae*). Queensland Arrowroot; Indian-shot; Tous-les-mois; But-sarana, *S*; Vailay-sembu, *T*.—A handsome herbaceous perennial, with large, bronzy leaves, 3 to 5 ft. in height, considered to have been originally introduced from the West Indies, commonly grown in peasants' gardens, more especially about Tamil cooly lines. The starchy, purplish, tuberous rhizomes, 6 to 8 of which are usually produced by each plant, are either cooked and eaten as a vegetable, or made into flour. The plant is sometimes cultivated commercially in Queensland, furnishing the "Queensland arrowroot." The crop, under favourable conditions, is estimated at from 5 to 8 tons of tubers per acre, yielding about 1 to $1\frac{1}{2}$ tons of prepared arrowroot. The latter, which may also be prepared as starch, is valued at about 6*d*. per lb. in London. The plant is propagated and cultivated in the same way as the ordinary Arrowroot, the rhizomes being planted in rows, about 3 by 2 ft. apart. The crop takes from 6 to 8 months from planting to come to maturity. See p. 300. §.

Colocasia Antiquorum (=C.—esculenta). (N.O. *Aroideae*).—A tuberous herbaceous perennial, with large handsome leaves, long cultivated in tropical countries and occurring under numerous varieties and names; the latter vary in different countries or even provinces, as Coco-yam, Tannia, Tanier, Eddo, Dasheen, &c., in the West Indies; Taro, Yautia, Gabi, Colalu, &c. in tropical South America and Pacific Islands; Melanga, &c., in Cuba; Talla, &c., in Malaya; Kachchi, Kachu, Arvi, &c., in India; Kiri-ala, Habarala, Daesi-ala, Kand-ala, Sevel-ala, Gahala, &c., in Ceylon. There are two distinct forms (or genera), one of which is characterised by peltate leaves (petiole joined at a point towards centre of leaf), the other by hastate or sagittate leaves (arrow-shaped), with the petiole joined at the leaf-base, as in ordinary leaves, *e.g.* Habarala, *S*. The latter form is sometimes placed under the genus *Xanthosoma*. §.



1, HABARALA. *Alocasia* (*Xanthosoma*) *indica* var. (with sagittate leaves).
2, KIRI-ALA. *Colocasia Antiquorum* var. (with peltate leaves).

The underground tubers vary in size from that of a small to a medium-sized or large potato, usually with a fibrous skin. Some varieties, however, seldom if ever produce tubers, being grown for the tender leaves and shoots only, which are cooked as a vegetable. In other varieties, as Daesi-ala of Ceylon and Dasheen of Trinidad, both tubers and tender leaves are eaten. Most varieties are more or less characterised by an acrid property, which, however, is removed by boiling and cooking. The tubers are a nutritious article of food, resembling artichokes, to which they are considered superior, being preferred by some people even to potatoes. They may be cooked and served in different ways, some (*e.g.* "Eddo," Trinidad "Dasheen," and Ceylon "Kand-ala") make delicious soup, and are used as a delicacy for invalids. Though a popular vegetable in the West Indies,* South America, &c., they are not commonly consumed in the East, except by the poorer people, to whom they are a regular stand-by.

The plants generally thrive best in moist, stiff soil or low-lying ground, as near swamps, streams, &c., though some are also adapted to drier ground. In dry districts they do well under irrigation. Tubers may be planted in rows, 3 ft. by 3 ft., or $2\frac{1}{2} \times 2$ ft., according to variety and locality. Certain varieties, as Thun-mas-ala, *S.*(=3-months yam), yield edible tubers in 3 months from planting, most varieties taking 6 to 9 months, some 10 months or more The yield under favourable conditions is variously estimated at from 3 to 5 tons or more per acre. "Taro" is extensively cultivated in Hawaii and tropical South America.

Varieties.—Numerous varieties, as already stated, are recognised, over 200 occurring in Hawaii alone. The principal varieties in Ceylon are : Kiri-ala or Sudukandala (leaves and stalks very pale green), Yakutala, Gahala, Kalu-kandala (leaf-stalks purplish green), Gerandi-kandala (leaf-stalks mottled), Thun-mas-ala, Daesi-ala, Habarala (leaves hastate), &c. "Mock-tannia" is said to be one of the best and most prolific variety in Trinidad.

Cyperus esculentus (*Cyperaceae*). Chufa ; Ground-almond ; Tiger-nuts.—A small, perennial grass-like sage, indigenous to South Europe, Western Asia and various parts of Africa. Its small, underground tubers are edible, having a nutty flavour, and may be cooked and used as a vegetable. These, when dry, look like large wrinkled peas. Roasted and ground, they are sometimes used for adlterating coffee. They also yield an oil used for culinary purposes, &c. Mr. Tudhope, Director of Agriculture for the Gold Coast, informs me that the plant is commonly cultivated by the natives of that country, chiefly in localities adjoining the sea-board, the tubers, which "are not at all unpleasant to eat," being sold in the local markets. The plant thrives in almost any arid, sandy soil, yielding a crop in 4 to 6 months, each plant producing up to 100 or 150 small tubers. This species does not spread or become a troublesome weed like *Cyperus rotundus*. See page 474.

Dioscorea. Yams ; Vel-ala, *S* ; Kodi-kelengu, *T*. (*Dioscoraceae*). Different species and varieties of the genus Dioscorea constitute the true Yams,—twining plants, generally with large, oval, 3-6 nerved leaves, and large, underground, edible, tubers, often with hair-like or prickly rootlets. In Ceylon, "yam" ("ala") is a common term for any tuberous plant. The Dioscorea yams are largely cultivated in the West Indies and tropical South America, where they form a standard article of diet with all classes, the best varieties being sometimes preferred even to good potatoes. In Ceylon and the Eastern Tropics, however, they have not

*Bull. of Dept. of Agric., Trinidad and Tabago, Parts 2, 1916, and 1, 1918.

as yet gained such popularity, and though often met with in peasants' gardens, and sometimes in markets and boutiques, they are not a common commodity.



DIOSCOREA YAMS.
1, "Java ala," or Natu-kelengu, *T.*
2, "Jaffna yam," or Kiri-kondol, *S.*
3, Rata-kondol, *S.*

Yams are easily cultivated and thrive best in loose, deep soil, up to an elevation of about 3,000 ft. They may be planted in mounds, or against fences, trees, etc., or in rows about 4 ft. apart, with about 2 ft. between the plants in the rows. The best time for planting in Ceylon is February and March, or when the plants are dormant. The ground should be dug to a depth of about 2 ft., and well manured. Pieces of the crown or yam-head, of about ¼ lb. each, with 2 or 3 "eyes," are used for planting as "setts." Cuttings will sometimes strike root if taken from mature portions of the stems. Poles or stout bamboo tops are fixed in the ground along the rows for support to the vines; or 3 poles or stakes may be arranged round the plant in tripod fashion. The crop is ready for harvesting in about 9 months from planting, the leaves then becoming spotted brown and the stems dying down to the ground. The yield may be at the rate of from 4 to 8 tons or more per acre, according to variety, soil, and locality. The tubers may be lifted and stored in a cool shed, under dry earth, sand, or lime; or they may be left in the ground and used as required, provided they can be protected from vermin and other enemies. Yams can be cooked and prepared for food in various ways, being roasted, baked, or boiled and steamed, etc.

Varieties.—There are n merous species and varieties, some half-dozen species being indigenous to the moist low-country jungle of Ceylon (see over). Many of the cultivated forms differ in colour and shape of tuber, as well as in foliage, &c. A large number of these probably belong to the species *D. alata.* Local or vernacular names are numerous and confusing the following include the principal varieties known in Ceylon.

Stem 3 to 5-winged or -angled, tuberiferous, without prickles; leaves opposite, entire: *Dioscorea alata var* :—Angili-ala (=Verraelvalli-kelengu, *T*); Bindhar-, Hingur-, or Ingur-ala; Japana-, or Rathu-ala (=Sayulalli-kelengu, *T*); Kaharata-ala (=Karavalli-kelengu, *T.*); Kiri-kondol (=Artuvalli-kelengu, *T*); White yam,

or Kirivel-ala (=Vaithila-valli-kelengu, *T*); Raja-ala; Rata-kondol; Ratavel-ala; (=Kodivalli-kelengu, *T*).

Stem round, tuberiferous, without prickles, leaves alternate: Udela or Uda-ala (=Kodikarrana-kelengu, *T*)=*D. bulbifera.*

Stem round or slightly grooved, tuberiferous, with prickles, leaves alternate or opposite, entire: Hiri-tala (=Sheenivalli-kelengu, *T*) =*D. obcuneata*; Java-ala, Natt-ala, or Maha-kukul-ala (=Shoravalli-kelengu, *T*); Katukukul-ala and Kukul-ala (=Shirru-valli-kelengu, *T*) =*D. fasciculata*; Jambur-ala (=Podhalivalli-kelengu, *T*); Kaha Japana-ala or Guinea-yam, =*D. aculeata.*

Leaves 3 to 5-digitate: Katu-ala (Mulluvalli-kelengu, *T*) =*D. pentaphylla.*

Stem round, not prickly, without aerial tubers, leaves opposite:—Gon-ala (=Kombuvalli-kelengu, *T*),=*D. spicato.* Inedible Ceylon yams:—Uyala (*D. tomentosa*); Panu-kondol (=*D. sativa*); and *D. intermedia.*

Yampee or Cush-cush (*D. trifida*) and Yellow-yam (=*D. Cayensis*) are favourites in the West Indies; "Lisbon" is a prolific bearer in Trinidad. "Niame-chino" and "Niame-pellu" are well-known Cuban varieties.

Helianthus tuberosus. Jerusalem- or Root-artichoke, see p. 314.

Ipomoea Batatas. (*Convolvulaceae*). Sweet Potato; Batala, *S*; Vel-kelengu, *T*.—A creeping or trailing perennial, producing succulent, tuberous roots, which are a tasty and nutritious article of food, being sometimes preferred to the common Potato. The Sweet-potato is considered to be indigenous to the tropics generally. It is cultivated in all warm countries, and may be grown successfully in sheltered valleys up to about 3,000 to 4,000 feet in the tropics, but does not usually thrive in the hills when exposed to heavy rains. Any moderately good soil will suit the plant, provided it is of a light porous nature. The ground, which should be well tilled, may be formed into ridges about 2½ ft. apart, or banked up into beds 3 ft. wide, and manured; cuttings about 12 in. long are planted in these at distances of about 12 inches preferably during rainy or cloudy weather; otherwise watering and shading are necessary.



SWEET POTATO. *Ipomoea Batatas.*

During dry weather, the ground should, if possible, be irrigated once a week. The crop should be available in about 4 to 5 months from planting, the leaves turning yellow when the tubers are mature. A yield of about 4 to 5 tons or more tubers per acre may be expected under favourable conditions.

Varieties.—The following are among the best varieties grown in Ceylon: Boniata, Sierra-morena, Boniato-Amarillo, Virginia, Jersey, and Nancimund.

Numerous varieties are recognised in the West Indies and America, such as Blue-belle, Red Bourbon, Barbados-barrel, Blanca, Mamey, White Gilkes, Prince Henry, etc. See *Recipes*, page 511.

Manihot utilissima (*Euphorbiaceae*). Tapioca ; Cassava ; Manyokka, *S.*—A shrubby perennial, 6 to 7 ft.high,native of tropical South America, cultivated in all tropical countries. It is supposed to have been first introduced into India and Ceylon by the Portuguese in the seventeenth Century. Two distinct kinds are recognised, viz. " Bitter " and " Sweet " Cassava (*Manihot utilissima* and *M. Aipi* respectively), and of these there are many varieties. All are characterized by the presence of hydrocyanic or prussic acid, which not infrequently results fatally to persons eating the roots carelessly prepared. The " Bitter " type contains a greater percentage of the poison than the " Sweet," in which it exists chiefly in the outer portion or cortical layer of the root, so that it is easily eliminated in the preparation for food (see below).



CASSAVA. *Manihot utilissima.*

Cassava is extensively cultivated in Tropical America, the West Indies, the Straits Settlements (chiefly by the Chinese), Trop. Africa, &c. In the first mentioned country, it has been the chief food of the aboriginal races from the earliest times. In the Philippines and Java, it is sometimes cultivated as food for stock, as well as for the starch obtained from the tubers. In India and Ceylon, its cultivation is rather limited and generally confined to small gardens, the large tuberous roots being cooked and used as a vegetable,or made into cassava meal and bread. The granulated tapioca of commerce is the farina obtained from the tubers by grating, washing, pressure. sifting, heating, &c., the poisonous juice being removed in these processes. S.

Tapioca has long been exported from Brazil, and in recent years from the Straits Settlements. When the tubers are used as a vegetable, it is especially important that they be fresh, as if kept for more than a few days after being taken from the ground they become dangerous to eat, and many of the fatal cases from eating cassava are probably due to neglect of this precaution. It is said that the natives of Guiana take red chillies steeped in rum as an antidote to cassava poisoning. Cassareep, a powerful antiseptic, capable of preserving meat, etc., is a by-product obtained by boiling down the poisonous juice of the " Bitter Cassava " ; it is the foundation of well-known sauces and the basis of the famous "Pepper-pot " of the West Indies.

Cassava is an exhausting crop, and cannot usually be grown profitably for more than three successive years in the same ground. It is sometimes grown as a catch-crop with permanent crops, as in young rubber or coconut plantations. The plant resists drought well, is suited to elevations up to about 2,500 ft., and thrives in deep, loamy, or light, rich, open soil. Deep tillage is essential. Propagation is by cuttings (10-12 in. long) of the stems, these being planted about 4 ft. × 3 ft. apart, in rows. The tubers are ready for harvesting in from 9-12 months from planting, according to locality and variety, some varieties taking longer than others to mature.

Yield.—The average yield varies from 7 to 8 tons of tubers per acre, according to variety, soil, &c.; as much as 12 tons or more may be obtained from new and well-manured ground, while on poor soils the yield may not be more than 3 tons. The yield of prepared tapioca also varies from about 1,600 lb. to 2,500 lb. or more per acre, the proportion being about 25 to 30 per cent. of the weight of tubers.

Varieties.—These are numerous and usually given local names in different countries. They differ in foliage, size and colour of tubers, character of stems, &c. Sin-yokka and Maha-sinyokka are well-known in Ceylon. A variety with very curly leaves has been given the name of "Kaffir Cassava."

Maranta arundinacea. (*Scitaminae*). West Indian- or Bermuda-arrowroot; Araluk or Hulankiriya, *S.*—A small stemless, herbaceous plant, with large leaves, native of Trop. America. The name "arrow-root" is said to have originated from the fact that the tuberous root was used by the Indians as an application to wounds inflicted by poisoned arrows. The plant is cultivated in most tropical countries for the sake of its white, starchy, underground tubers (rhizomes), which are used either as a vegetable, or (by a process of washing, grating, sifting, &c.) made into the powder known as arrowroot. The arrowroot of commerce



QUEENSLAND ARROWROOT.
Canna edulis.



WEST INDIAN ARROWROOT
Maranta arundinacea.

is obtained chiefly from the West Indies, notably Bermuda and St. Vincent, where the plant is systematically cultivated. See also *Queensland Arrowroot*, pages 295, 300. §.

Propagation is by means of the tubers (rhizomes), or by suckers, these being planted 5 to 6 in. deep, in rows or furrows about 2½ ft. apart, with about 15 in. between the plants in the row. The commencement of the rainy season should be selected for planting. A light, loamy, well-drained soil is the best, wet or clayey soil being unsuitable. The crop is an exhausting one, and the richer the soil the better. The plant thrives from sea-level to about 3,000 feet in a moist, hot climate. Shade is not essential, though in light soils and exposed localities, a light checkered shade is beneficial. The flowers should be removed from the plants as they appear. The tubers are usually ready for harvesting in from 8 to 10 months from the time of planting, their mature condition being indicated by the leaves flagging and dying down. Under favourable conditions an acre should produce on an average about 4 to 5 tons of tubers, the latter yielding about 18 to 20 per cent. dry arrowroot, or about 18 to 20 cwts. per acre. Arrowroot usually fetches at present about 4*d.* to 6*d.* per lb. in London, according to quality and demand.

Oxalis crenata. (*Oxalidaceae*). "Oka."—A small Peruvian plant, allied to the Common Oxalis weed (see p. 475.), producing numerous small tubers, which sometimes grow to the size of small plums, cultivated in Peru, where the tubers, being boiled, and flowered with pepper and salt, etc., are eaten and relished. The acid succulent leaf-stalks are used in salads.

Plectranthus tuberosus. (*Labiatae*, Coleus family). "Country-potato;" Innala or Ratala, S.—A small herbaceous plant with succulent, strongly aromatic leaves, native of S. India, Java, &c., commonly grown in Ceylon, etc., by peasants for the small, watery but edible tubers. These are often retailed in the markets and boutiques, being used as a vegetable in curries, while the leaves are used in medicine. They appear to have little to recommend them as an article of food; but their quality might possibly be improved by cultivation and selection. This and other species of Plectranthus are cultivated in Africa, Madagascar, Cochin China, etc. Readily propagated by cuttings or tubers, which may be planted about 8 in. apart in a bed of light rich soil.

Tacca pinnatifida. (*Taccaceae*). Indian Arrowroot; Gerandi-kidaran, *S*; "Lukeh" of Malaya.—A stemless, tuberous plant, with leaves 2-3 ft. long and parted into 3 segments, native of the dry region of Ceylon (Bintenna, Batticaloa, Jaffna, &c.), being found in open, grassy places; also indigenous to India, Burma, and Malaya; commonly cultivated in Travancore and other parts of India, Tropical Africa, Fiji, Hawaii, etc., for its large, round, tuberous root. The latter yields a considerable quantity of white nutritious fecula, considered to be equal to the best arrowroot and relished as an article of food. The tubers, dug up after the leaves have died down, are put through a process of rasping, macerating, and washing in cold water for 4 or 5 days; the fecula then separates, and is prepared in the same manner as sago. In the crude state it is intensely bitter and acrid, but these qualities are removed by the above process. The plant is suited to a rich, porous soil, propagated by division of the rootstock, and may be planted at distances of 2 ft. by 3 ft., in rows.

(4).—MISCELLANEOUS VEGETABLES AND FOOD CROPS.

Amarantus oleraceus. (*Amarantaceae*). "Tampala," *S*. There are several cultivated varieties of this and other species, producing brown or yellow, small, smooth seeds, commonly used for food by the peasants.

They are quick-growing annuals, all known in Ceylon as "Tampala", varying in height from 3-6 ft. or more, and commonly met with in the tropics, either cultivated or as weeds. The tender leaves and shoots are boiled and used in curries, or used as a substitute for spinach. Some varieties, as "Lansi-tampala," are cultivated for the seed, which is made into flour, etc. Others are grown for their highly coloured ornamental foliage (see page 133). They are readily raised from seed, and thrive in any ordinary soil. Sow in rows, 2 ft. by 2 ft. if for leaves, or 3 ×2 ft. if for seed, in light, sandy soil. See pages 308, 311

Andropogon Sorghum. See *Sorghum vulgare*, page 306.

Arachis hypogaea. (*Leguminosae*). Ground-nut; Earth-nut; Monkey-nut; Pea-nut; Pinder; Rata-kaju, *S*; Nella-kadalai, *T*.—A small, annual, trailing plant, native of Brazil and cultivated in all tropical countries. It is remarkable for its habit of burying its seed-pods in the ground to ripen, hence the name "ground-nut." The cultivation and export (chiefly for the oil) of ground-nuts is an important industry in West Africa, South India, Burma, and elsewhere. Ground-nuts have been tried in Ceylon as an intercrop with permanent products, as with rubber, coconuts, &c., but have not proved a commercial success, partly owing to depredations by vermin. The plant is, however, sometimes grown in small gardens in the low-country. §

In tropical America, parts of the West Indies, tropical Africa, and India, ground-nuts are commonly used as an article of food as well as for export. The "nuts" (seeds) are also used largely in confectionery, or roasted and eaten as dessert. In the West Indies, they often fetch from



GROUND-, OR MONKEY-NUT.
Arachis hypogaea.

MADAGASCAR GROUND-NUT.
Voandzeia subterranea.

4*d*. to 6*d*. per lb. unshelled. The nuts contain about 45 per cent. of edible oil, used in salad oils, also largely in the manufacture of margarine, toilet soaps, cold cream, etc. After the expression of the oil from the seed, the residue (ground-nut cake) forms a valuable cattle-food or

manure, some 35,000 tons of which is annually imported into Ceylon for use as a manure for Tea, &c. See p. 394.

A light, friable, well-tilled soil suits the plant best, the presence of lime being especially beneficial. A very wet climate is unsuitable for the crop. The seed, after being shelled, may be sown 2 to 3 together, about 3 in. deep, in rows about 2 or 2½ ft. apart, with about 10 in. between the seeds in the row. Just before the commencement of the rainy season is the proper time to sow. About 80 lb. (or 2 bushels) of seeds should be sufficient to sow an acre. From about 4 to 5 months, according to variety and soil, are required to produce a crop. When ripe, the plants are dug up and the nuts picked by hand. The yield per acre may vary from 1,000 lb. to about 1,500 lb. of unshelled "nuts," though with good cultivation larger yields have been recorded. There are numerous varieties, these being distinguished by yield, foliage, habit of growth, &c. "Mauritius" is one of the best. $.

Basella alba. (*Chenopodiaceae*). Country Spinach; Niviti, *S*; Pasali, *T*.—A slender, herbaceous, twining annual with succulent, roundish or cordate, edible leaves, which furnish an excellent substitute for spinach. It is commonly cultivated, easily propagated by cuttings or seed, and thrives best in rich or well-manured soil. Sow or plant in rows, and afford stakes for support.

B.—rubra has red stems and is similarly cultivated, but the green form above described is generally preferred.

Boussingaultia baselloides. (*Chenopodiaceae*). Ala-niviti, *S*.—A small herbaceous creeper of Trop. America, producing an edible tuber. The leaves are used as spinach. Sometimes grown in low-country gardens of Ceylon.

Capsicum grossum or **C.**—frutescens. (*Solanaceae*). Capsicum; Chilli- or Bell-pepper; Malu-miris, *S*; Karri-kochika, *T*. Small, annual, bushy plants, of which there are numerous varieties cultivated. Though related to the smaller pungent kinds of pepper-chillies (see *Spices*, page 334), they are distinguished from them by the large, quite pungentless, hollow fruits. These are round or oblong, much wrinkled, 3 to 5 inches in diameter, varying from deep green to orange, bright red, amber, &c., and are much relished when boiled and used as a vegetable, or served raw in salads. The plants thrive best in loose, rich soil, under light shade, and are suited to low and medium elevations, provided the rainfall is not excessive.

Cordeauxia edulis. (*Leguminosae*). Yoheb-nut of Trop. Africa. A perennial plant, sometimes cultivated in parts of Africa for its edible seeds.

Edible birds' nests.—Though only partly a vegetable product, edible birds' nests rank as an important article of table delicacy in China, where they are made into a celebrated soup. These nests are formed by species of swifts (*Collocalia*) inhabiting caves, and their chief nutritive value is derived from the dried salivary secretion with which the birds line the nests. Young, white nests are the most highly prized; these are sold at fanciful prices, varying from about £35 per thousand, "the best quailty commanding their weight in silver." The annual import into Canton alone is said to amount to about 9,000,000 nests. Edible birds' nests are still exported from Ceylon to China to a small extent, some 10 cwt. valued at Rs. 3,016 having been exported in 1923. They are collected, under Government licence, from caves, chiefly in the Southern Province.

Hibiscus esculentus. (*Malvaceae*). Okra or Ochro ; Gobba ; Gumbo; Lady's Fingers ; Bandakka, *S* ; Bandak-kai, *T*.—An erect annual of the " Shoe-flower " family, 4 to 6 ft. high or more, bearing large roundish or palmate leaves and erect horn-like pods, 5 to 8 in. long. When young these are an agreeable mucilaginous vegetable, much relished by some people when boiled and served in salads, or in soups, &c. As the pods approach maturity they become fibrous and inedible. The plant is grown throughout the tropics, and occurs in several varieties. It is not suited to high elevations, except in sheltered valleys. Sow seeds at the commencement of the rains, in rows about 3 ft. apart, subsequently thinning out the plants to distances of about 18 in. in the row. Or sow in a bed, and afterwards transplant the seedlings into rows in well-prepared and manured soil. The dwarfer varieties may be planted 24 × 15 in. A crop is obtained in from $2\frac{1}{2}$ months onwards. The plant does best in rich and well-manured soil. §.



OKRA. *Hibiscus esculentus.*
1, flower bud ; 2, flower; 3, fruit.

Ipomoea aquatica. (*Convolvulaceae*). Kan-kun, *S*.—A small semi-aquatic creeper, with tender arrow-shaped leaves, often cultivated in peasants' gardens. The leaves and young stems are commonly used for vegetable curries. Thrives best in a shallow trench where moisture can be retained. Propagated by cuttings.

Ipomoea Bona-nax. Moon Flower ; Alanga, *S* ; Alangai, *T*. A perennial climber, with very large, pure white flowers, which open late in the evening and close early the following morning ; the fleshy calyces are often used as a vegetable for curries, soups, etc. Sometimes cultivated in small gardens, chiefly by Tamils. Easily propagated by cuttings or seed. Thrives up to about 3,000 ft.

Jaffna- or Sea-Moss. Kadala-passi, *T*. (*Gracilaria lichenoides*).—An edible, creamy-white sea-weed found growing on the northern shores of Ceylon and parts of South India, Malaya, Burma, &c. The plants are collected, dried in the sun on mats for 2 or 3 days, then washed several times in fresh water, and again exposed to the sun. The " moss " is in the form of fine, string-like, white shreds and is very light. When boiled, strained, and left to settle, it forms a jelly, which is emollient and demulcent, considered to be nutritive, and is used as a delicacy for invalids. The flavour of sea-weed may be disguised by the addition of milk, wine, or aromatics.

Japanese- or Chinese-moss, Agar-agar.—A preparation of sea-weed (chiefly *Gelidium*) familiar in the form of nearly white, thin, shiny membranous flakes, obtained mostly from Japan. It is extensively used as a food adjunct, *viz.* as a thickener in jellies, soups, &c.

and largely employed in laboratories as a culture medium for bacteria; also used in sizing textiles, &c.; worth about 5*s*. per lb. in England.

Moringa pterygosperma. (*Moringae*). Horse-radish Tree; Drumsticks; Murunga, *S*; Murunga-kai, *T*.—A short, slender tree, about 25 ft. high, with small tripinnate leaves, cultivated in gardens throughout Ceylon, India, etc. The roots are used as a substitute for horse-radish, the leaves for vegetable curries as well as for seasoning and in pickles, and the long unripe pods ("drumsticks") as a curry vegetable, the latter being boiled and sliced like beans. The flowers and bark are used in native medicine, and a valuable oil ("Oil of Ben") is obtained in India from the seeds. Propagated by seed or cuttings.



AGATI OR KATURU-MURUNGA. *Sesbania grandiflora.* (1, pods; 2, flowers).

Sesbania (Agati) grandiflora. (*Leguminosae*). Katuru-murunga, *S*; Agatti-keerai, *T*.—A small, erect, quick-growing, sparsely branched, soft-wooded tree, about 15 to 20 ft. high, bearing large pendulous flowers. The fleshy petals, as well as the tender leaves, are relished in curries and soups, or fried with butter. The long pendulous pods do not appear to be eaten. The bark, leaves and flowers are medicinal. Propagated by seed. Commonly cultivated in Ceylon. §.

Solanum Melongena. (*Solanaceae*). Brinjal; Egg-plant; Aubergine; Wambotu, *S*; Katrikai, *T*.—A low bushy annual, usually with sharp prickles along the stems and leaf-stalks, commonly grown for its large, smooth, polished fruit, which forms a favourite vegetable and is cooked and served in various ways. There are numerous varieties, differing chiefly in the shape, size, and colour of fruit. The latter may be round, ovoid, or cucum-



BRINJAL OR AUBERGINE. *Solanum Melongena.* (1, flower; 2, fruit in section).

ber-shaped, and white, grey, or purple, the latter colour being usually characteristic of the best varieties. Brinjals thrive best in a rather dry climate, with irrigation, and in light, rich, well-tilled soil. They are grown most successfully in the Negombo and Dumbara districts of Ceylon, and are also suited to fairly high elevations, provided the climate is not too wet. Sow seed in a well prepared bed or in boxes, and transplant the seedlings when about three inches high into rows, about 3 ft. × 2 ft. The plants should begin to bear in from 3 to 4 months, and continue to yield for 3 4 months. A crop of about 40,000 fruits (or about 8 to 12 fruits per plant) is considered a good average yield. See p. 305. $.

Sorghum vulgare. (*Gramineae*). Guinea-corn ; Kaffir-corn ; Great Millet ; Turkish Millet ; Dhurra or Doura ; Mazzagua ; Karal-iringu, *S*; Cholam , *T*.—A tall anual plant of the grass family, 5 to 8 ft. high, cultivated from remote ages as a cereal food-crop. It requires similar conditions of soil as Maize, and is suited to a rather dry climate. Though largely cultivated in India, Burma, Africa, etc., it is but little grown in Ceylon. The small hard grain is very nutritious, being rich in albuminoids though lacking in gluten. It is made into flour, which is sometimes mixed with wheat flour, and prepared in different ways for the table. The straw affords good fodder. Seeds may be sown in furrows about 3½ ft. apart, and the seedlings subsequently thinned out to about 12 inches in the row. About 8 lb. of seed will sow an acre. In India, the plant is often grown mixed with another crop, such as *Cajanus indicus*. The seed should be sown before the end of the rains, so that the crop may be harvested in the dry season, that is, in about 3½ to 4½ months after sowing. The yield may vary from 30 to 50 bushels per acre, according to variety soil &c. When ready for harvesting, the " ears " are cut off near the top of the stem ; after drying for a few days, these are ready for threshing. There are numerous varieties, which are distinguished by habit of growth, size of ears, and colour of seeds, which may be white, cream, red, or black ; the black-seeded varieties are generally known as Kaffir-corn, and the red as Dhurra. Well-known varieties are : Feterita, Dwarf Milo, Dwarf Kaffir, and Pink Kaffir. Birds are often very destructive to the crop, and the only practical remedy is to employ scare-crows, or watchers with devices of rattling tins. $.



TYPES OF GUINEA CORN, OR DHURRA. *Sorghum vulgare*, VAR.

Spinach. See p. 325 ; also *Basella, Talinum, Amarantus, Portulaca, &c.*

Voandzeia subterranea. (*Leguminosae*). Vandzon; Madagascar- or Bambarra-groundnut.—A creeping annual, with erect, long-stalked leaves, each composed of 3 leaflets. Like the common ground-nut, the flower-stalks, after flowering, bend down to the earth, in which they develop and ripen their pods. The plant does not, however, produce trailing branches, and the fruits are set close to the stem. The seeds ("nuts") are a common article of food in Madagascar and different parts of Trop. Africa, where the plant is cultivated and known by different names. In Zanzibar they are an article of local trade. The plant has been carried by the Negro slaves to certain parts of Tropical South America, where it has become naturalised. It is known in Surinam as "Gobbe," in Natal as "Igiuhluba," and in Madagascar as "Pistache Malgache." In yield and cultural requirements the plant resembles the common ground-nut. See *Arachis*, page 302. §.

Kerstingiella geocarpa. (*Leguminosae.*)—A kind of "ground-nut," similar to the preceding species in habit, etc., found and cultivated in Togoland, &c., and known as "Kandela." It is a prostrate herb, rooting at the nodes, and bearing white, red, or black seeds.

Zea Mays (*Gramineae*). Indian-corn; Maize; Mealies of S. Africa; Bada-iringu, *S*; Cholum, *T*.—An annual monoecious grass, 5 to 8 ft. high, native of Mexico, cultivated from very early times. The unripe tender heads (cobs) are, when properly cooked, a nutritious and delicious vegetable. They are prepared in numerous ways, as boiled in milk, roasted and served with butter, pepper and salt. The ripe grains are made into flour, which in some countries form the staple food of the inhabitants. In America they are also used in the manufacture of starch and for the production of corn-oil. The crop has long been cultivated in the Eastern tropics, but is grown to greatest extent and perfection in the warmer parts of N. America, also in S. Africa, parts of India, Australia, &c. It thrives best on rich, deep soil, and is not adapted to very wet or wind-swept localities. It may be grown in the tropics up to 4,000 or 5,000 feet, provided wind and rain are not excessive. A dry period for maturing the crop is necessary.

The ground being well prepared and manured, drills may be made 3 ft. apart, the seed sown about 2 to 3 in. deep and about 6 in. apart, the seedlings being afterwards thinned out to distances of about 12 inches; or 3 or 4 seeds may be sown together, in holes about 12 or 15 in. apart, afterwards thinning out the weaker plants when a few inches high. In rich soil wider spacing is necessary. About 10-12 lbs. of seed is thus required to sow an acre. The plants should be earthed up when about 1½ to 2 ft. high. The cropping period varies from 3½ to 4 months, according to variety and climate. Each plant should produce from 2 to 4 cobs, varying from 8 to 12 in. long. The yield also varies considerably according to variety, &c., 40 to 50 bushels per acre being a good average crop. A bushel of average seeds weighs about 60 lbs., and a pound contains about 1,500 seeds. See also *Fodder Grasses*, p. 451.

Varieties.—These come under two main types, viz. "flint" and "dent" grains. Flint varieties are considered to ripen more rapidly than the "dents," though the latter are often preferred for general cultivation. The plant is naturally subject to cross fertilisation, so that it runs into numerous varieties. Among the best and most distinct are:—Pride of the North, Iowa, Silvermine, Longfellow Dent, Hickory King (sweet or sugar-variety with white seed), Golden Flint, Mastadon, and Waterloo.

Talinum triangulare; also *T. ventricosa*, *T. verticillata*, &c. (*Portulaceae*).—Small plants with small succulent leaves; the latter are edible and often used for spinach, as are also those of other plants of this family. See also *Portulaca*, p. 312.

(5).—CEREALS OR DRY GRAINS.

COMMONLY CULTIVATED IN THE TROPICS.

SUITED TO DISTRICTS WITH LIMITED RAINFALL, NEW CLEARINGS, &C.

Amarantus paniculatus or **A. frumentaceus.** Amaranth; Pungkiray, *T*; Lansi-tampala, *S*; "Sag" of Bengal.—A robust, quick-growing annual, 5-7 ft. high, with striated stem and long-petioled, ovate-lanceolate, bronze or reddish leaves, commonly cultivated in India, Ceylon, &c., for the small black, white, or yellowish seed, which are an article of food with peasants in the Eastern Tropics. The young leaves of this and other species (or varieties) are also used as a vegetable. See p. 301.

A.—gangeticus and other species, as **A.—tricolor, A.—melancholicus, A.—oleraceus,** &c. Tampala, *S*.—Handsome erect annuals, about 3-4 ft. high or more, bearing small black seeds, commonly cultivated in India, Ceylon, Malaya, &c., for the leaves, which are used as a vegetable. Some garden varieties are grown for ornament on account of their bright red or yellow foliage. See pages 133, 301.

Chenopodium album. Bajar, Taku, &c. (India). An erect herb with toothed leaves and small green flowers. The small seeds are eaten and considered by some superior to Buckwheat. The leaves are used as a pot-herb and green vegetable. Cultivated in Bengal, Punjab, &c. See pp. 337, 398.

C.—Quinoa. "Quinoa".—South American species, growing to a height of about 5 ft.; leaves glaucous, powdery beneath; seeds very small, shining, and acrid, but on soaking and boiling the bitter property is removed, and they form a "favourite dish in Chili." 15,000 seeds go to an ounce.

Coix Lachryma-Jobi. Job's tears; Kikirindi, *S*."Adlay" of the Philippines, &c.—A robust grass with broad leaves, 4-6 ft. high, common in Ceylon (naturalised and cultivated); cultivated in parts of India as a cereal, also in Malaya, &c., for fodder (see pp. 448, 461). Several varieties are known.

Eleusine coracana. Kurrakan, *S*; Nacher or Kel-varagu, *T*; "Ragi" of S. India, Malaya, &c.; Nachni (*Hind.*).—An erect sedge, about 2-3 ft. high, producing a terminal cluster of incurved spikelets, with small, round, reddish seed, commonly cultivated in Ceylon, India (especially in Mysore), Malaya, &c. It is suited to poor or rich soil, and yields from 800 to 1,000 lb. (say 12-16 bushels) of grain per acre according to locality, maturing a crop in 3 to 5 months. About ½ bushel seed will sow an acre.

Fagopyrum esculentum. *Polygonaceae*. Buckwheat; Kotu, Bro, &c., of India. An upright, annual herb, of rapid growth, with angular, hollow stems, hastate-cordate leaves, and small 3-angled fruit; cultivated in parts of India for the seeds, which are eaten by the poorer classes and "by the Hindus on feast days." It is bitter, and is regarded as heating and unpalatable.

Panicum miliaceum. Indian Millet; Meneri or Wal-meneri, *S*; Pani-chamai, or Katakuny, *T*; Chena (*Hind.*).—An erect, annual grass, 2-3 ft. high, with rather broad hairy leaves and a much divided, nodding panicle. Largely grown in dry parts of India, and to some extent in Ceylon and other warm countries for its grain, yielding 600 to 800 lb. or more per acre.

P.—miliare. Little Millet ; Heen-meneri, *S*; Samai or Chamai, *T* ; Kutki or Gundli (Hind.).—Annual, tufted grass, 2 to 3 ft. high, with long drooping panicles, cultivated to some extent in India, Ceylon, &c.

P.—Crus-galli var. **frumentaceum.** Cockspur Grass ; Sanwa Millet ; Sanwa or Kheri (*Beng.*); Wel-marukku, *S* ; Mondy, *T*.—An erect, quick-growing grass, 2 to 4 ft. high, with large leaves and erect, rigid panicles composed of many incurved spikelets, cultivated in parts of India for its grain; common in the dry region Ceylon, often in paddy fields. "Sanwa" is an inferior grain, its chief merit being its rapid production, a crop being sometimes matured within six weeks of sowing. The straw is an excellent fodder. See page 449.

Paspalum scrobiculatum. Koda Millet ; Amu or Karal-amu, *S*; Varagu or Varaku, *T*; Kodaka (*Hind.*). An erect, perennial grass, 2½-4 ft. high, common in India, Ceylon, &c., sometimes cultivated for its grain, which is of inferior quality and, having traces of poison, requires careful washing and preparation before use. The yield is sometimes as much as 400 to 500 lb. or more per acre. Several varieties are recognised.



1, *Pennisetum typhoideum.* (PULL-PADDY; POLLU, *S*). 2, *Setaria italica.* (TANA-HAL, *S*; TINAI-CHAMAI, *T*.)

Pennisetum typhoideum (=*Panicum spicatum*). Pull-paddy; Bulrush-or Spiked-millet; Bajra (*Hind*); Kumbu, *T*; Pollu, *S*.—An erect grass with thick, round stems, attaining a height of 4 to 6 ft. or more. Leaves broad and long; spikes terminal, cylindrical, smooth, dark-brown, 6 to 9 in. long; extensively cultivated in parts of India. Yields 500-800 lb. of grain per acre, in 3½ to 4 months from sowing. $.

Setaria italica. Italian Millet ; Kangui (*Hind.*) ; Kakun of Bengal ; Shamai or Tinai, *T*; Tana-hal, *S*.—An annual grass, about 2-3 ft. high, bearing cylindrical spike-like panicles with smooth grain, commonly cultivated in the drier parts of India, Ceylon, &c. Considered to be nutritious and digestible, being one of the best of dry grains. A yield of 600 to 800 lb. per acre should be obtained under favourable conditions. $.

Sorghum vulgare (Andropogon Sorghum). Great Millet or Guinea corn ; Durra ; Cholum, *T*; Karal-iringu, *S*; Joar (*Hind.*); Jowari (*Beng.*). See page 306. §.

S.—saccharatum (*Andropogon saccharatus*). Broom-corn ; "Dheodan" of India.—An annual grass, cultivated in parts of Northern India, either for fodder or for the sugar obtained from the stems. The grain is sometimes used as food. See page 363.

(6).—*ANALYSES OF VEGETABLES, PULSES, AND DRY GRAINS.

PULSES, ETC:—	Water.	Albuminoids or Proteids (flesh-formers).	Carbohydrates. (Starch, sugar, etc.)	Oil or fat.	Fibre or cellulose.	Ash.
Arachis hypogaea. Ground-nut.	7.5	24.5	11.7	50.0	4.5	1.8
Cajanus indicus. Pigeon-pea.	10 5	22·3	60·9	2·1	2·1	3·0
Canavalia ensiformis. Sword-bean.	12.5	25.0	48.6	2.8	7.	3.4
Ceratonia Siliqua. Locust-or Carob-bean. ..	14.6	7.1	67.9	1.1	6.4	2.9
Cicer arietinum. Chick-pea. See p. 286 ..	7.5	24.5	11.7	50.0	4.5	1.8
Cyamopsis psoralioides. Cluster-bean.	11.8	29.8	46.2	1.4	7.7	3.1
Dolichos Lablab. Lab-lab Bean.	12.1	22.4	54.2	1.5	1.2	3.0
D.—biflorus. Horse-gram ; Wula-wala, *T.* ..	11.0	22.5	56.0	1.9	5.4	3.2
Glycine hispida. Soya-bean ; Bhat (*Hind.*) ..	11.0	35.3	26.0	18.9	4.2	4.6
Lathyrus sativus. Vetchling ; Khessari (*Hind.*) ..	10.1	31.9	53.9	0.9	—	3.2
Lens esculentus. Lentils.	11.8	25.1	58.4	1.3	1.2	2.2
Lupinus albus. Lupines ; Turmas (*Hind.*) ..	12.5	31.7	33.7	5.0	13.5	3.6
Phaseolus Mungo var. Black-or Green-gram. ..	10.8	22.2	54.1	2.7	5.8	4.4
P.—vulgaris. Haricot-beans.	14.0	23.0	52.3	2.3	5.5	2.9
P.—lunatus. Lima-bean.	13.3	19.7	57.8	1.2	4.3	3.7
P.—aconitifolius. Moth-bean; Dew- bean ..	11.2	23.8	56.6	0.6	4.2	3.6
Vigna Catiang. Catiang-bean ; Black-eye. ..	12.5	24.1	56.8	1.3	1.8	3.5
OTHER VEGETABLES :—						
Artichokes, Jerusalem.	80.0	2.0	15.5	0.2	1.3	1.0
Beet, sugar.	81.5	1.0	15.4	0.1	1.3	0.7
Cabbage, Drumhead (inner leaves).	89.4	1.5	7.0	—	1.3	0.8
Carrot.	85.0	1.4	10.8	0.2	1.7	0.9
Cassava (Meal)	34.1	2.2	60.4	.8	.8	1.7
Kohl-rabi or Knol-kohl.	87.0	1.3	9.5	0.1	1.1	1.0
Lettuce	93.0	0.7	4.7	—	0.6	1.0
Parsnip.	85.1	1.3	10.9	0.3	1.4	1.0
Peas.	14.3	22.4	52.5	2.0	6.4	2.4
Potato.	75.0	2.1	20.6	0.3	1.1	0.9
Pumpkin.	89.1	0.6	6.5	0.1	2.7	1.0
Turnip.	91.0	1.2	6.0	0.2	1.0	0.6
DRY GRAINS (See also p) :—						
Avena sativa. Oats (seed)	14.3	12.0	55.7	6.0	9.3	2.7
„ „ (meal)	10.5	11.0	52.2	4.5	14.5	6.8
Coix Lachryma-Jobi. Job's Tears.	13.2	7.3	73.2	1.5	2.5	2.3
Eleusine coracana. Ragi ; Kurrakan, *S.* ..	13.2	7.3	73.2	1.5	2.5	2.3
Fagopyrum esculentum. Buck-wheat. ..	14.0	9.0	58.7	1.5	15.0	1.8
Oryza sativa. Paddy ; Goyan, *S* ; Arisi, *T.* ..	12.8	7.3	78.3	0.6	0.4	0.6
Panicum Crus-galli var. frumentaceum. ..	12.0	8.4	72.5	3.0	2.2	1.9
P.—milaceum. Indian Millet.	12.0	12.6	69.4	3.6	1.0	1.4
P.—miliare. Little Millet ; Shamai, *T.*... ..	10.2	9.1	69.0	3.6	4.6	3.5
Paspalum scrobiculatum. Koda Millet. ..	11.7	7.0	77.2	2.1	0.7	1.3
Pennisetum typhoideum. Bulrush Millet. ..	11.3	10.4	71.5	3.3	1.5	2.0
Secale cereale. Rye (seed)	14.0	11.0	67.4	2.0	3.5	1.8
Setaria italica. Italian Millet; Tinai, *T.* ..	10.2	10.8	73.4	2.9	1.5	1.2
Sorghum vulgare. Guinea-corn ; Dhurra. ..	12.5	9.3	72.3	2.0	2.2	1.7
Sorghum saccharatum. Broom-corn. ..	12.8	11.8	68.3	3.0	3.0	1.1
Triticum vulgare. Wheat (Seed). ..	14.4	13.0	66.4	1.5	3.0	1·7
„ „ „ (Meal)	12.6	11.8	74.1	1.2	0.7	0.7
Zea Mays. Indian-corn.	12.5	9.5	70.7	3.6	2.0	1.7

*"Food Grains of India" by Prof. A. H. CHURCH.

(7).—EDIBLE FLOWERS IN THE TROPICS.

Various flowers are edible and relished in different countries, either as an article of food or for flavouring purposes. In Europe, violets, primroses, pot-marigolds, rose-buds and other flowers are used in delicate salads or preserves. The following are some of the principal flowers used for food in tropical or sub-tropical countries.

Abutilon esculentum.—Flowers commonly eaten as a vegetable in Brazil.

Banana.—Young flower-heads commonly used as a vegetable in Ceylon, etc.; used in China for pickling.

Bassia latifolia. Illipi; Mahwa; Indian Butter-tree. In India the fleshy flowers, produced in February, are dried and eaten by the peasants, the average annual yield per tree being about 200 lb. It is estimated that some 25,000 tons of the flowers are gathered in India every year. These are sometimes used for the extraction of alcohol.

B.—longifolia. "Mee", *S.* A medium-sized tree, similar to the preceding species, but with narrower leaves, found chiefly in S. India and Ceylon; used for similar purposes in India to the "Mahwa." In Ceylon, the seeds are used for the extraction of oil. See page 395.

Bombax malabaricum. Red cotton-tree; Katu-imbul, *S.*—The fleshy calyces of the large red flowers, collected as they drop, are much relished as a curry vegetable by the Burmese.

Calligonum polygonoides. Phogalli.—Flowers eaten in Northern India, being made into bread or cooked with butter.

Hibiscus Sabdariffa. Rozelle.—The fleshy, persistent, enlarged calyces are used for flavouring and for making jelly, etc. See pages 264, 430.

Ipomoea Bona-nox. Moon-flower. The fleshy calyces are commonly used as a vegetable in Ceylon.

Lilium Thunbergii.—The flowers form a choice culinary delicacy in China.

Rivea ornata. (*Convolvulaceae*). The fleshy flowers are eaten in the North of Ceylon; not cultivated.

Sesbania (Agati) grandiflora.—Flowers much relished when boiled or fried See page 305.

(8).—EDIBLE HERBS, &c., COMMONLY USED AS FOOD IN CEYLON BY THE POORER PEOPLE, BUT NOT CULTIVATED,

SHOWING PARTS USED.

Acalypha indica. Kuppamaniya, *S.* (Euphorbiaceae). Leaves.
Achyranthes aspera. Gas-karal-heba, *S.* (Amarantaceae). Leaves.
Acrostichum aureum. Kere-koku, *S.* (Filiceae). Tender fronds.
Aerva lanata. Pol-kudu-pala, *S.* (Amarantaceae). Stems and leaves.
Allmania nodiflora. Kumatiya, *S.* Leaves.
Alternanthera triandra. Mukunu-wenna, *S.* (Amarantaceae). Tender stems and L..
Amarantus gangeticus. Sudu-tampala, *S.* (Amarantaceae). Tender stems and leaves
A.—polygonoides. Kura-tampala, *S.* ,, ,, ,,
A.—spinosus. Katu-tampala, *S.* ,, ,, ,,
Aponogeton crispum. Kekatiya, *S.* (Naiadeae). Tuberous roots.
Argyreia populifolia. Giritilla, *S.* (Convolvulaceae). Tender leaves.
Asparagus falcatus. Hathawariya, *S.* (Liliaceae). Young shoots and roots.
Asplenium esculentum. Miwana-kola, *S.* (Filiceae). Tender fronds.
Atriplex repens. Elichchevi, *T* Foliage eaten as a vegetable at Jaffna.
Boerhaavia diffusa. Peta-sudupala, *S.* (Nyctagineae). Leaves.
Cassia auriculata. Ranawara, *S.* (Caesalpineae). Leaves and young pods.
C.—occidentalis. Peni-tora, *S.* Leaves and flowers.
Cassia tomentosa. L., fruit, and fl's eaten as a curry vegetable.
C.—Tora. Peti-tora, *S.* Leaves and flowers.
Celosia argentea. Kirihenda, *S.* (Amarantaceae). Stems and leaves.
Ceratopteris thalictroides. Kudamahu-weralla, *S.* (Filiceae). Succulent leaves.
Commelina benghalensis. Diya-meneriya, *S.* (Commelinaceae). Stems and L.
C.—clavata. Girapala, *S.* Stems and leaves.
Costus speciosus. Tebu. *S.* (Scitamineae). Tuberous roots.

Cycas circinalis. Madu, *S.* (Cycadeae). Sago made from seeds.
Dregia volubilis. Kiri-anghuna, *S.* (Asclepiadeae). Leaves.
Gynandropsis pentaphylla. Wela, *S.* (Cappurideae). Leaves; strongly aromatic.
Hibiscus furcatus. Napiritta, *S.* (Malvaceae). Tender leaves.
Hydrocotyle asiatica. Hin-gotu-kola, *S.* (Umbelliferae). Stalks and leaves.
Impatiens flaccida. Kudalu, *S.* (Geraniaceae). Stems and leaves.
Klugia notoniana. Diya-nilla, *S.* (Gesneraceae). Leaves.
Lasia spinosa. Kohila, *S.* (Araceae). Tender leaves.
Leucas zeylanica. Geta-tumba, *S.* (Labiatae). Leaves.
Lippia nudiflora. Herimena-kola, *S.* (Verbenaceae). Leaves.
Marsilea quadrifolia. Diya-embul-embiliya, *S.* (Rhizocarpeae). Stalks and leaves.
Monochoria hastaefolia. Diya-habarala, *S.* (Pontederiaceae). Tender stalks & L.
Nasturtium officinale. Kakutu-pala, *S.* (Cruciferae). Stalks and leaves.
Nelumbium speciosum. Nelun, *S.* (Nymphaeaceae). Seeds.
Nymphaea Lotus. Olu, *S.* Seeds.
Oxalis corniculata. Heen-embul-embiliya, *S.* (Geraniaceae). Stalks and leaves
Pandanus odoratissimus. Rumpi, *S.* (Pandanaceae). Young leaves for flavouring.
Polypodium quercifolium. Bainduru, *S.* (Filiceae). Young fronds in bud.
Portulaca oleracea. Genda-kola, *S.* (Portulaceae). Stems and leaves.
P.—quadrifida. Heen-genda-kola, *S.* Stems and leaves.
P.—tuberosa. Urugenda-kola, *S.* Stems and leaves.
Solanum indicum. Tibbatu, *S.* (Solanaceae). Tender fruits.
S.—nigrum. Kalukanweriya, *S.* Stalks and leaves.
S.—xanthocarpum. Ela-batu, *S.*; Kandan-kathrikai, *T.* Yellow fruits.
Typhonium trilobatum. Panu-ala, *S.* (Araceae). Tender leaves.

CHAPTER XXII.

TEMPERATE OR SUB-TROPICAL VEGETABLES AND FOOD-CROPS

The following include vegetable crops suited chiefly to sub-tropical conditions, or to elevations of about 3,000 feet upwards. Many may be grown with moderate success in the cool seasons at lower elevations,some even at sea-level. For convenience of reference, it is considered preferable in this case to give precedence to the common or " English " name over the botanical, the former being better known. The botanical name and Natural Order are enclosed in brackets. See p. 284.

Aracacha, or Peruvian Parsnip. (*Arracacia esculenta.* Umbelliferae) —A low Parsnip-like plant, producing edible, starchy, tuberous roots, the flavour of which has been compared to a combination of parsnips and potatoes ; native of Peru, where it is cultivated up to 7,000 feet altitude ; introduced at Hakgala Gardens, Ceylon, in 1884.

It is propagated from seed, or by division of the small heads or stems which spread out from the crown,the setts being planted in rows about 20 inches apart. The plant takes from 10 to 12 months to mature a crop, but some tubers may be gathered for use 2 months earlier than this if required. It will thrive in any good soil, and is best adapted to the higher elevations. Commonly cultivated in Colombia up to 8,000 feet elevation.

Artichoke, Chinese. (*Stachys tuberifera.* Labiatae).—A dwarf herbaceous plant, bearing underground white spiral-like tubers, 2 to 2½ inches in length and about ½ an inch in thickness. They are eaten either cooked as a vegetable, or raw like radishes, resembling the latter in flavour, with a suggestion of the Jerusalem Artichoke. The plant has been found to thrive at Hakgala Gardens, but has not become popular in Ceylon as a vegetable.

Artichoke, Globe. (*Cynara Scolymus.* Compositae).—The tender part of the unexpanded roundish flower-head,after being boiled and cooked is much relished as a vegetable. The plant thrives to perfection at Nuwara-Eliya, growing sometimes in a semi-naturalised state, but is unsuited to elevations below 4,000 feet. Propagated by seed or suckers, preferably the former. Seed should be sown early in the year, in boxes or pots under cover but exposed as much as possible to the light, otherwise the seedlings are apt to damp off. The seed should germinate in 10 or 12 days after sowing. Prick out the seedlings when strong enough into a well-prepared and sheltered bed, and when these are about 4 in. high, plant them out 3 ft. by 4 ft. apart, in rows. Good heads should be produced in about 8 months from the time of planting. The plants thrive best in a rich moist soil, as by the side of water channels or streams

and is worth growing for ornament on account of its large, handsome, deeply cut, glaucous leaves.

Varieties.—"Green Globe" and "Purple Globe" are both good.

Artichoke, Jerusalem, from *girasole*, Italian. A better name is "Root-artichoke;" "Sun-root" has also been suggested. (*Helianthus tuberosus*. Compositae).—This is one of the most successfully cultivated of temperate vegetables in the tropics, and, strangely, it generally thrives better in the low-country than at the higher elevations. It flourishes in indifferent soils, but does best in well-manured, moist, sandy loam. Normally the plants reach a height of 6 to 8 feet or more, but in the tropics they usually grow to only about half that height. At the commencement of the rainy season, plant the tubers in rows about 2½ ft. apart, and about 10 in. distant in the row. Pick off any flowers that may appear on the plants. A crop of tubers may usually be obtained in about 4 months from the time of planting, and when these are taken up they should be covered with dry earth or sand and used as required. In the tropics the tubers deteriorate to some extent, so that new setts should be imported from time to time. The yield in temperate countries is usually from 6-10 tons per acre. See p. 310.



ASPARAGUS. *Asparagus officinalis.*

Asparagus. Harthawariya, *S.* (*Asparagus officinalis*. Liliaceae).—The cultivation of this delicious vegetable is hardly suited to the tropics, though at fairly high elevations, or under sub-tropical conditions, some measure of success can be obtained. The young tender culms or shoots are the parts used. The plant requires a rich, friable and well-drained soil, which should be heavily manured. Being a native of the sea-coast, it is considered to benefit from a sprinkling of salt applied to the surface soil once a year. It is best to import strong 3-years old roots once every 2 or 3 years or so; but plants can, if desired, be raised from seed, which should be sown in boxes under shelter. When the seedlings are a few inches high, they should be planted out in large, deep holes, care being taken not to in-

jure the delicate roots. In Europe, the seed is generally sown in the beds where the plants are to remain. There, a bed of Asparagus is in its prime at five years old, and lasts for a number of years. For the first two years none of the shoots or branches is cut, the plants being encouraged to make strong crowns or root-stocks. "Connover's Colossal" and "Reading Giant" are good varieties. S.

STOCKDALE mentions: "In Mauritius, seed is sown annually, and the plants when one year old are transferred to their permanent beds. The latter are prepared by digging trenches 3 ft. wide to a depth of 15 to 18 inches. Six inches of good soil is placed at the bottom of the trench, followed by 2 or 3 inches of good, rotten cow-dung. The roots are then planted and covered with 9 inches of soil mixed with leaf-mould and more manure. The plants are allowed to grow, flower and seed, and are then cut down; the soil is removed from the roots and replaced with good rotten manure and fresh soil mixed with salt. The next crop of asparagus is cut until it begins to become tough, then it is allowed to run to seed, and after the seed has ripened it is cut down again and treated as above described."

Beans, Broad. (*Vicia Faba.* Leguminosae).—Broad-beans are seldom grown successfully in the tropics. The plants set fruit but sparsely, even in the cool dry months, and when pods are produced they are usually small and lacking in flavour. The production of pods may, however, be considerably encouraged by pinching back the tops of the plants when in blossom, and by artificially pollinating the flowers. In Ceylon, seed is best sown in October or November. Seeds should be soaked in hot water for some hours, and then sown 4 inches apart, in drills, with about 18 inches between the latter, covering the seeds with 3 inches of good soil. There are two distinct types, the "Long Pod" and "Broad Windsor," the former being considered the better suited to the tropics.

Beans, Kidney-, or **French-.** (*Phaseolus vulgaris.* Leguminosae). Bonchi, *S.*—This excellent vegetable can be grown in the moist and cool season at all elevations from sea-level, but to most perfection at 4,500 to 6,000 feet, and is commonly cultivated in market gardens. The different varieties come under two distinct classes, viz.—(a) "Dwarf" sorts, which attain a height of 14 to 18 inches and do not need stakes for supports; (b) tall or "Runner Beans," which are climbers and grow 6 or 8 ft. in length, requiring supports. The conditions of culture for the tall and dwarf sorts are the same. The latter come into bearing sooner, and are more prolific, than the Runner Beans, which, however, remain productive for a longer period.

The seeds should be sown in rows in well-manured soil, with a distance for "dwarfs" of 18 or 20 in. between the rows and about 6 in. between the seeds; and for "climbers" 3 ft. between the rows and 10 in. between the seeds in the row. Frequent sowings should be made so as to keep up a succession of crops; sowings made towards the end of the monsoon rains give the best crops. The seeds germinate quickly, and the plants usually come into bearing in about six weeks from the time of sowing. Among the best of the *dwarf* sorts are:—"Canadian Wonder," "Butter Beans," "Mont d' Or," "Sutton's Perfection," and "Veitch's Hybrid." *Runner Beans*:—"Chelsea Giant White," "Epicure," "Excelsior," "White Long Pod," etc. A dwarf variety with cylindrical pods, which is remarkably free from fibre, is sometimes grown in Ceylon up-country gardens; it is known as "Murungabonchi," and is especially to be recommended.

Beans, Scarlet-Runner. (*Phaseolus multiflorus.* Leguminosae).—A herbaceous perennial climber with scarlet flowers, native of South America, the tender pods of which are used like those of French-beans. The plant is seldom cultivated in Ceylon, as it has been found unsuited

to the climate at any elevation, for although it grows and blossoms freely it seldom produces pods.

Beetroot. (*Beta vulgaris*. Chenopodiaceae). This grows well in up-country gardens, and at low elevations also yields very fair roots, which are the parts used. The plant generally thrives best in a rather heavy, moist soil, and, being naturally a native of the sea-coast, is supposed to benefit by an application of salt. For a suitable chemical manure mixture, see pp. 17-24. Farmyard manure, if used, should be in a thoroughly decomposed state. The ground should be dug deeply and formed into beds, with an even, smooth surface ; draw small drills about 1½ in. deep by 12 inches apart; into these sow the seed thinly and evenly, and cover with fine soil, afterwards pressing down the surface. The seed germinates in about 10 days. The seedlings must be thinned out to about 6 in. apart when well above the surface, and those removed may be transplanted if desired. A crop should be obtained in 2½ to 3 months.

Varieties.—Electric, Dell's Crimson, Middleton Park, and "Turnip-rooted" are all good sorts. On the plains in India, acclimatized seed is considered to give the best results.

Leaf Beet. (*Beta cicla*. Chenopodiaceae). A species of beetroot grown for its leaves, which are used in soups, etc., for flavouring. Cultural treatment the same as for common beet.

Borecole, Kale, or Curly Greens. (*Brassica oleracea acephala*. Cruciferae). —A variety of cabbage characterized by very crumpled or curly leaves, which spread out in plume-like fashion and do not form a compact head. These are not considered fit for use in Europe until they have had some frost. Owing to their ornamental appearance, they are frequently employed for garnishing as well as for cooking purposes. They can be grown successfully at medium and high elevations, but are more suited to a cold climate and are seldom seen in gardens in Ceylon. Cultural directions the same as for Cabbage.

Broccoli. (*Brassica oleracea Botrytis*. Cruciferae).—This is practically a kind of Cauliflower in which the flowers do not form a compact head ; it is grown as a winter crop in cool countries, and is unsuitable for cultivation in the tropics.

Brussels Sprouts. (*Brassica oleracea gemmifera*. Cruciferae).—This favourite vegetable is a variety of Cabbage which, instead of forming one single head, produces numerous small heads or "sprouts" crowded along the stem towards the top, the stem being usually 2-3 ft. high.

It is a winter vegetable in Europe, &c; but thrives at high elevations in the tropics and is commonly grown in up-country gardens. Cultural requirements are similar to those of the Cabbage. Sutton's Matchless, Aigburth, and Dwarf Gem are all good varieties.

Cabbage ; Gova, *S.* (*Brassica oleracea*. Cruciferae).—This useful vegetable is grown abundantly in up-country gardens, and excellent specimens, sometimes weighing up to 20 lbs. or more, may often be seen. At low or intermediate elevations also, it thrives sufficiently well to yield at least a crop of green leaves, which are much prized by the peasants for vegetable curries. A rich well-drained and manured soil is essential. The seed may be sown thinly on a sheltered border of finely worked, loose soil; when the plants are 4 or 5 in. high, they should be planted out at distances of about 1½ ft., in rows about 2 feet apart. The young plants require to be shaded until strong enough to take care of themselves. A crop should mature in about 3 months. In the tropics, propagation is often by cuttings from shoots which appear on the stem ; plants thus raised are less susceptible to the club-root disease than seedling plants.

The *club-root disease*, to which the Cabbage family is specially liable, is the greatest drawback to Cabbage cultivation in the hill districts of Ceylon (see p. 495). The ground becomes infested with it as soon as the first crop of Cabbage is grown, so that a change of soil for each crop of the latter is advisable, if not essential. As a preventive, fresh slaked (powdered) lime, may be applied at the rate of about 75 bushels per acre, or about 15 lbs. to 100 sq. feet. All diseased plants should be burnt. *Cut-worms* (Black-grub) are also a very destructive to young Cabbage seedlings, being perhaps attracted by the club-root disease. See pp.481, 488.

Varieties.—Sutton's Earliest, Sutton's Maincrop, Early Battersea, Early York, and the hardy Drumhead are among the best.

Cabbage, Red. (*Brassica oleracea capitata rubra.* Cruciferae).—This thrives well at 4,000 to 6,000 ft., but is not much grown in Ceylon. It is used chiefly for pickling. Cultural requirements are similar to those of the Cabbage. The principal varieties are "Red Drumhead," "Red Dutch," and "Dwarf Red."

Cabbage, Savoy. A dwarf variety of Cabbage with crimped leaves, usually forming firm, rather flat heads. Thrives well at high elevations, and considered a delicacy, is not much grown in Ceylon.

Cabbage, Shantung (*Brassica chinensis.* Cruciferae). Also known as "Choude Chine" and "Pe-tsai."—A species of Cabbage, shaped like a Cos lettuce and weighing when well-grown 5 to 6 lbs. or more.

This has long been in high repute in China as a vegetable. MR. HUGHES, late Commissioner of Customs at Chefoo, stated: "When boiled it is nearly as good as Sea-kale; eaten raw, in a salad, it is of so delicate a flavour that I know of no vegetable in England to approach it." This cabbage thrives best in moist, rich soil, and has the advantage of standing the rain well, growing rapidly to a size fit for consumption. It is grown from seed, the seedlings being planted in rows about 20 in. apart, with about 15 inches between the plants in the rows. When nearly full grown, the heads should be tied up so as to encourage them to form a firm, white heart.

Capsicum.—See pages 303, 334.

Cardoon. (*Cynara Cardunculus.* Compositae).—A perennial plant, much cultivated on the continent of Europe for the sake of the fleshy mid-ribs, which, however, are not much relished in England. This does not appear to be grown in Ceylon, and its cultivation in India seems equally uncommon. Seedlings may be raised under cover, and planted out in trenches about 3 ft. apart, with a distance of 18 in. between the plants in the rows. Later on, the earth is drawn up to the plants as in Celery cultivation, for the purpose of blanching the leaves.

Carrot. (*Daucus Carota.* Umbelliferae).—This popular vegetable can be grown very successfully at medium to high elevations, and also at lower elevations with some success. In up-country market gardens carrots are among the best grown vegetables. A loose, rich, sandy soil which has been manured well for the preceding crop is the most suitable, fresh manure being considered to be unsuited to the crop. The seeds should be sown thinly in drills about 9 in. apart, the young plants being afterwards thinned out to distances of about 3 inches. Further thinning out may be continued by drawing for use the largest or most crowded plants. The best way of storing carrots is to cover them in a heap of damp sand, in a dry airy shed.

Varieties.—These are divided into two distinct classes, viz. the *Long-rooted*, which comprises the Altringham, James Intermediate,

White Belgian, etc.; and the *Short-rooted* or *Horn* kind, including "Scarlet Dutch Horn," "Early Short Horn," etc.

Cauliflower. Mal-gova, *S.* (*Brassica oleracea Botrytis.* Cruciferae).—This delicious vegetable is a variety of Cabbage, the dense white flower-heads being the part used. The Cauliflower thrives well at elevations of 4,000 to 6,000 ft., and a rich, well manured and limed soil suits it best. Cultivation, etc., the same as for Cabbage. Acclimatized seed, obtained chiefly from Northern India, are said to do best in Bengal.

Varieties.—Among the best are: Veitch's Autumn Giant, Walcheren, Dean's Early Snowball, and Large Asiatic. See pp. 317, 493, 501.

Celeriac ; Turnip-rooted or Knob-Celery. (*Apium graveolens rapaceum.* Umbelliferae).—A variety of Celery, the stem of which forms an irregular knob, which is used in salads, while the leaves are used for flavouring purposes. It can be grown from 1,000 ft. upwards, but there is little to recommend its cultivation where Celery can be grown.

Celery ; Seldry, *S.* (*Apium graveolens.* Umbelliferae).—This can be grown with great success in up-country gardens, and even in the low-country or on the plains very fair stalks can be produced, while the plant is worth growing for the sake of the leaves alone for flavouring purposes. The essential conditions for Celery culture are constant moisture and rich, well-manured soil. The small seed should be sown in a box under cover, the small seedlings being afterwards pricked out into beds or boxes; when about 4 in. high, plant these out about 6 to 8 in. apart in a deep trench, having filled the bottom of which to a depth of 6 in. with good manure mixed with some soil. Later, a little fertiliser, as sulphate of potash or superphosphate, may be given. Blanching of the stems or leaf-stalks is effected by depriving them of the light, *i.e.* in practice by drawing up the soil to the plants at intervals as they grow, the leaves meantime being loosely tied, or held together by means of boards placed temporarily against them. A good method of earthing up for blanching is to take a piece of bamboo about 18 in. long and slit it in two; having pointed the ends, drive these into the earth, close on either side of the plant; the latter, encompassed by the bamboo, is then earthed up, the bamboo sections being afterwards removed. Celery takes about 4 to 5 months from the time of sowing to be ready for use.

Varieties.—Amongst the best are Wright's Giant Groove, Cole's Solid Red, Golden Yellow, and Mammoth White.



Sechium edule. CHO-CHO OR CHAYOTE.

Cho-cho, Cayote, or Chayote. (*Sechium edule*. Cucurbitaceae).—A perennial robust creeper, with leaves like those of the Cucumber, native of the West Indies, introduced from Jamaica into Hakgala Gardens, Ceylon, in 1884. It is much grown at the higher elevations in the West Indies, South America, and also in the Mediterranean region, being known in the latter country as "Chayote." The plant has become well established in Ceylon, especially in the hill districts, and thrives from 1,000 ft. upwards; but it is not much cultivated, not being in general demand as a vegetable, and the peasants are prejudiced against it. Propagation is effected by planting the entire 1-seeded fruit *in situ*, in mounds of well-manured soil. It requires natural or artificial supports for the vines to grow over, and thrives up-country without shade, but is benefited by light shade at lower elevations. See p. 292. S.

The pear-shaped, pale-green or white fruits are used like vegetable-marrow and are in season almost throughout the year, the plants commencing to bear in 3 to 4 months after planting. Well-grown fruits weigh from 2 to 3 lbs. each; these are sold in the local markets and boutiques at 3 to 5 cts. each. The plant produces under ground a large yam (tuber), which is relished by some people as a vegetable. In Mexico this is boiled and candied, or sliced and fried for table use. The white-fruited variety seems better adapted for the low-country than the green form.

Chou Moellier, or Cabbage Broccoli, see p. 451.

Cress, Garden. (*Lepidium sativum*. Cruciferae).—A small annual, commonly cultivated in temperate countries for the sake of the young leaves, which are used uncooked in salads.

It is a very quick-growing and short-lived plant, being ready to cut for use within a few days after sowing. Seeds may be sown broadcast on a smooth surface, in a box or bed, which should be shaded from the sun. Frequent sowings are necessary in order to keep up a succession of cuttings.

Cress, Indian. (*Tropaeolum majus* and var's. Geraniaceae).—The flowers as well as the young leaves of several varieties of the annual Tropaeolum are much relished by some people in salads.

The plants are readily grown from seed and thrive at medium to high elevations; they are also very ornamental, especially the climbing varieties, which are excellent for covering trellis-work, fences, rocky banks, etc. See p. 202.

Cress, Water. Kakkutu-pala, or Wataressa, *S.* (*Nasturtium officinale*. Cruciferae).—A low perennial herb, native of Europe, etc., naturalised in Ceylon, being commonly met with in swampy situations, in the neighbourhood of rice fields, or at high elevations. The young leaves form a favourite salad, though not much used as such here. Water-cress may be readily propagated from seed, or by cuttings or divisions of the old plants, and is easily grown in a patch of soil through which water is made to flow; stagnant pools are unsuitable for New Zealand, where the plant has been introduced, it has become a formidable pest, having established itself in almost every water-course and spring.

Cucumber. Rata-kekiri, *S.* (*Cucumis sativus*. Cucurbitaceae).—The superior varieties of Cucumber, cultivated to such perfection in hot-houses in temperate countries, can only be grown with success in the tropics where a greenhouse or a good heating frame is available. Such protection is necessary in order to enable equable conditions of temperature and moisture being maintained. The hardier "Ridge" cucumbers

may, however, be grown in the open, in the same way as Pumpkins or Vegetable-marrow. Excellent specimens have been grown in frames at Hakgala Gardens, though market gardeners in Ceylon seldom attempt to grow cucumbers of any kind. Seeds should be sown in pots or boxes under cover, and the seedlings planted out when about 3 in. high. Pinch out the tips of the plants when they are about 8 in. high, and afterwards the tip of each shoot 2 in. beyond the young fruit, so as to cause the latter to swell. A grateful substitute for the "English" cucumber is found in the native "Pipingha,"—see *Tropical Vegetables*, page 291.

Endive. (*Cichorium endivia*. Compositae).—An annual of Northern China, cultivated for its stocky head of curly leaves, which when tender are used as a salad and in other preparations. The plant is of easy culture, and may be seen occasionally in up-country gardens in Ceylon. Propagated from seed.

Horseradish. See *Condiments and Seasoning Herbs*, page 346; also *Moringa*, page 305.

Knol-kohl or **Kohl-rabi.** (*Brassica caulo-rapa*. Cruciferae).—This vegetable holds a place intermediate between the Cabbage and the Turnip, and is supposed to combine the flavour of both. The stem above ground grows into a turnip-like head and is the part used. The plant is often erroneously referred to as the turnip-rooted Cabbage, a different plant, the tuberous root of which is used. Knol-kohl thrives remarkably well in the low-country, being able to resist heat and drought better than most vegetables of the Cabbage family. Seed should be sown in drills about a foot apart, the plants being afterwards thinned out to a distance of 8 or 9 in. in the row; or seedlings may be raised in a box or sheltered bed, and transplanted like Cabbage. The best time for sowing is at the commencement of the monsoon rains. There are several *green* and *purple* varieties, the green sorts being generally preferred. The crop should be fit for the table in about 8 to 10 weeks from sowing.

Leeks. (*Allium Porrum*. Liliaceae).—Leeks thrive to perfection at the higher elevations, but their cultivation is seldom worth attempting below 2,000 feet. Sow seeds on a sheltered bed or in boxes, before the commencement of either of the monsoons; prick out the seedlings when large enough to handle, and transplant these at distances of 6 inches into well-manured, deep trenches. As the plants increase in height, the trench should be filled in gradually with earth so as to encourage the production of long, thick, succulent and well-branched stems, which are the part used. Leeks require rich soil, plenty of manure and constant moisture. The "London Flag" and "Musselburgh" are old favourite varieties, which are probably still perhaps unsurpassed for quality.

Lettuce. Salada, *S.* (*Lactuca sativa*. Compositae).—This takes first place as a salad plant, and can be grown at almost all elevations in the tropics, but to greatest perfection in the hills. The plant is an annual, prefers a rich, mellow, humous soil, and responds well to manuring. Sowings should be made at intervals of three weeks or a month, so as to keep up a succession of crops. It is best to sow the seed in shallow drills on a well-prepared bed, afterwards thinning out the plants to about 8 inches apart; or the seed may be sown in seed-pans or boxes,

and the seedlings transplanted out when they have obtained their second pair of leaves, though it is well to remember that Lettuce does not always take well to transplanting. In the tropics, the plants soon run into seed. A method sometimes adopted to prevent them from seeding is to cut the tap-root below the surface of the soil, this being also considered to have the effect of causing the plant to form a good heart.

Varieties.—These are divided into two classes, viz. "Cabbage-lettuce" (from the round cabbage-like heads, with broad leaves), and "Cos-lettuce," the latter being distinguished by erect, conical heads and rather narrow, pointed leaves. The former is considered the better kind for wet climates. There are numerous sub-varieties, as "White Dutch," "Golden Queen," "Little Gem," "White Silesian," "Green Paris," etc. The bronze-leaved kind is not generally liked.

Maize.—See *Tropical Vegetables*, page 307.

Mushrooms. Included in the family *Agaricaceae* are mushrooms and toadstools, which are characterised by having the spores borne on the gills (*lamellae*), usually placed below the cap (*pileus*). In Ceylon the vernacular names "Bim-mal" (Sinh.) and "Ka-lang" (Tamil) are applied to all fungi. While many of the tropical fungi, whether growing naturally on the soil or on decayed tree-trunks, etc., are edible, others are undoubtedly very poisonous. It is not always easy, especially for inexperienced persons, to distinguish between these, though some people consider they can always do so. The best forms of mushrooms are usually those which, when young, resemble round, white buttons; when a day or two old they open out like an umbrella, and the gills (under side) are found to be of a delicate pink colour.

Poisonous kinds, though in some cases resemble these characters, are said to turn to a bright yellow colour when cooked. Fungi with a slimy skin, or which when broken or bruised show a deep blue colour, should be avoided. PETCH prefers not to lay down any hard and fast rule by which a novice may attempt to identify an edible from a poisonous fungus, and considers that actual experience is the best guide. Nor does he attach much importance to the nutritive value of edible fungi generally, an opinion shared by many other botanists. English mushrooms are, however, a popular article of diet with many people, and are commonly imported in hermetically sealed tins for consumption.

For growing mushrooms the following hints may be useful. A dark and fairly dry room is essential; a room or cellar in an unused shed or out-house will answer the purpose. Excessively wet or dry atmosphere and a high temperature must be avoided. Horse-dung, freed from grass or straw, should be collected daily, and kept under cover until a sufficient quantity has been secured. It should be spread evenly over the floor to prevent rapid fermentation. A bed is then made, about 3 ft. deep, consisting of alternate layers of the prepared horse-dung and good loamy soil, finishing with a layer of the latter on the top. The whole being beaten down firmly, the bed should be allowed to settle and ferment for about a week.

Small cubes, about an inch square, of mushroom spawn are then plantd on the surface, about 6 in. apart and an inch deep. Water the whole thoroughly and, if the weather be dry, sprinkle the surface of the bed every morning and evening with water. A crop of mushrooms may be expected in 6 weeks to 2 months from the date of "spawning", and the beds should continue productive for at least 2 months later. Mushroom spawn in brick form may be imported from nurserymen. This should be stored in an air-tight tin until required for planting. Imported

spawn in this form is usually prepared from the mycelium of *Agaricus campestris*, the common field mushroom of Europe, which is not indigenous to Ceylon and can only be cultivated successfully in the hill districts.

Oca-quira, Melluco, or **Ulluco.** (*Ullucus tuberosus.* Basellaceae)—A small plant of Peru, cultivated for its tubers, which are consumed like potatoes. Introduced at Hakgala Gardens in 1885, it grew rapidly and produced tubers from 2 to 3½ inches long and shaped like a "kidney potato;" but it failed to become popular here as a vegetable.

Usually the tubers do not grow to so large a size as that mentioned. The plants trail over the surface of the ground, rooting and producing a number of small tubers at each node. In good soil a crop should be mature in about 4 months from planting. Suited to sub-tropical conditions.

Onion ; Lunu, Rata-lunu, *S.* (*Allium cepa.* Liliaceae).—Onions thrive best in the tropics at the higher elevations and in rather dry districts, preferring a rather light soil enriched with well-decomposed manure. The seed may be sown broadcast on raised beds, or in shallow drills about 9 inches apart; being then covered with a sprinkling of fine soil, and the surface gently pressed down, as with the back of a spade or a flat board. Or the seed may be sown in a nursery bed or in boxes, and the seedlings transplanted out when strong enough into well-prepared beds. About 4 lbs. of seed per acre are usually allowed. The plants should not be closer than 6 inches in the drill, and be as near the surface as possible so as to encourage the bulbs to increase in size. A good crop may yield from 4 to 6 tons or more per acre.

Varieties.—Ailsa Craig, Blood-red, Sutton's A1, Tripoli, and Veitch's Main Crop are leading sorts. In India, acclimatized varieties, as "Silver-skin" or "Patana-onion", and the large "Red-onion" are recommended for the plains.

Egyptian Onion.—This produces on the flower-stalks bulbils of the size of marbles, which are excellent for pickling. Offset bulbs are also formed underground, and propagation is effected by both forms.

Potato Onion.—This is propagated by offsets produced underground which are comparatively small in size and irregular in shape. The bulbs are planted singly, and around these new ones are formed.

Welsh Onion. (*Allium fistulosum*).—This affords the popular "Spring onions" of temperate countries. The plant is quite distinct from the common onion; no bulb is formed, the young tender stem being the part used.

"Small" Onions.—See *Shallots*, p. 325.

Oxalis crenata.—See *Tropical Vegetables*, etc., page 301.

Parsley. See *Condiments, Seasoning and Pot-herbs*, page 347.

Parsnip. (*Pastinaca sativa.* Umbelliferae).—This vegetable can be grown most successfully in up-country gardens, especially in sheltered and moist situations with loose, deep and rich soil, but does not thrive at elevations much below 3,000 ft. Its cultural requirements are similar to those of Carrots, but the plant needs greater space than the latter. Seed is best sown in drills about 18 in. apart, the plants being thinned out when a few inches high to distances of about 8 inches in the row. Medium-sized roots are preferred to very large ones, which are liable to be bad or woody at the core.

Peas. Bola-kadala, *S*; Pairu, *T.* (*Pisum sativum.* Leguminosae). Peas of very fair quality can be grown in the hill districts, whilst at lower elevations also appreciable crops may be obtained if seed be sown at the proper season and in well-manured soil. In India as well as Ceylon, "acclimatized seed" often yields better crops than imported seed, es-

pecially on the plains. A small variety imported from India as a food-stuff, which may be obtained from the boutiques in Ceylon, will, if sown, often give fairly good crops in the low-country. It grows to a height of about 3 ft., and bears small pods with round grey seeds. Rich, limy soil, deep cultivation, a liberal supply of manure, and sufficient but not excessive moisture are required to grow good peas. In dry periods a mulching of farm-yard manure is beneficial. An application of nitrate of soda when the plants are well above ground will give them a good start. A wet season is unfavourable to the crop; therefore, the best time for sowing is before the end of the monsoon rains, *i.e.*, approximately (for Ceylon) July-August and November-December.

If the weather be dry, water the ground occasionally after sowing the seed. Sow in drills, which should be 4 in. deep, the seeds being about 3 in. apart in the row; cover with about an inch of soil. As the plants grow, earthing up must be attended to, and when they are about 6 inches high, twigs and branches should be placed along either side for support. The distance between the rows (drills) may be about 2 ft. for dwarf varieties, and up to 4 ft. for larger kinds. Where the ground has to be economised, the rows may be several feet apart, and the intervening space cultivated with smaller crops.

Varieties.—These are numerous, and many differ but little. The following are distinct and of first-rate quality: Telephone, Sutton's Excelsior (about 18 in. high), Sutton's Green Gem (15 in.), Veitch's Acme (3 ft.), Sutton's Ideal (3 ft.), Yorkshire Hero (2 ft.), and Captain Cuttle (4 ft.). The dwarf and medium-sized varieties are, as a rule, the most suitable for the tropics, tall sorts which grow to a height of 6 ft. or more being less satisfactory. "Sugar Peas" ("Sans Parchemin" of the French) have sweet, fleshy pods, which may be eaten whole, or used in stews, &c.

Potato. Arthapel, *S*; Urula-kelengu, *T.* (*Solanum tuberosum.* Solanaceae).—Very fair crops of potatoes can be grown at the higher elevations in the tropics, as in the neighbourhood of Nuwara Eliya, and more especially in the drier districts of Udapussellawa and Wilson Bungalow in Ceylon. At Bangalore, two crops a year can be obtained, and at other similar elevations in India excellent potatoes are produced almost all the year round. Potatoes planted at Calcutta early in January yielded, it is stated, tubers of good size and quality by the end of March, but the best results are obtained when planted early in November. In yield, however, if not in quality, potato crops in the tropics are seldom comparable to those of temperate countries. In Ceylon, potatoes are hardly worth growing under 4,000 ft. elevation.

The best conditions are a light, friable, moist loam, gently sloping ground with good natural drainage, and a moderately dry climate. The ground must be well-manured and moderately limed, and a change of soil for each crop is essential. The following fertilisers are recommended as a stimulating mixture, *viz*: 5 lbs. superphosphate, 2 lbs. sulphate of ammonia, 3 lbs. kainit; apply about 4 oz. of the mixture per running yard of row. The best time for planting varies according to district, but usually from July to September, and February to April, will be found the most satisfactory periods in Ceylon. New potatoes, fit for consumption, should be obtained in about 3 months from the time of planting.

In gardens, potatoes are usually planted at distances of about 12 in., in drills 24 in. apart, and in fields about 12 in. by 30 in. respectively. Taking setts weighing about 2 oz. each, or of the size of an ordinary hen's egg, about 8 cwt. should be sufficient to plant an acre. The practice of cut-

ting a piece off the root-end of the tuber, and cutting large tubers in half, is generally recommended. Sprouting tubers in shallow boxes before sowing is also sometimes adopted. A yield of about 5 tons per acre in the tropics may be considered a good average return, though in temperate countries the average yield may be 10 to 12 tons per acre.

Potato crops are liable to disease in the tropics as elsewhere. The most common diseases in temperate countries are the "Potato Blight" (*Phytophthora infestans*), appearing as brown patches on the leaves, which eventually turn black and die, and the "Wart disease" (*Synchytrium endobioticum*). Both diseases affect the tubers, which become unfit for eating. Spraying the growing crops with Bordeaux-or Burgundy-mixtures as a preventive against the former disease has of late become a recognised practice, the spraying being usually done twice or three times, at a fortnight's interval, before the crop begins to mature. In Ceylon, the prevalent potato disease is "Ring Blight" (*Bacillus Solanacearum*), which appears as a black ring when the tuber is cut across (see *Fungus Diseases*). The larvae of the "Potato moth," which has been imported into India with seed potatoes, have become a troublesome pest in that country; consequently, seed-potatoes from India or other countries where the pest exists should be fumigated at the ports of entry. Protection from frost, by means of cadjans or other covering, is necessary in hill gardens in Ceylon during January and February. The following are among the leading sorts:

Early varieties:—Ninety-fold, Epicure, May Queen, Midlothian, Duke of York, Star of Reading.

Middle Season varieties:—British Queen, King George V., Stirling Castle.

Main-crop or *late varieties*:—King Edward, Arran Chief, Dalhousie, Windsor Castle, Great Scott, Factor, Iron Duke.

See also under *Useful References*, page 511.

Radish. Rabu, *S.* (*Raphanus sativus*. Cruciferae).—Radishes are easily grown at all elevations. The seed, if sown broadcast on the smooth surface of a bed, will germinate in two or three days, and the roots are ready for use in about 3 weeks to a month afterwards. Sowing should therefore be made at frequent intervals to keep up a succession. Radishes do best in a moist and partially shaded situation. The young plants should at first be thinned out to 2 or 3 inches apart, further thinning being effected by taking up the largest as these become fit for use. There are numerous varieties, which differ mainly in the shape of the succulent root, this varying between long, ovoid, and turnip-rooted. "Cabbage-radish" is a name sometimes applied to a large variety, introduced from India, commonly grown by the peasants in Ceylon, chiefly in the low-country. The large outer leaves are picked as required and used as a vegetable, but the spongy tuber is seldom eaten.

Rhubarb. (*Rheum Rhaponticum*. Polygonaceae).—This delicious vegetable can be grown with much success in hill gardens, but is quite unsuited to low or even intermediate elevations. The use of the succulent leaf-stalks for tarts, stewing, etc., is of comparatively modern date. Formerly the leaves only were used as a pot-herb, like spinach, though this is a dangerous practice as they contain oxalic acid. Rhubarb thrives best in rich, deep, moist soil and in a sheltered, shady situation. In Europe it is usually propagated by division of the roots or crown, but in the tropics it is best raised from imported seed, which should be sown every second or third year in order to keep up a strong stock.

Salsify. Oyster Plant. (*Tragopogon porrifolius*. Compositae).—This is of easy cultivation up-country, except during the heavy monsoon rains, and is commonly grown in hill gardens. The root, which is not unlike a thin, slender parsnip, is the part eaten; it is about the thickness

of the fore-finger, about 9 inches long, and is fit for use in 3 to 4 months from the time of sowing the seed.

The plant thrives in rich, sandy soil. Seeds may be sown in drills, after the heavy rains are over, the seedlings being afterwards thinned out to about 4 in. apart. The flavour of the roots has a fancied resemblance to that of an oyster. The roots are prepared for the table in various ways, being par-boiled, cut into large pieces and fried in butter ; or they may be boiled, then grated and made into cakes.

Scorzonera. Viper's Grass. (*Scorzonera hispanica.* Compositae).—A herbaceous perennial, native of Europe, similar to Salsify but differing from it in having broader leaves and black-skinned roots. The latter are the part used, and they are considered by some to be superior to Salsify.

The same cultural conditions as for Salsify will suit Scorzonera ; but the roots of the latter take longer to become ready for use. The plant is seldom grown in Ceylon.

Scorzonera deliciosa.—A species characterized by a sweeter flavour than the preceding, extensively cultivated in Sicily, etc.

Sea Kale. (*Crambe maritima.* Cruciferae).—This vegetable, the young blanched and crisp shoots of which are used, is seldom if ever grown in the tropics, the climatic conditions, even at the higher elevations, being usually unsuited to it.

Shallots ; Red onions ; Rathu-lunu, *S.* (*Allium ascalonicum.* Liliaceae).—A small, bulbous perennial, grown for its bulbs, which are used for flavouring purposes, much in the same way as garlic ; they do not, however, possess so strong an odour or flavour as the latter. Shallots are imported into Ceylon from Bombay, and sold in almost every bazaar or boutique, being commonly known as " small onions " and largely used for curries, pickling, etc. They may be grown successfully in a rather dry climate, at medium elevations, and thrive best in light rich soil, responding well to an application of kainit, nitrate of soda, or superphosphate. They may be planted in drills about 8 in. apart, with a space of 6 in. separating the bulbs in the drill. Plants may also be raised from seed.

Solanum Commersoni. (Solanaceae).—A comparatively new vegetable, allied and similar to the common Potato, the tuber being violet or purple ; introduced from Uruguay. Grown experimentally in England in 1902, at the instance of the Board of Agriculture, this plant gave promising results, " yielding heavily and being found entirely resistant to disease." It " appeared to be susceptible to cultivation, and rapidly improved when grown in fertile soil," giving a yield at the rate of about 6½ tons per acre, " without any manuring or cultivation beyond a single hoeing when the shoots first appeared." The plant is considered best suited to a rather wet soil. It was introduced at Hakgala Gardens, Ceylon, in 1909, and yielded fair-sized tubers, closely resembling the common potato both in appearance and eating quality, but the yield was poor as compared with the latter.

Sorrel. (*Rumex Acetosa.* Polygonaceae).—A perennial, native of Europe, sometimes grown for its acid leaves, which are either used as an ingredient in salads, or boiled and used as spinach.

Sorrel is seldom cultivated in the tropics, but is suited to up-country gardens and may be propagated and grown like Spinach, preferring a shady situation. Sow seed in drills one foot apart, and thin out the plants afterwards as may be required.

Spinach. (*Spinacea oleracea.* Chenopodiaceae).—A stemless annual, native of Northern Asia, cultivated in cool countries for the sake of its soft edible leaves which when suitably cooked and dressed

are an agreeable vegetable. Spinach can be grown well at medium and high elevations with but little trouble, though seldom grown in market gardens in Ceylon. As it takes up but little space and is soon ready for cutting, it may be planted between rows of slower-growing crops, such as Peas. Seed may be sown during the rains in drills about a foot apart, the plants being afterwards thinned out as may be necessary. Spinach loves a rich, moist soil, a shady situation, and liberal watering in dry weather.

Spinach, New Zealand. (*Tetragonia expansa*. Chenopodiaceae).—A tall annual, native of New Zealand, the leaves of which are used in the same manner as English spinach. It is coarser than the latter, has rather hairy, glaucous leaves, and is of easy culture. It grows luxuriantly in hill gardens in Ceylon, where it often reproduces itself from self-sown seed, Seed may be sown in drills, about 18 inches apart, the seedlings being afterwards thinned out as required.

Spinach, Native. See *Basella*, page 303.

Spinach substitutes. See *Amarantus*, *Boussingaultia*, *Talinum*, &c.

Tomato. Tak-kali, *S*; Takkali-kai, *T*. (*Lycopersicum esculentum*. Solanaceae).—A climbing annual, native of South America, commonly grown in most countries for its fruit, which are esteemed in salads and for making sauces, flavouring soups, etc. Superior varieties, when well-grown, are also used for dessert. Tomatoes can be grown with much success in the tropics, especially in rather dry districts, at medium elevations, as in Uva and Dumbara in Ceylon. They do best in rich, moist, well-drained, limy soil, and should not be grown for more than one season consecutively in the same ground. Imported seeds of good varieties should be used when possible, though seed from selected fruits grown locally may yield satisfactory crops. The seed should be sown thinly in pots or boxes, the seedlings being afterwards planted out, when strong enough, into boxes or tubs, or on a sheltered border facing the morning sun, as under the eaves of a shed. Supports for the plants must be provided in the form of firm stakes, a fence, or low trellis.

In prolonged wet weather, protection from heavy rains should be afforded, as otherwise the fruit may split, become distorted, or fail to ripen. Enclosing the fruit, whilst on the plant, in thin paper or muslin bags is recommended as a protection from insect pests. When the fruits fail to ripen on the plants in wet weather, they may be picked green, if they have attained approximately full size, and kept on a shelf in a dry sunny place for a few days, as this will considerably advance their ripening. The plants should be regularly pruned, superfluous growth being cut out, shoots pinched back or removed, and the leaves reduced so as to admit light to the fruit.

Seedlings should be raised under cover and planted out about 4 ft. apart in mounds or ridges. Fairly shallow planting is advisable, and rich loamy soil is the best, though good crops may be obtained from soils of a lighter nature, provided they are well manured and limed. Phosphatic fertilisers are especially recommended, being conducive to fruitfulness.

Turnip. (*Brassica rapa*. Cruciferae).—Turnips of very good quality can be grown at the higher elevations, and even in the low-country very fair roots may be obtained. In the hill districts they are regularly grown for home consumption or for market purposes, the best crop being produced in the drier seasons.

Turnips thrive best on soils of a light sandy nature and enriched with well decomposed manure ; stiff retentive soils are ill adapted for them. Seed may be sown broadcast on well prepared beds, or in shallow drills about 16 to 18 in. apart, the seedlings being thinned out when about 3 in. high, leaving a space of about 6 to 7 in. between them; further thinning can be effected by picking the largest turnips for use as required. The best time for sowing is before the end of each monsoon.

Varieties.—Amongst the best are Early Snowball, Early White Dutch, Veitch's Red Globe, and Sutton's Perfection. On the plains of India, acclimatied varieties are said to give the best results.

Udo or **Oudo** (*Aralia cordata.* Araliaceae).—A shrubby perennial with large pinnate leaves, attaining a height of 5 to 6 ft. The young and blanched stalks, which are from 10 to 16 in. long, are eaten as a salad vegetable in Japan, where the plant is extensively cultivated, in private as well as in market gardens. It grows freely at Peradeniya, but is not relished here as a vegetable.

Vegetable Marrow. (*Cucurbita Pepo.* Cucurbitaceae).—This agreeable vegetable is commonly and very successfully grown in the hill districts, but is not generally suited to low elevations. The plant grows rapidly and trails over the surface of the ground, producing its large, oblong gourds, which should be picked before they have attained full size, as they are then most palatable. Seed may be sown singly in a pot or box, the stronger seedlings being afterwards selected, when a few inches high, and transplanted into well-prepared mounds of rich soil and manure about 6 ft. apart. The plant is monoecious, *i.e.* the sexes are in separate flowers on the same plant. The female flowers must therefore be fertilised, either by insects or by hand, with the pollen of the male flowers, as otherwise fruit will not set. The female flowers can at once be distinguished by their large and roundish base (ovary), also by their having no pollen. See p. 292. §.

CHAPTER XXIII.

SPICES, CONDIMENTS, AND SEASONING HERBS

1.—*SPICES.*

From remote ages the spices of the tropics have attracted traders from distant lands, and formed a lure for adventurous explorers. Some of the ancient cities of Europe are said to have been indebted for a large share of their wealth to the trade in tropical spices during the time of the Romans. Cinnamon, which has long been associated with the "spicy breezes" of Ceylon, was from very early times perhaps the most coveted of all spices. It is mentioned in the Songs of Solomon and in the Book of Proverbs; the Arabians supplied it to the Greeks and Romans, but jealously shrouded in mystery the source of its origin and the manner of obtaining it. Being first brought from Ceylon to the western coast of India, it was carried thence to Arabia and Egypt by African and Arabian traders, finally reaching Europe after a journey of many months. Cinnamon was for a long period a State monopoly in Ceylon, and its cultivation was not declared free until 1833. At one time cinnamon was sold in London for £8 per lb., pepper at 10s. per lb., while other spices commanded similar fabulous prices. As recently as 1880, cardamoms were sold for over 9s. a lb. In 1826 the English import duty alone on pepper was 2s. 6d. a pound, on cinnamon about 3s. a pound, on nutmegs and mace 3s. 6d. a pound each, on cloves 5s. 7½d., and on vanilla nearly 17s. per lb.

Distribution of Spices.—For a long period the supply of different spices was confined to their native habitat, as nutmegs and cloves in the Moluccas and cinnamon in Ceylon. These at one time formed State monopolies, and their cultivation was subject to severe Government restrictions, an infringement of which was met by rigorous punishment. Thus, during the Dutch occupation of Ceylon, the offence of infringing the law regarding cinnamon was punishable by death. Cloves and nutmegs were similarly guarded in the Moluccas, and the plants were either deliberately destroyed, or their cultivation was enforced to suit official requirements. An amusing story told in this connection is to the effect that the Home Dutch Government, being ignorant of the fact that both nutmegs and mace were produced by the same tree, once despatched orders to their Colonial Governor requesting him to reduce the number of Nutmeg trees and to increase the cultivation of Mace trees. But even nowadays it is not, perhaps, generally known that both these spices are the product of one tree.

It is common knowledge that the Dutch Government of that period deliberately exterminated the clove and nutmeg trees in certain islands of the Moluccas, in their endeavour to secure the monopoly of these spices, while confining their cultivation to Banda and Amboyna. Notwithstanding these restrictions, however, the escape of the precious spice plants to other countries was gradually effected, both by smuggling and, it is said, by the agency of migrating birds. Thus, it is stated, "wild pigeons extracted the nutmeg from its fleshy covering, digested the mace, and voided the seed uninjured in other countries." The French succeeded in 1770 in introducing the clove tree into Mauritius and Reunion, whence it reached Zanzibar, now the principal clove-producing country. Jamaica obtained the ginger plant from India, and has long practically commanded the supply of that spice, while Reunion and Seychelles became famous for the production of vanilla, whose native home is South America.

Uses of Spices.—Spices form an important class of vegetable products, being valued in cookery, confectionery, in the preparation of beverages and liqueurs, and in perfumery. Several are of special importance in medicine, either on account of their effect in aiding the digestion by increasing the gastric juices, or for disguising nauseous decoctions. The antiseptic and preservative properties of certain spices, due to their volatile oils, both in domestic and scientific uses, are well known. The appropriateness of spices to sacred uses, as for burning in incense, has long been recognised, and in certain social religious customs of oriental countries spices are to this day commonly employed. It is recorded that spices were used in the funeral piles of the Egyptian kings, and that Nero burnt at the obsequies of his wife "a quantity of cinnamon and cassia exceeding the whole importation into Rome for one year"! Not the least virtue of certain spices is their effect in sweetening the breath, more especially in countries where "betel-chewing" is practised. For this purpose cardamoms are commonly used and esteemed in India and Ceylon, and staranise in China and Japan.

The following are the principal spices of the tropics, given in alphabetical order, with brief descriptions and notes on their cultivation and uses, etc. The botanical name and Natural Order are given within brackets.

Allspice ; Whole-spice ; Pimento ; "Jamaica Pepper" (*Pimenta officinalis.* Myrtaceae). A small tree with smooth greyish bark, 25-30 feet high, native of the West Indies and Central America. The dried unripe berries, which are of the size of small peas and of a glossy black colour when ripe, are the allspice or pimento of commerce. The name "allspice" is due to a supposed resemblance of the spice to a combination of the odour and flavour of cinnamon, nutmegs, and cloves. The tree was introduced into Ceylon early in the last century. At Peradeniya it flowers in the dry weather and usually produces a small crop of fruit in July-August, but it is rarely met with in this country outside the Botanic Gardens. It is considered to yield best in a hot and rather dry climate, preferring a loose loamy or alluvial, well-drained soil.



ALLSPICE. *Pimenta officinalis.*

The berries are picked when just ripe but still green, and are then dried in the sun, the latter process taking 6-10 days. The fruits are sufficiently dry when they become black in colour and when, on shaking, the seed rattles inside. Gathering is effected by means of a long stick with a crook at the end, the fruit-bearing clusters being broken off and thrown down, and the berries then picked off the stalks by women and children. An Allspice tree, under favourable circumstances, begins to bear when 7 or 8 years old, but is not usually in full bearing until about 18 to 20 years old, when it may yield as much as 100 lb. of the dried spice. Jamaica is the only country at present that exports this spice, and its annual export varies from 9-10 million pounds or more; the average price realised in the Island is about 25*s.* per 100 lb., though as much as 30-40 shillings is sometimes obtained for specially fine samples. The market price in England varies from 3½-4d. per lb.

Pimento oil, obtained by distillation from Allspice leaves, is imported into England and sold for about 3*s.* to 3*s.* 6d. or more per lb. Added to rum, it forms what is known as bay-rum. See below.

Allspice, Lemon-scented. (*Pimenta acris* var. *citrifolia.* Myrtaceae).—This distinct spice-tree was introduced from Dominica to Peradeniya in 1888, and has become well established, being about 40 feet high and of an erect slender habit; but it has not yet fruited here. The leaves are strongly aromatic, and emit on crushing a delightful lemon-scented odour. It is, however, considered to be of little value as a source of Bay-oil.

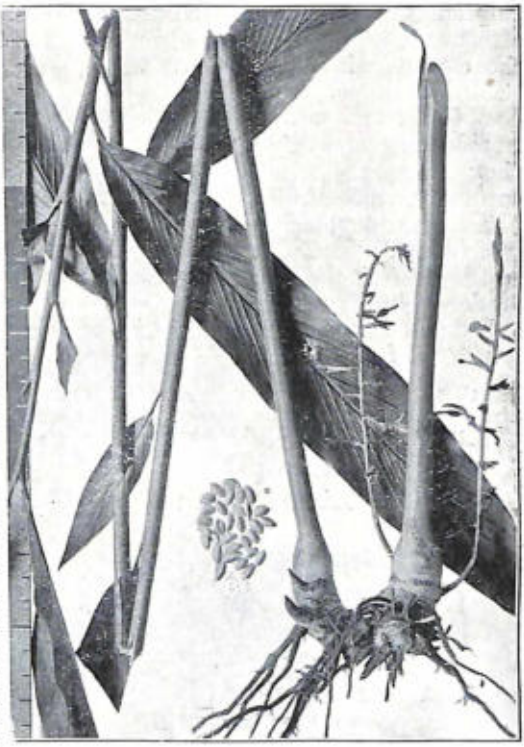
Allspice, Carolina. (*Calycanthus floridus.* Calycanthaceae).—A hardy shrub of North America, the wood and roots of which are of a spicy nature and have a strong aromatic odour.

Allspice, Japan. (*Chimonanthus fragrans.* Calycanthaceae).—A shrub with small, pale yellow flowers, similar to the latter species. Suited to sub-tropical conditions only.

Bay Tree, or **"Wild Cloves."** (*Pimenta acris.* Myrtaceae).—A small, erect, West Indian tree, the aromatic leaves of which, when dried, yield by distillation an oil which is used in the preparation of bay-rum, &c. A return may be obtained in about three years from planting, and on an average 100 lb. of green leaves will yield about 16-20 oz. of oil. It is estimated that the return per acre may be at least 53 lb. of oil, which is usually valued at from about 6*s.* upwards per lb. The tree has been long established at Peradeniya, but seldom bears seed there. The dried leaves, obtained mostly from trees growing in a wild state, are exported from some of the West Indian islands for the extraction of oil.

Canella-bark: "Wild" or "White" Cinnamon. (*Canella alba.* Canellaceae).—A medium sized tree, 30-40 feet high, native of the West Indies and South America. The orange-coloured bark is hot, bitter, and aromatic and is imported to a limited extent into Europe, chiefly from the Bahamas, for medicinal purposes, being prepared in the form of long quills similar to cinnamon. It yields about 1 per cent. of essential oil. In the West Indies the bark is used as a condiment, and in Porto Rico the twigs are thrown on the water to stupefy fish in order that they may be easily caught. See *Drugs,* page 376.

Cardamoms ; Ensal or Enasal, *S*; Alaka or "Cardamungu," *T*. (*Elettaria Cardamomum*. Scitamineae).—A perennial with large leafy shoots, 8 to 12 feet long, and strong creeping root-stock (rhizomes), native of the moist forests of Ceylon and Southern India up to about 4,000 feet. In cultivation it thrives best at 2,500 to 4,000 feet, under natural shade, preferring a moist, sloping jungle which has been mostly cleared of undergrowth. Protection from strong winds is essential, and trees must be planted for this purpose where the original trees are deficient. The spice consists of the ovoid fruit capsules, which contain numerous small, brown seeds, and have a strong aromatic odour and flavour. The capsules are gathered before they are fully ripe, washed free from sand, etc., and then placed in large, light trays supported on trestles, on which they are slowly dried and bleached in the sun. The use of such trays facilitates the removal of the crop indoors at night or when a shower threatens. In dull weather the process of bleaching may be assisted by placing the trays with the capsules for about an hour over the fumes of burning sulphur in a hermetically closed case or compartment, at the bottom of which the sulphur is set alight and left to smoke. 2 lbs. of

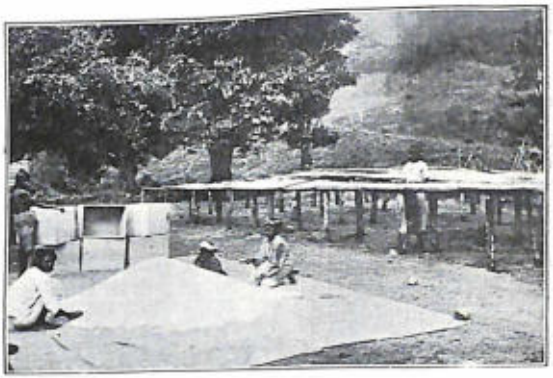


MYSORE CARDAMOM.
Elettaria Cardamomum.
A, flowers; B, dried fruits.



MYSORE CARDAMOM PLOT.

sulphur is sufficient to bleach about 100 lb. of cardamoms, which must afterwards be exposed to the sun for a few hours. When well bleached the capsules should be creamy white, smooth and silky. They vary in size and shape, from ½ to ¾ inch long, and from oblong to ovoid; they are graded accordingly, the grades being known as "longs," "mediums," "shorts," and "greens," the last grade including shrivelled and insufficiently ripened fruits, bleached or unripe. They are then packed in lead-lined chests for export. Cardamoms are a powerful aromatic and



CARDAMOM DRYING.



BLEACHING CARDAMOMS OVER SULPHUR FUMES.

are used chiefly in medicine, and as an ingredient in curry powders, &c. They are also used in confectionery, and are a reputed aphrodisiac. The small brownish seeds, which are the essential part of the spice, are much esteemed



WILD CARDAMOM OF CEYLON.
Elettaria Cardamomum var. *majus*.

for use with masticatories or for sweetening the breath, and sugar-coated cardamoms are much used at Hindu festivals and ceremonials.

Propagation is by division of the crowns (rhizomes), or by sowing seed (which take 2-3 months to germinate) in well-prepared nursery beds. In planting out, 3-4 rhizomes are placed in each hole or clump, the latter being spaced about 10 feet each way. In good soil a small crop may be obtained in the second year from planting, and from the 4th or 5th year an average yield of about 250 lbs. per acre may be prooured, according to cultivation, nature of the soil, etc. The plants are in bearing all the year round, but chiefly during the dry periods, viz. Feb.-March (principal crop) and Aug.-Sept., the crop being gathered once every fortnight or three weeks. The fruits should be cut with small, pointed scissors, not pulled by hand, and gathered when ¾ ripe; if left to ripen fully, they are liable to split open and disperse the seeds.



CLIPPING CARDAMOMS BY MACHINE.

Prices fluctuate, according to demand from about 3s. to 5s. or more per lb. in London. At the present time the local price in Ceylon is about Rs. 3.00 to Rs. 3·25 per lb. 1 lb. of fresh fruit contains about 800 capsules of average size, each of the latter containing 14-17 seeds. 10 lbs. of fresh fruit produces 2½ lbs. of seed. About 50,000 seeds go to a pound. The chief country of consumption is America. Germany was a large consumer before the Great War. The export of cardamoms from Ceylon has decreased from 821,184 lb. valued at Rs. 797,818 in 1909, to 312,256lbs. valued at Rs. 563,995 in 1923. It is estimated there are some 7,000 acres at present under cardamom cultivation in Ceylon.

Varieties.—Two distinct varieties found in cultivation are known by the names "Mysore" and "Malabar." The former is distinguished by the erect or arching racemes, which bear the flowers and fruit, and by the leaves being glabrous on both sides; while in the "Malabar" the racemes trail on or near the ground, and the leaves are softly pubescent on the underside. The former variety is therefore preferred for cultivation, as the fruits are not so liable to get damaged or soiled as those of the trailing variety. "Nepal," "Bengal," "Java," "wild or bastard" (of Siam) are forms of cardamoms derived from various species of *Amomum*, which are of local importance only. The Ceylon "wild cardamom" bears the largest capsules, which sometimes attain 1½ inches in length.



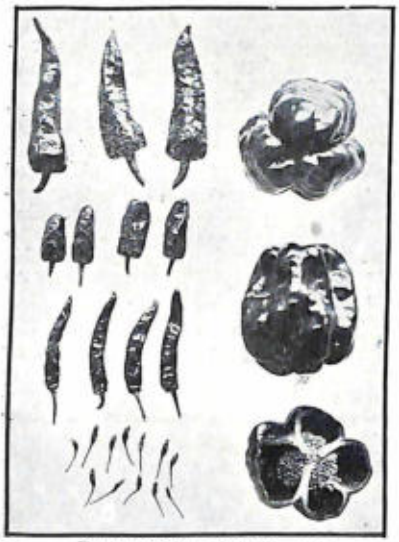
CASSIA BUDS
Cinnamomum Cassia.

Cassia Bark; "Cassia Lignea," or "Chinese Cassia" (*Cinnamomum Cassia*. Lauraceae).—A medium-sized tree, 30 to 40 ft. high, with long, lanceolate, brittle leaves, allied to Cinnamon. The tree is a native of Southern China and was introduced in 1882 at Peradeniya, where it is now well established and often bears seeds, usually in July-August. "Cassia" has been known from the earliest times as a spice. It is mentioned in the Bible and by early Greek authors, also in Chinese herbals

as early as 2700 B.C. The whole tree is pleasantly aromatic, and its bark is used as a substitute for the true cinnamon. It is commonly cultivated in its native country for its fruit ("Cassia buds") as well as bark; the former is picked by hand and dried for use in medicine, and the bark is harvested, peeled off and "quilled" in a similar manner to cinnamon, and made up in bales for export.

Unlike cinnamon, the tree is not grown as a bush, so that the bark is obtained from the branches, which are periodically cut down. The yield per acre is said to be about 11 piculs (1 picul = 133⅓ lb.), which is sold by the producers for about 30 Malay dollars per picul. "Cassia buds" are worth about 80s. per cwt. in London, and Cassia oil, obtained from the leaves as well as bark, is usually valued at about 3*s.* 6*d.* to 4*s.* per lb. The tree is propagated from seed, and requires similar conditions of soil and climate to Cinnamon. See page 398.

Chillies ; Red Pepper ; Capsicums ; "Miris" or "Gas-miris," *S*; "Kochikai," *T*. (*Capsicum spp.* Solanaceae).—Small annual or biennial, herbaceous, shrubby plants, cultivated throughout the tropics for the sake of their pungent fruits, usually an indispensable constituent in the food of people in tropical countries. The scarlet, sun-dried, pod-like fruits are ground to powder and used in pickles, sauces, "Cayenne pepper," medicine, &c. Most of the numerous cultivated varieties have been derived from the following species, viz : *Capsicum minimum* (Bird-chillie or Guinea-pepper), *C. frutescens* (Goat- or Spur-pepper), *C. grossum* (Bell-capsicum, or Bull-nose pepper). The last named is entirely free from the burning pungency peculiar to the others, and may be eaten cooked as a vegetable, or raw in salads, having, when tender, a pleasant flavour. See page 303.



DIFFERENT FORMS OF CHILLIES.

Left: Pungent varieties,—A, *Capsicum frutescens* ; B, *C. minimum*; C, *C. grossum* or "Bell Pepper", not pungent.

Chillies thrive best in open, humous and well-tilled soil ; they will grow up to 3,000 feet or more above sea-level, but are not generally suited to a wet climate. Seeds may be sown in beds, and the seedlings planted out in well prepared ground when 3 to 4 inches high, being spaced about 2 × 1½ ft., or at the rate of 10,000 plants to the acre. A crop is obtained in about 6-8 months from planting, and the yield may be from 1,000 lb. to 1,400 lb. of dried chillies per acre. E. African and Zanzibar Chillies are valued at present in London at from 50*s*-55*s* per cwt. Nepaul chillies usually fetch the highest price, being sometimes sold for 80*s.* or more per cwt. Chillies are largely exported from Zanzibar, India, Natal, West Indies, etc.

Cinnamon ; "Kurundu," *S*; "Kuruva," *T* ; "Darchini," *Hind.* (*Cinnamomum zeylanicum*. Lauraceae).—A moderate-sized or fairly large tree, 40 to 60 feet high, with 3-5-nerved, alternate leaves,

native of the moist low-country of Ceylon and South India. Although cinnamon was one of the earliest known spices, its cultivation does not appear to have been undertaken till 1770, by the Dutch. Previous to this the spice was derived from wild or uncultivated trees. In cultivation, the tree is grown as a bush, by sowing or planting closely, in clusters about 3 ft. in diameter, so as to produce numerous long, straight, clean shoots. When the latter have attained the thickness of one's finger, *i.e.* when about 2 years old, they are cut close to the ground, in order to obtain the bark. Cutting is done when growth is active and the bark easily removed, *i.e.* after rainy weather has set in, usually in May-August and Oct.-Dec. in Ceylon. The bark will not peel in dry weather. The peelers, who sit at distances of about 2 or 3 feet apart, make a longitudinal slit along the length of the stem and a parallel slit on the opposite side; the bark is then removed with the point of a curved knife, placed in a heap and covered with sacks so as to undergo slight fermentation. The following day the outer skin of the bark is scraped off with the same knife, the peeler placing the bark along a smooth stick and holding both in position with the aid of his or her toes at one end. The bark, being then placed in the shade to dry, contracts into "quills." These are dried in the shade. The end of one is then placed inside another, forming smooth "canes" about 3 feet long which, when dry, are of a light yellowish brown colour. They are then made up into bales of about 60-65 lb. each, and wrapped with hessian for export.



HARVESTING CINNAMON IN CEYLON.

About 50 to 60 lb. of quills per acre may be expected from the first crop, in the third or fourth year from planting, the yield increasing each year until about the tenth year, when 150 to 180 lb. per acre may be obtained. About 6½ million pounds (including quills and chips) were exported from Ceylon in 1909, valued at £181,976, while in 1923

the figures dropped to about 5,038,208 lb., valued at about £139,797. Some 40,000 acres are estimated to be under the product in Ceylon, but this is being gradually replaced by coconuts. Cinnamon oil or essence is largely used in medicine, and the "bark" for flavouring purposes. The latter is usually valued in London at about 1s. 6d. to 3s. per lb. for *fine quills*, and from 4d. to 6d. for *chips* and *featherings* (see below).

Propagation is usually by seed, which are in season about June-July; 25 seeds are sown *in situ*, about 6 inches apart, in a cluster; or these may be sown in a nursery and the seedlings afterwards removed in clumps, with as much of the earth as possible attached, and transplanted to the field. A space of about 6 ft. should be left between each cluster or "stool," or say 9 or 10 ft. from centre to centre of clump.

The Cinnamon tree thrives in almost any fairly deep and well-drained soil. Some of the best flavoured bark produced in Ceylon is grown on deep soil composed largely of white sand, near the west coast, where the average rainfall is about 85 to 100 inches and the average temperature about 80°. F. The tree thrives up to about 2,000 feet alt. in the moist zone. Cinnamon *Chips* and *featherings* are the waste portions resulting from the cutting and peeling operations, and are exported for the distillation of *cinnamon oil*. The latter is also extracted in Ceylon to some extent, and exported. Oil is also obtained from the leaves and bark, by distillation; leaf-oil is usually worth about 4*d* to 6*d*. per oz., and bark-oil from 3*s*. to 5*s*. per oz., according to purity.

Cinnamon was the first article of importance exported from Ceylon, and at one time was sold in Europe at fabulous prices. It is now exported to some extent from Java and Seychelles, but Ceylon is still by far the most important source. The demand for it has considerably decreased since the war.



PEELING CINNAMON BARK.

Varieties.—There are several varieties of Cinnamon recognised by the Sinhalese, as "Peni-" or "Rasa-kurundu," "Pengiri" or "Tittha-kurundu," and "Kahata-kurundu," all Sinhalese names. The quality of the bark, however, appears to be largely dependent on soil and climate, as well as on preparation and cultivation.

Tazpat the Indian name for *Cinnamomum Tamala*, a medium-sized tree of the Himalayas, cultivated in the Khasia Hills, &c., for the sake of the leaves ("Tazpat") or bark, which is also known as "Indian Cassia-lignea." Both leaves and bark are used medicinally and for flavouring, but are of local importance only.

Cinnamomum Culilawan, a medium-sized tree of Amboyna, with small leaves and aromatic bark, the flavour of which is considered to resemble that of cloves; introduced at Peradeniya about 1870.

Clove; "Karabu" or "Karabu-netti," *S.* and *T.* (*Eugenia caryophyllata*. Myrtaceae).—A small conical tree, 25-30 ft. high, native of the Moluccas, introduced into most tropical countries. It was established in Ceylon before the arrival of the British in 1796. The cloves are the dried unexpanded flower-buds, which are picked green by boys, usually during January in Ceylon, and spread in the sun for a few days to dry, when they become dark-brown. The tree likes a deep rich sandy soil, on sloping land, and thrives up to 2,500 feet. It is propagated by seed, which takes 5-6 weeks to germinate. The seedlings, which are of very slow growth, may be planted out when 12 or 15 inches high, at distances of about 20 feet apart each way, *i.e.* at the rate of 108 plants per acre.



CLOVES. *Eugenia caryophyllata.*

The first crop may be obtained when the trees are about 9 or 10 years old, the yield increasing until they are about 20 years old, when an average of 6-8 lbs. of dried cloves per tree may be procured. Zanzibar and Pemba furnish about 90 per cent. of the world's supply of cloves, and about half of the crop goes to India. The market price in London varies from 1*s* to 1*s* 6*d* per lb. for Zanzibar cloves, to 2*s*. or more for fine Penang cloves, which are usually considered the best. Clove oil is worth about 9*s* 6*d* per lb. at present. The Ceylon Customs give the export of cloves (with which is included mace) from Ceylon in 1923, as 45 cwt. valued at £ 210.

Madagascar Clove, or Clove-nutmeg. (*Ravensara aromatica*. Lauraceae).—A medium-sized tree, 30-40 feet high, with small leathery leaves, native of Madagascar, introduced into Ceylon in 1847. The whole tree is strongly aromatic. The round fruits are of the size of marbles, each of which has a large, hard, kernel, which is considered to combine the odour of nutmeg and clove; it is used locally as a spice, and is sometimes exported in small quantities to France. The tree is propagated by seed, and is suited to the moist low-country under 2,500 feet altitude.



MADAGASCAR CLOVE. *Ravensara aromatica.*

Brazil Clove. (*Dicypellium caryophyllatum*. Lauraceae).—A Brazilian tree, the "cloves" of which are said to be remarkable for their fine aroma, being largely employed in Brazil for flavouring as well as for medicinal purposes. The bark and wood furnish an essential oil known as "Clove Cassia," or Clove bark-oil, for the extraction of which it is imported into France.

Ginger; "Inguru," *S*; "Inji," *T.* (*Zingiber officinale*. Scitamineae).—A herbaceous perennial, with leafy shoots which grow to a height of about 2-3 ft., native of Tropical Asia, but introduced and

cultivated in all tropical countries. The underground tuberous stems (rhizomes), resembling thickened roots, are the ginger of commerce. These are called "hands" or "races," from their palmate shape, and are exported in two forms, *peeled* and *unpeeled* (*i.e.* uncoated and coated respectively) ginger. The former is prepared by scalding the tubers in boiling water, and then removing the epidermis with a narrow-bladed knife. Unpeeled or coated ginger (*i.e.* not deprived of the epidermis) is merely washed, and then dried in the sun. The rhizomes are exported in bags or barrels, and are valued in England at from 60*s*-80*s* or more per cwt., according to quality. Jamaica ginger usually commands the highest price, Calicut or Cochin sorts coming second, and Japanese and West African generally third.



GINGER. *Zingiber officinale.*

The plant requires an equable hot and moist climate, a shaded situation, a rich well-tilled, humous or loamy soil, and thrives up to about 4,000 feet. It is propagated by division of the tubers or rhizomes, which are planted about 18 × 12 in. apart, in rows. Manuring is essential, and occasional irrigation in dry weather is beneficial. A harvest is yielded in about 10 months from planting, when the leaves begin to wither. Under favourable conditions an acre is said to give as much as 2,000 lbs. or more cured ginger, but the average yield is probably nearer 1,500 lbs. Ginger has long been highly valued for medicinal purposes, more especially in England; it is also esteemed in preserves and confectionery. *Preserved ginger* is prepared largely in China, where the plant is extensively cultivated for this purpose.

Grains of Paradise; Guinea Grains, or Melegueta Pepper. (*Amomum Melegueta*. Scitamineae).—A herbaceous, bushy perennial, 5 to 6 feet high, with arching leafy shoots, allied to the Ginger and Cardamom plants, native of West Tropical Africa. The flowers and fruit are produced on long trailing cord-like runners or racemes, which issue from the base of the plant. The small dark-brown aromatic seeds constitute the spice, and are exported from the Gold Coast, Nigeria, &c., being used chiefly in veterinary medicine; also sometimes for flavouring cordials, spirits, wine, &c. At one time they were in considerable demand, and were used as a substitute for, or for adulterating pepper, &c. They are largely employed by the natives of Tropical Africa for seasoning their food. About 1,000 cwt. of this spice is imported annually into England, where it is valued at about 60*s* to 65*s* per cwt.

Mace; "Wasa-vasi," *S*; "Poollie," *T*.—This consists of the net-like wrapper (*aril*) surrounding the nutmeg, inside the husk (see Nutmeg). At first crimson-scarlet, it becomes yellowish brown with drying and exposure. Mace is a much-esteemed spice, being used in confectionery and for culinary purposes. In yield, the proportion of mace is about one-fifth in weight of that of the nutmeg; 100 nutmegs should produce about

3½ oz. dried mace. *Good pale* to *fine red* mace usually fetches, according to demand, from about 2*s*. to 2*s*. 6*d*. per lb. in London.

Massoia Bark, or "Meswi-bark." (*Massoia aromatica*. Lauraceae.) An aromatic bark obtained from a large tree in New Guinea, closely allied to Cinnamon. The tree is not cultivated, and very little is known of it.

Nutmeg ; "Sadhika," *S* ; Sadhikai," *T*. (*Myristica fragrans*. Myristicaceae).—A medium-sized or large tree, usually 40-50 feet high (sometimes 70 to 80 feet), native of the Moluccas, introduced into Ceylon about 1804, and now often met with in low-country gardens or compounds. The nutmeg of shops is the hard, brown, ovoid kernel of the fruit. It is enclosed in a thin brittle shell, immediately surrounding which is the scarlet aril or mace in the form of a net (see *mace*); next to this is the large, thick, fleshy and juicy husk. The pale-amber fruit resembles a large apricot. When ripe, *i.e.*, about 6-7 months from flowering, the husk splits open and discloses the glossy, dark-brown nut (seed) covered with the mace, as already stated. The fruit is then picked, or the nuts are allowed to drop to the ground, when they are collected ; they are then separated from the mace, and both dried separately in the shade, or on shelves in heated sheds. For export, the nuts must be dried thoroughly, so that each rattles in the shell. Dusting them with lime prevents mould. Drying the mace slowly in an airy shed has the effect of preserving its bright colour. The nuts are graded for export ; 60 to 120, according to size, go to 1 lb., fetching in London about 10d. per lb. for the smaller, to about 1*s*. 8*d*. for the larger size. Nutmeg oil, obtained from the seed, is worth about 4*s* to 6*s* per lb.



NUTMEG. *Myristica fragrans*.

1, flower ; 2, fruit opening and showing nut inside covered with scarlet mace ; 3, fleshy fruit as it splits open in two, showing mace-covered nut on right ; 4, mace-covered nut ; 5, nut deprived of mace.

The tree thrives best in deep loamy and well-drained soil, in a hot and moist climate, up to 2,500 feet elevation. When young it is benefited by light shade from thinly planted shade-trees, as Dadap or Gliricidia. Being usually dioecious (male and female flowers borne on separate trees), it is impossible to distinguish the sex of a tree until it flowers. The proportion of one male to 10 or 12 female trees (or 10 males to an acre) should be sufficient to ensure the pollination of the latter. The trees come into bearing at the age of about 9-10 years, bearing at first only a few hundred fruits each; they increase in yield until about 30 years old, when the average crop may be about 4,000 nuts per tree a year, though some trees may bear as many as 12,000 or more. They produce two main crops, which spread over the greater part of the year, and continue productive for very many years. Trees over 80 years old, in Peradeniya Gardens, bear heavy crops annually (chiefly in June-August and October-December) and appear to be still in their prime.

Propagation is usually from seed, which take about 3 months to germinate. Sow in pots or boxes under cover, or in a well-prepared bed in a moist, shady corner:

cover seeds with an inch of fine soil,and water daily in dry weather. When the seedlings are large enough to handle, transfer them to baskets or bamboo pots, and plant out in permanent positions when about 10 in. high, at distances of about 26 ft. apart each way. Owing to the uncertainty of the proportion of male to female plants when raised from seed, propagation by budding or inarching is recommended. Old trees, however, sometimes become hermaphrodite (bearing both male and female flowers), so that old "male" trees may become fruitful. The principal sources of nutmegs are the Moluccas and Celebes Islands. In recent years the cultivation has been taken up in the West Indies, especially Grenada, on commercial lines, as it was also to a small extent in Ceylon before the advent of rubber-planting. The export of nutmegs from Ceylon in 1923 is given as 302 cwt., valued at Rs. 6,204(=about£414.)

Calabash Nutmeg, also called "Jamaica Nutmeg." (*Monodora Myristica.* Anonaceae).—A small tree of West Tropical Africa, with large oval leaves and sweet-scented flowers, introduced at Peradeniya in 1897. The large globular fruit contains a number of aromatic seeds, whose odour and flavour are considered to resemble those of the nutmeg proper. The tree is suited to the moist low-country, and thrives in any moderately good soil. It has not yet fruited at Peradeniya.

Other so-called nutmegs are, the "Brazil Nutmeg" (*Cryptocarya moschata.* Lauraceae); "Clove Nutmeg" (see "Madagascar Clove"); the Papua Nutmeg (*Myristica argentea*), and the "Wild Nutmeg" of India and Ceylon (*Myristica laurifolia*). The last named, a large tree with spreading branches and long lanceolate oval leaves, common in Ceylon from 1,000 to 5,000 ft., bears an oblong-ovoid nut, about 1½ in. long, furnished with orange-yellow mace, which is of no commercial value.

Pepper ; Gammiris, *S* ; Molavu, *T.* (*Piper nigrum.* Piperaceae).—A creeping perennial vine, indigenous to the moist low-country forests of Ceylon, S. India and Malaya. Both "black" and "white" peppers are obtained from the same plant. The berries (pepper-corns) when of a reddish colour are picked and spread in the sun, when they become black and shrivelled. These, when ground with the outer covering left on, form "black pepper;" deprived of the black covering (first by soaking in water for 7 or 8 days, then rubbed or macerated with the feet or otherwise), "white pepper" is obtained. A decorticating machine is sometimes used for the latter process.



PEPPER. *Piper nigrum.*

The pepper vine requires moist heat with shade, and thrives up to about 2,500 feet above sea level. Artificial or natural supports, in the form of posts or trees, are necessary, the latter being preferable and more durable. Erythrina, Mango, Jak, Kapok, and other quick-growing trees are suitable live supports, while they also provide a beneficial light shade. In Sumatra and Malaya, tall posts or trellises of some hard and durable wood are often used for supports. Propagation is best by cuttings, which should be selected from the ends of the best bearing vines. These may be either started in a nursery bed, or planted out where they are to remain. A small crop may be expected in the third year from planting, but the vines will not be in full bearing till the sixth or seventh

year. In India, Malaya, and Ceylon, the main crop is produced usually from March to May, and a smaller crop in August or September.

With good cultivation, an annual yield of about 2,000 lb. or more per acre should be obtained, allowing for the plants (" stools ") to be planted 7 ft. by 7ft., say 880 to the acre. The most economical method of cultivation is to grow the vines on trees which are used as shade along roadsides or for other crops, as " Dadaps " in Tea or Cocoa, the cultivation in this case costing but little. Pepper plants will continue to yield good crops for 25-30 years. The trade price of " black pepper " in London ranges from 3*d.* to 5*d.* per lb., " white pepper " usually fetching 2*d.*-3*d.* per lb. more. The chief sources of supply are the Straits, Java, Sumatra, and Malabar. Ceylon exported 3,653 cwts. of pepper in 1923, valued at £7,800.



PEPPER VINES ON THORNY DADAP TREES (*Erythrina indica*), IN CEYLON.

Pepper, Cayenne.—This is made by drying and grinding into fine powder the smaller and most pungent kinds of chillies, *i.e.*, the fruits of species of Capsicum, especially *C. frutescens* and *C. minimum*. The Cayenne-pepper of shops, however, is said to be usually adulterated with flour or other powders.

Pepper, Long.—This consists of the unripe fruiting spikes of *Piper Longum*, dried in the sun. The plant is a native of India and Ceylon, and is cultivated in parts of India. "Long pepper" is used chiefly in medicine, being less pungent than *P. nigrum*.

Pepper, Japan. (*Xanthoxylon piperitum*. Xanthoxylaceae).—A deciduous tree of Japan, the black aromatic pungent fruits of which resemble pepper-corns and are used as a spice in Japan.

Pepper, Ashantee. (*Piper Clusii*. Piperaceae).—A handsome pepper vine of West Tropical Africa, where the corns of which are used as a spice. These were at one time exported to Europe for use as pepper. The plant is not cultivated.

Pepper, Negro; Ethiopian, or West African pepper. (*Xylopia aromatica*. Anonaceae).—A tall shrub, native of Western Africa, producing clusters of pod-like fruits, about 2 inches long. These are aromatic and pungent, and are used in West Africa in a dried state as a spice.

Pepper-tree. *Schinus molle*. (See p. 181). The small pungent berries are sometimes used as pepper.

Star Anise. (*Illicium verum*. Magnoliaceae).—A shrub or small tree, native of Southern China, where it is cultivated for the sake of the fruits, which, when ripe, burst open and spread out in the form of a star. The whole fruit is agreeably fragrant and aromatic, and in China and Japan is much used as a condiment in cookery, also for chewing after meals to sweeten the breath and as a digestive. It forms an important article of commerce in the Far East, and is imported into Europe, and formerly America, for flavouring liqueurs and spirits, being the chief flavouring ingredient in the French "Anissette de Bordeaux." An aromatic oil ("anise oil") obtained from the fruit by distillation, is quoted at present at about 3*s*. per lb. in London, but it is often as much as 6*s*-7*s*. Seeds have been imported on different occasions and sown at Peradeniya, but none has ever germinated. It is said that the Chinese boil the seed before it leaves the country, so as to maintain the monopoly of the spice. The "Japanese Star Anise" is the fruit of *Illicium anisatum*, the odour of which somewhat resembles that of Bay leaves (*Pimenta acris*).

Turmeric; Kaha,*S*. (*Curcuma domestica*, formerly *C.—longa*. Scitamineae). —A perennial herb, about 2-3 ft. high, cultivated throughout tropical Asia. The tuberous rhizomes are of a bright orange-yellow colour and waxy resinous consistency; they are ground into a fine powder, which has an aromatic taste, somewhat resembling ginger. This is commonly used as a condiment in cookery, more especially in the tropics, and is a prominent constituent of curry powders; it is also employed in India for dyeing wool and silk. $.



TURMERIC. *Curcuma domestica*

Turmeric is cultivated largely in India and Formosa, and is exported to Europe, etc. It is valued in London at from about 18*s*-24*s* per cwt. The plant is propagated by the rhizomes or by division of the crown, and is suited to loose, rich soil, under partial shade; it thrives in a hot and moist climate up to about 3,000 feet. Under average conditions an annual yield of about 18 cwt. per acre may be obtained. Cultivation is much the same as for Ginger, and a crop may be obtained in about 8 months from planting. The "tubers" should be dug up as soon as the stems fade. They are prepared for market by drying in the sun, being usually scalded in hot water to check or destroy their vitality and, thereby, prevent sprouting. Madras turmeric is generally quoted in London at from 60*s*. to 80*s*. per cwt.

Vanilla. (*Vanilla planifolia*. Orchideae).—A large, creeping orchid with long, elliptic, fleshy leaves, native of Mexico, introduced into Ceylon in 1847. "Vanilla Beans" are the dried and cured pod-like fruits, so much esteemed from early times for flavouring in confectionery, &c. *Vanillin*, the active principle of vanilla, has in recent years been produced artificially, and this for a time resulted in making Vanilla cultivation a pre-

carious industry. The usual price of "vanilla beans" ranges from 6*s*. to 10*s*. per lb.; but at the time of writing (June, 1924) 55*s*. to 70*s*. per lb. is quoted in London, an increase of some 350 per cent. occurring in a few months. The vine thrives best in a hot and humid climate, from sea-level to about 2,000 feet. It requires light chequered shade, and support by means of trees, trellises, or other material, or a hedge with strong stems and and light foliage. Among suitable live supports for Vanilla are: "Physic-nut" (*Jatropha Curcas*), Calabash Tree (*Crescentia Cujete*), Dadap (*Erythrina*), and the Temple Tree or Frangipani (*Plumeria*). Low-branching trees with sparse foliage are the best.

Propagation is by cuttings about 3 ft. in length, which are planted *in situ*. Two cuttings are planted against each tree or other support, on opposite sides; the lower ends are covered with some surface soil or humus, and the rest of the cuttings are trained up and tied to the supports. The latter (*i.e.*, spacing) should not be closer than 8 × 8 ft. or 680 to the acre. The cuttings soon develop aerial roots which adhere to the supports, after which the plants require but little attention beyond spreading, supporting, and training the vines and keeping weeds in check. The minute black seeds of the cultivated vanilla are usually sterile. See p. 144.



VANILLA. *Vanilla planifolia*.
1, full-grown vanilla pods.

The vines begin to blossom about 15 to 18 months from planting, and a small crop may be obtained about 9 months later. The principal flowering season in Ceylon is April to May; in Malaya it is September-November. In the wild state the flowers are fertilised by bees and humming birds; but in cultivation this seldom occurs, and it is necessary to pollinate or "marry" the flowers by hand, as otherwise few if any will set fruit. The "marrying" process must be done in the morning, while the pollen masses and the receptive stigma are fresh. The operation consists in lifting the 2 adhesive pollen masses (pollinia) on a small piece of smooth stick and bringing these in contact with the viscid stigmatic surface, under the rostellum. An expert can pollinate from 700 to 1,000 or more flowers in half a day. Not more than 8 flowers in a cluster should be fertilised, and a vine should not be made to bear more than about 30 pods, half that number being sufficient for a weak plant. The smooth cylindrical pods should be ready for gathering in 8 or 9 months after fertilisation of the flowers, the proper state for harvesting being indicated by a slight yellowing at the ends. In heavily shaded situations, the pods take longer to mature.

Curing is usually begun by dipping the pods into almost boiling water for about 20 to 30 seconds, after which they are alternately placed between blankets to "sweat" and in the sun to dry. In order to induce fermentation, they may be rolled up in a blanket and placed in a closed box, being taken out each day and spread in the sun for one or two hours; this process may be continued for about 14-20 days or more, when the pods will have become brown and pliable. The method of curing, however, varies somewhat in different countries. In Seychelles, instead of placing the pods in the sun each day, they are spread on trays in a heated room (with a temperature of say 90° to 100° Fah.), and afterwards placed between double blankets. This takes a few weeks longer than the former method. The

pods ("beans") are afterwards treated in a cooler temperature, being occasionally squeezed and drawn through the fingers, so as to render them pliable. It is considered that the more slowly vanilla is cured the better. When the curing is complete, *i.e.* in about 3 to 5 weeks from picking, *vanillin* accumulates as a coating of fine crystals on the pods. Pods which are inclined to split should be tied up at the end with a piece of thread. The pods are then graded according to lengths, made up in pound-packets, and packed in soldered tins for export. On an average, 125 cured pods will weigh a pound. The standard size of boxes used in Seychelles for exporting vanilla is 13 inches long, 9 in. broad, and 6 in. deep. A lining of silver paper or tin-foil is placed in the box, the pods are packed fairly loosely, and the lid then soldered down.

It is more particularly as a secondary or minor crop that Vanilla is to be recommended for cultivation. An acre of good healthy vines on, say, 600 trees or supports should, it is considered, give a yield of about 100 lb. of cured pods. The yield per acre in Hawaii has been estimated to approximate 13,000 pods, amounting to about 120 lb. of cured beans. In Seychelles, however, 8,000 pods to the acre, equalling about 50 lbs. of cured vanilla, is considered a good average yield. A fair crop should weigh at the rate of about 100 pods to the pound, though of pods 9 in. in length, only 66 go to a pound, and of 8 in. pods, 80 go to the pound.

The market price of vanilla fluctuates considerably, according to quality and demand. (See p. 343). The export of vanilla from Ceylon in 1922 is given as 31 cwt., valued at nearly £1,200. The chief countries of production are Tahiti, Mexico, Reunion, Comoro, Madagascar, and Seychelles.

Diseases. Excessive shade, over-crowding, and heavy cropping are all liable to weaken the vines and predispose them to disease. The most serious fungus disease to which the Vanilla plant is subject is probably *Calospora Vanillae*, which has proved so disastrous to the Vanilla industry in Seychelles.

Vanillon or **Vanilloes.** (*Vanilla pompona*).—A native also of Mexico, yielding an inferior quality of vanilla known by the name of "Vanillon" or "Vanilloes." This is claimed, however, to have certain advantages over vanilla proper, as its pods, which are short and thick, are not so liable to split and are more easily cured, whilst the vines are said to flower and fruit more or less throughout the year.

Vanilla Essence.—According to the *Journal of the Jamaica Agricultural Society*, this product is prepared in Jamaica from vanilla beans and sold at 20*s.* per gallon, which is said to be equivalent to 10*s.* 6*d.* per lb. for cured beans.

Synthetic Vanillin. Notwithstanding the introduction of this article, there is still a large and remunerative demand for vanilla, which is esteemed for flavouring purposes, perfumery, scents, &c. There is said to be a reluctance on the part of manufacturers to use artificial vanillin, more especially since the introduction of legislation in France and the United States restricting the use of artificial food products. Artificial vanillin was first made about 1891 from eugenol, obtained from the oil of cloves, but other processes have since been invented for its manufacture, including, it is said, the utilisation of coal-tar products.

Winter's Bark. (*Drimys Winteri.* Magnoliaceae).—A small tree of temperate South America, the bark of which is aromatic and sometimes used as a spice and in medicine. The tree is established at Hakgala Gardens, Ceylon.

2.—CONDIMENTS AND SEASONING HERBS.

Aniseed ; Maha-duru, *S.* (*Pimpinella Anisum.* Umbelliferae).—An annual, cultivated in the South of Europe for its small seed-like fruits, which are much used in confectionery, cookery, and in the manufacture of a well-known cordial. The leaves also may be used, when available, for flavouring and for garnishing. The plant requires a light, rich soil, and may be grown from seed sown broadcast, or in drills 8 inches apart. Suited to a rather dry climate; commonly grown on the plains in India, but is not cultivated in Ceylon. Aniseed usually fetches from 24*s* to 26*s* per cwt. in London.

Basil, Sweet; "Suwanda-tala," *S* ; "Tulsi" of India (*Ocimum Basilicum.* Labiatae).—An annual, about 2 ft. high, native of and commonly cultivated in India, Burma, &c., for its yellowish-green essential oil obtained by distillation. The plant is often met with in peasants' gardens in Ceylon. It is cultivated in Europe and elsewhere for its highly fragrant and aromatic leaves, which are used

for flavouring soups, etc., but their strong odour is disagreeable to many persons. The plant is sacred to the Hindus, and is commonly cultivated near their temples. Thrives best at low and medium elevations. See pages 397, 456.

Borage. (*Borago officinalis.* Labiatae).—A small annual with coarse hairy leaves and pretty, blue flowers, both of which are sometimes used in Europe for garnishing, but more frequently as an ingredient in claret-cup. It is not often grown in Ceylon or India, though it thrives at the higher elevations, especially in the dry seasons.

Caraway ; Shimai-shombu, *T.* (*Carum Carvi.* Umbelliferae).—A biennial, native of E. Europe, 2 to 3 ft. high, cultivated in Holland, &c., for its well known aromatic " seeds " (fruits), which are much used in confectionery, also for flavouring spirits and perfuming soap. It does not seem to be grown on any important scale in the tropics. The seed may be sown broadcast, or in drills about 12 inches apart. The seed is valued at from 70*s* to 100*s* per cwt. in London, and Dutch "Caraway-oil " at about 28*s* per lb.

Caraway, Black. (*Carum nigrum*). A form with dark "seeds," cultivated and valued chiefly in N. India. **Carum copticum,** " Ajwan " or " Ajowan," see p. 376.

Chervil. (*Anthriscus sylvestris.* Umbelliferae).—An annual, native of Europe, the young leaves of which are sometimes used as an ingredient in salads and for flavouring purposes. Suited to the higher elevations in the tropics. Sow seed broadcast on a bed of smooth surface.

Chives. (*Allium schoenoprasum.* Liliaceae).—A small perennial, cultivated for its leaves, which are used in salads and soups instead of young onions. It is propagated by seed or division of the roots, and will grow in ordinarily good soil. The plant is little known in India or Ceylon, and the same is probably true of the rest of the tropics.

Clary. (*Salvia pratensis.* Labiatae).—A small biennial, the leaves of which are sometimes used for flavouring soups, etc. Seed may be sown in drills about 16 inches apart, or in boxes, the seedlings being afterwards transplanted at distances of 9 or 10 inches apart. Sometimes grown in hill gardens.

Coriander ; "Kotthamallie," *S.* (*Coriandrum sativum.* Umbelliferae).—An annual, commonly cultivated in India, whence large quantities of the seed are exported. The latter is used for the extraction of a volatile oil, also in confectionery, medicine, etc., and fetches from 30*s* to 45*s* per cwt. in London. The leaves as well as the " seed " (fruits) are use for flavouring curries, soups, &c. Succeeds in ordinary soils ; usually grown in India as a mixed crop, the seed being sown broadcast. See p. 398.

Curry-Leaf.—See " Karapincha," page 346.

Cumin ; Sudu-duru, *S* ; Seerugam or Shiragam *T.* (*Cuminum Cyminum.* Umbelliferae).—An annual, 2-3 ft. high, with Fennel-like feathery leaves, and "seeds" (fruits) like Caraway, but slightly larger and lighter in colour than the latter. This appears to have been cultivated in Palestine from very early times, and is mentioned in the Old and New Testaments. Cumin has properties similar to those of Caraway and Dill, and at one time largely took the place of these in cooking, medicine, &c. It is still employed in Germany, Holland, etc., and very largely imported into tropical South America generally, where, I am informed, it takes precedence over all other condiments for seasoning purposes. It is also imported into India, Ceylon, Straits, etc., and sold everywhere in the bazaars or boutiques as a condiment for meat-curries, etc. Apparently it is nowhere cultivated within the Torrid Zone, the chief sources of production being Malta, Persia, Turkey and Morocco, though it is also grown somewhat extensively in the Punjab and N. Provinces of India. Cumin seed fetches in London from 80*s*. to 115*s*. per cwt., and cumin essential oil about 48*s*. per lb.

Black Cumin; "Kalu-duru," *S.*—is the seed of *Nigella sativa* (Ranunculaceae), a herbaceous plant, native of Southern Europe, extensively cultivated in parts of India for the seed, which is aromatic, carminative and stomachic.

Dill ; " Satha-kuppai, " *T.* or *S.* (*Peucedanum graveolens.* Umbelliferae).—A biennial of S. Europe, the aromatic leaves of which are used in soups, sauces, etc.; the seeds yield an oil of medicinal value, from which the well-known "Dill-water " for infants is made. The plant is of easy culture and thrives in various parts of India. Seed may be sown broadcast or in drills. Dill seed is valued in London at about 22*s.* per cwt., and Dill-oil at about 26*s* per lb.

Fennel; "Enduru," "Divi-duru," "Maha-duru," or "Bata-enduru," *S*; "Perum-seeragam," *T.* (*Foeniculum vulgare.* Umbelliferae).—A herbaceous perennial, native of S. Europe, commonly grown in gardens in Ceylon, Malaya, India. &c. In North-western India it is commonly met with in a wild or cultivated state, the " seeds " (fruits) being used for the extraction of a volatile oil, valued in medicine, &c. The tall, finely-divided, aromatic leaves are used in fish sauces and for garnishing ; the leaf-stalks are employed in salads, and the seed (furrowed ovoid fruit) in confectionery and for flavouring liqueurs. Indian Fennel seed is valued in London at about 40*s* per cwt. The plant thrives best in moist situations, being suited to medium and high elevations. Seed may be sown in beds of well prepared soil.

Fenugreek ; " Ulu-hal " or " Asumodhagam," *S*; " Uluva-arisi," " Mathai " or "Vendayum," *T*; "Mathi," "Channi Rajani " of India (*Trigonella Foenum-graecum.* Umbelliferae). An annual, largely grown in India for the small, brown, grain-like, strongly-scented fruits, which are largely used for flavouring, as in curry stuffs ; they are also used in medicine, and yield a yellow dye. Seed is sown broadcast at the rate of about 20 lb. per acre, and the crop ripens in 2½-3 months from sowing.

Garlic ; " Sudu-lunu," *S.*; " Vella-vengam," *T.* (*Allium sativum.* Liliaceae).—A bulbous-rooted perennial, native of Central Asia and naturalised in Southern Europe; much cultivated in India and the East generally for its small, white, onion-like bulbs, which have a pungent flavour and an overpowering odour. These are sometimes used in Europe for flavouring soups, stews, etc. In India, Ceylon, and many other tropical countries, they are largely used in native cookery and medicine. The plant will thrive almost anywhere on the plains or hills, but succeeds best in light rich and rather dry soil. It is commonly cultivated in native gardens in Ceylon, but the market supplies are imported principally from India. Propagated by the bulbs.

Horehound. (*Marubium vulgare.* Labiatae).—A small perennial, sometimes cultivated in England as a pot-herb. A decoction of the leaves is a popular remedy for coughs, etc. Not commonly grown in Ceylon or India. Propagated by seed.

Horse-radish. (*Cochlearia Armoracia.* Cruciferae).—This well-known seasoning plant is commonly grown in hill gardens throughout India, Ceylon, and elsewhere in the tropics, but is quite unsuited to the plains or low elevations. The bitter tuberous roots, being scraped or grated, are used in soups, sauces, etc. The plant is propagated by division of the roots, with a portion of the crown attached, and thrives best in a deep, rich and rather moist soil. Deep holes may be made about 15 inches apart, in rows, and filled in with well-manured soil. Four or five months are required to mature a crop. By clearing away the soil from the upper portion of the root, and removing the fibrous side-roots, the main root becomes thicker and longer.

Horse-radish Tree ; " Murunga," *S.* (*Moringa pterygosperma.* Moringeae).—A small tree, the main thick root of which is commonly used throughout India as a substitute for horse-radish, to which, however, it is much inferior in flavour. The long, pendulous pods, produced chiefly in March and April, are very generally consumed by the natives, in an unripe state, as a curry vegetable.

Hyssop. (*Hyssopus officinalis.* Labiatae).—An aromatic dwarf shrub, cultivated in European gardens. The leaves are sometimes used for flavouring, as well as in medicine. Propagated by seed. Succeeds in light rich soil; not suited to low elevations, but may be grown in the hills.

"Karapincha" *S* ; " Karavempu," *T*; Curry-leaf. (*Murraya Koengii.* Rutaceae).—A small tree of the Orange family, native of Ceylon, and found chiefly in the dry region. It is familiar as the Curry-leaf plant, the pungent aromatic leaves being a constant ingredient in curries, mulligatawny, etc. The tree prefers light

rich soil, and with cultivation will thrive up to at least 2,000 feet elevation. Propagated by seed, which are in season chiefly in April.

Lavender. (*Lavendula vera.* Labiatae).—A dwarf shrub, native of South Europe,commonly grown for its pleasantly scented flowers,which are dried, made up in small packets and placed in wardrobes, etc. The aromatic leaves are sometimes used as an ingredient in seasonings. The plant is cultivated commercially for the highly-esteemed perfume, Lavender-water, obtained by distillation of the flowers. Lavender thrives well at medium and high elevations in the tropics, flowering and seeding freely. Propagated from seeds or cuttings.

Lemon Grass ; " Sayra," *S.* (*Cymbopogon citratus.* Gramineae).—The white fleshy heart of the leafy stalks of this well-known fragrant grass (cultivated for the oil obtained from the leaves) is very generally used by the peasants of Ceylon for flavouring, being also sometimes used in pickles. The stalks are commonly sold in the markets and boutiques at ½ cent each. See pages 399, 400.

Marigold, Pot. (*Calendula officinalis.* Compositae).—An annual of Southern Europe, commonly grown as an ornamental flowering annual. The showy yellow flowers are edible, and on the continent of Europe are generally used for flavouring soups, etc. See *Flowering Annuals*, page 197.

Marjorum, Sweet. (*Origanum vulgare.* Labiatae).—A biennial, native of Northern Africa, etc., cultivated in European gardens for its aromatic leaves, which are used either green or dried for seasoning soups, etc. It is propagated by seed, and is adapted to cultivation in hill gardens in the tropics.

Marjorum, Pot. (*Origanum Onites.* Labiatae.)—A perennial seasoning herb, native of Sicily. Propagated by division of the roots.

Matti, or **Mathai,** see Fenugreek, page 346.

Mint ; Meenchi, *S.* (*Mentha viridis.* Labiatae).—A small herbaceous perennial with creeping rhizomes ; one of the most valuable of all seasoning herbs, universally cultivated in temperate climates. The tops and young leaves are used for flavouring in numerous ways, as in soups, salads, and sauces, or boiled with peas, potatoes, etc. The plant grows freely in Ceylon hill gardens, becoming semi-naturalised in some localities ; it also thrives moderately well in damp and shady places in the low-country. It is easily propagated by division of the roots and underground stems, and is especially suited to a moist rich soil, in partial shade.

Country Mint ; "Odu-talan" *S.* (*Mentha javanica*).—A small plant, 1-2 ft. high, closely resembling the European mint or " Meenchi " in appearance and scent.

Mustard; Aba, *S*; Kadugu, *T;* "Rai" of India. (*Brassica juncea.* Cruciferae).—An annual, 2-3 ft. high, introduced and naturalised in Ceylon, commonly found in waste places in the low country. The small seeds are much used, whole or crushed for flavouring pickles and in numerous preparations. The Mustard of India is similar to the European " Black Mustard " (*Brassica nigra*), whose seeds when ground form the familiar condiment " mustard." The leaves of *Brassica alba* or " White Mustard" are used in salads. Propagation is by seed, which may be sown broadcast on a smooth surface of loose, friable soil. See pages 378, 395.

Parsley. (*Petroselinum sativum.* Umbelliferae).—From early times this has been cultivated as a medicinal plant. It is now universally grown for seasoning and garnishing purposes, and no garden is complete without it. It grows luxuriantly in up-country gardens in the tropics and, with some shelter from the sun and heavy rains, will also thrive tolerably well at medium and even at low elevations. Seed is best sown at the end of the heavy rains or, on the plains, before the cold weather sets in, either in drills in the open, or in boxes under cover, afterwards transplanting the seedlings out with a good ball of the earth in which they have germinated. A rich humous soil suits the plant best, and

light shade is beneficial. There are many varieties of Parsley, among those well-known being "Sutton's Imperial Curled," "Myatt's Garnishing," "Fine Double Curled," etc.

Rosemary. (*Rosmarinus officinalis.* Labiatae).—A dwarf shrub, native of South Europe, commonly grown in cool countries for its fragrant leaves. These are occasionally used for seasoning, and a decoction is made from them for relieving headaches and for hair-wash; they are also used in the manufacture of Eau-de-Cologne and other scents. Propagated from seed. Suited for hill gardens. French Rosemary-oil is valued at about 3*s.* per lb. See p. 457.

Rue; "Herb of Grace;" "Arudha," *S*; "Tirumuti-patchi," *T.* (*Ruta graveolens.* Rutaceae).—A small under-shrub with small, glaucous-grey leaves, commonly grown in gardens in Europe. The leaves have a strong unpleasant odour and a hot bitter taste; they are sometimes used for garnishing, but more frequently in medicine on account of their carminative properties. The plant may be grown in shaded spots at low or medium elevations, but does best up-country. It is commonly grown in peasants' gardens in Ceylon, being much valued in native medicine. Propagated from seed or cuttings.

Sage. (*Salvia officinalis.* Labiatae).—This well-known seasoning plant is successfully cultivated in hill gardens in the tropics. It will also succeed fairly well at intermediate elevations, if seed is sown at the beginning of the wet or cool seasons. Though usually propagated by seed, it may also be raised by cuttings. The plant is a small evergreen shrub, native of South Europe, and thrives best in light, rich, well manured soil.

Samphire. (*Crithmum maritimum.* Umbelliferae).—A small, sea-coast perennial, native of Europe, sometimes cultivated for its leaves, which are used in salads and as a seasoning and for pickling vinegar. The plant requires a light sandy soil and a moist situation. Sprinkling it occasionally with salt water is said to encourage its growth.

Savory, Summer. (*Satureia hortensis.* Labiatae).—An annual, native of Italy, frequently cultivated in gardens in Europe as a seasoning herb. The whole plant is aromatic, and the tops are used for flavouring salads and soups; they are also boiled along with peas, beans, etc. Though well suited to hill gardens in the tropics, the plant is seldom grown in Ceylon. Propagated from seed or by suckers.

Savory, Winter. (*Satureia montana*).—A small evergreen shrub, native of South Europe, often grown for seasoning purposes. Cultivation the same as for Summer-savory. Propagated from seed or by division of the crowns.

Shallots, see *Temperate or Sub-Tropical Vegetables*, p. 325.

Tarragon. (*Artemisia Dracunculus* . Compositae).—A small perennial, native of Siberia, cultivated for its aromatic leaves; these and the young tops are used in salads and soups, being also pickled with cucumbers; an infusion of them forms the much-esteemed tarragon-wine, also tarragon-vinegar. The plant requires a light free soil, and is generally propagated by division of the roots. It does not appear to be well-known in the hill gardens of Ceylon or India.

Thyme. (*Thymus vulgaris.* Labiatae).—This dwarf shrubby plant is a favourite amongst seasoning herbs, the aromatic leaves being generally relished for flavouring soups, stuffing, etc. The plant thrives at the higher elevations, preferring a light rich and rather dry soil and a sheltered situation. It is propagated by seed, which may be sown broadcast on a bed with a smooth surface, or in shallow drills 8 inches apart. The seedlings should afterwards be thinned out to distances of about 4 inches each way; or seed may be sown in pots under cover, the seedlings being pricked out and transplanted when strong enough. Instead of being grown in a bed, thyme may be planted as an edging to beds or borders.

Ulu-hal, see Fenugreek.

SECTION 4.

CHAPTER XXIV.

BEVERAGES AND EDIBLE PRODUCTS

SEE ALSO CHAPTERS 21 AND 22.

Tea. Thay-gas, *S*; Tey-ile, *T*.—The tea of commerce consists of the cured young leaves and tender tips of shrubs belonging, it is supposed, to either of two distinct types or races of *Camellia Thea*, viz., "var. Viridis" and "var. Bohea," both of which comprise numerous sub-varieties or jats. The former, a native of North-eastern India, is considered to be the stock from which the races of "Assam Indigenous" and "Manipuri," and most of the varieties cultivated in India, Ceylon, and Java, have been derived. The China Tea (variety "Bohea") is distinguished by its squat, straggling habit and comparatively thick leaves; it is the kind chiefly grown in South China, and is cultivated on some of the higher estates in Ceylon, being hardier than, but not so productive as, the Indian kinds referred to. The " Assam Hybrid " is considered to be a natural hybrid between the " Assam " and " China " teas. Left to itself, the Assam Tea is an erect tree, 30 to 40 feet high, but in cultivation it is " topped " early, at a height of about 1½ ft., and kept as a bush, never being allowed to grow higher than about 3-4 ft., except, of course, for seed purposes.

Tea has been cultivated from time immemorial in China and Japan. Its cultivation in Ceylon on a commercial scale may be said to date from 1867, although the earliest record of its introduction to the Botanic Gardens goes as far back as 1839 for Assam Tea, and to 1824 for China Tea. Tea was first introduced into England about 1658, in the reign of Charles II, when it cost £3 per lb. Tea is now extensively grown in Southern India, Bengal, Assam, Java, and Ceylon. In the latter country the export rose from 23 lb. in 1873 to over 215 million lb. in 1915, and about 418,000 acres are now under the product. The export from Ceylon in 1923 was about 182 million pounds, valued at about £12,380,000. China is considered to be the largest tea-producing country, though the bulk of its production is consumed locally. In recent years, tea has been successfully cultivated on a commercial but limited scale in Natal and Nyassaland. $.

The tea plant, more especially the Assam type, is adaptable to a wide range of climate and soils, provided the rainfall is abundant (not less than about 70 inches) and evenly distributed. In Ceylon it thrives from sea-level to over 6,000 ft. It will not, however, flourish in a dry climate, especially at low elevations. The soil must be well-drained, and when deficient in humus this

should be supplied by means of green-manuring, as by inter-planting quick-growing leguminous trees or shrubs which can be lopped frequently, the twigs and leaves being left on the ground to form a mulch, or lightly forked in. See pages 23, 214. Manuring periodically, with artificial or cattle manure, is necessary in order to maintain the crop in a healthy and vigorous condition.



TEA FIELD IN CEYLON, with pluckers at work.

Tea seed is usually sold by the maund (80 lbs.), which contains from 18,000 to 20,000 seeds, according to jat, the better the jat the heavier the seed. Manured and properly cultivated plants generally yield the heaviest and best seeds. A maund should produce from 14,000 to 18,000 plants, or sufficient to plant up 3 acres at 4 ft. by 3 ft. apart, or 4 acres at 4 × 4 ft., making a liberal allowance for failures.

Propagation is by seed, which may be sown in raised nursery beds, at distances of 4 inches apart each way, the beds being shaded by fern fronds or Grevillea leaves fixed in the ground slanting-wise. It is best, however, to raise plants in small plant-baskets or bamboo-joints, as such plants may be planted out direct without injuring the roots. Efforts have been made to grow Tea by cuttings and other vegetative means, but, though theoretically much to be desired, these methods have so far not been practicable on a commercial scale. In about 10 months from the time of sowing, the seedlings should be ready for planting out in the field. Holes being made in lines, the plants are set out at distances of about 4 ft. by 3 ft., or 4 ft. by 4 ft. apart, being shaded, and watered when necessary, until well established. About 18 months after planting, the plants are "topped," *i.e.* cut back to about 15 inches from the ground, so as to induce a spreading bush. The first crop of leaf is obtained in the third year in the low-country, being a year or so later at higher elevations. At low elevations plucking takes place about every ten days, and at the higher altitudes once a fortnight or three weeks, according to elevation. When the bushes stop "flushing," they are pruned back severely, this being necessary at intervals of about 16-20 months in the low-country, and of about 3-4 years up-country. When in full bearing, at 7 or 8 years old, the crop of made tea may, according to elevation, soil, and degree of cultivation, be from about 500 lbs. to over 1,000* lb. or more per acre; 700 lbs. is considered a good average yield.

The tea plant takes kindly to cultivation and lives to a great age. The oldest Tea in cultivation in Ceylon is over 60 years of age, and shows no falling off in vigour. *Plucking*, which is usually done by women or boys, consists in nipping off by hand the tender end leaves with the bud and shoot; taking two leaves and the end bud constitutes *fine* plucking and affords a good quality tea, while 3 or 4 leaves and a bud forms *coarse* plucking and yields tea of a lower quality. Pluckers will pluck from 30 to over 80 lb. of green leaf a day, according to the condition of the field and the activity of the workers. 4 lbs. of green leaf will produce 1 lb. of made tea.

Black Tea.—The leaf being brought to the factory, it is *withered* on tiers of hessian screens in drying sheds, through which hot air is driven; it is then *rolled* by

*On Mariawatte Estate, Gampola, Ceylon, a field of over 100 acres gave an average of 1,357 lb. per acre for over seventeen years.

means of rolling machines, during which the process of *fermentation* or oxidation also takes place; this is followed by spreading the mass of bruised leaf for 1 or 2 hours, in a cool temperature, for further fermentation. *Firing* is done in drying machines, then *sifting*, by means of which the tea is simultaneously sorted into *grades*, as "souchong," "pekoe souchong," "orange pekoe," "broken orange pekoe" (the best quality), and "dust." It is then packed into lead-lined chests of uniform sizes for export. A full-size chest contains 80-100 lbs.; a ½ chest, 40-50 lbs. The quantity and value of tea exported from Ceylon in 1924 is expected to show a considerable increase over the figures for 1923.

Green Tea, as distinct from *black* or ordinary tea, is made by subjecting the green leaf at once to a process of steaming in a revolving cylinder, and afterwards by rolling, drying, etc., the processes of withering and fermentation being omitted China teas are usually made on this principle. There is a certain demand for green teas in some countries, notably the United States, and Ceylon now manufactures and exports a considerable quantity to meet this demand. Over 2¼ million pounds of green tea were exported from Ceylon in 1923, valued at £1,571,048. The export was nearly 4 times this amount 10 years ago.

Brick Tea.—A cheap and coarse tea, made in China and used largely in Tibet, being boiled with salt, butter, etc. Brick or tablet-tea is made in two forms, one of which consists almost entirely of twigs and leaves of the tea plant, pressed with some glutinous substance and dried in moulds; the other is made up of the finer siftings and dust of ordinary tea compressed into slabs. The latter kind is consumed chiefly in Russia.

Leppet or **Leptet Tea** is prepared in Burma and the Shan States, where it is used as a vegetable rather than a beverage. It consists of green tea leaves pressed and preserved on the principle of a silo, these being afterwards prepared for use by mixing with garlic, salt, oil and other ingredients.

Soluble Tea. A process was invented a few years ago by the late Mr. Kelway Bamber, Ceylon Government Chemist, by which the essence of tea was extracted and rendered available in a concentrated, soluble, fine powder form, known as "soluble tea." Though it had much to recommend it, especially to travellers, it has not been a commercial success, and has ceased to be manufactured.

Mate, Yerba de Mate, or **Paraguay Tea.** (*Ilex paraguensis*. Ilicineae).—A small bushy tree, with serrate, alternate leaves, not unlike those of the Tea plant proper, native of South America, where it is extensively cultivated, the dried leaves being used as tea. In Brazil and Paraguay, matè forms one of the leading articles of local trade, being exported to neighbouring countries in considerable quantities. From Brazil alone the annual export, chiefly to the Argentine, is about 140 million pounds, valued at over 2 million pounds sterling, averaging about 4-5d. per lb. Matè is also occasionally imported into Europe.



1, ASSAM TEA (*Camellia Thea*, VAR. *Assamica*); 2, PARAGUAY TEA (*Ilex paraguensis*).

In preparing the leaves for use, they are first partly dried in the sun, then artificially heated, the latter process requiring practically all the skill necessary in the preparation of the product, for the leaves must be dried thoroughly and

evenly, without scorching; they are then usually ground small and packed tightly into bags for market. An infusion from them may be prepared and served in the same way as tea, but it is customary to drink it from the spout of a tea-pot, or sometimes through a tube with a strainer at the bottom, called a "bombilla". The tea contains a certain percentage of caffeine, and is the favourite beverage of a large proportion of the population of Brazil, Paraguay, Uruguay, and the Argentine Republic, etc., being considered to be a mild stimulant, laxative and diaphoretic, and to have the power of "increasing intellectual lucidity and vigour." The plant has been introduced at Peradeniya, and thrives in ordinary soil. Like the Indian tea, it is suited to different elevations, in moist districts. §.

Arabian Tea. "Khat" or "Cafta." (*Catha edulis*. Celastraceae).—A small shrub, 5-6 ft. high, native of and cultivated in Arabia and parts of East Tropical Africa, introduced in 1882 at Peradeniya, where it flourishes in ordinary soil, with or without shade. The leaves and young twigs form a considerable article of local trade in its native habitat, being made into a beverage, like tea, or chewed both in the green and dry state. The plant has stimulating properties, and its use is said to be of great antiquity, preceding that of coffee. In appearance the plant is not unlike ordinary tea. §.



ARABIAN TEA, OR KATHA. *Catha edulis*



AYAPANA TEA. *Eupatorium Ayapana.*

Ayapana Tea. (*Eupatorium Ayapana*. Compositae).—A low, spreading, semi-herbaceous, creeping shrub, 2-3 ft. high, with long, narrow leaves, which as well as the stems are of a bronze tint. It is indigenous to Brazil, and cultivated to some extent in Mauritius and Reunion for the sake of its medicinal properties, the leaves and young twigs being used for making a decoction like tea, which is regarded as a mild stimulant and a cure for dyspepsia. The plant is also sometimes cultivated in India, where it is similarly employed and esteemed. It is easily propagated by cuttings or suckers, and thrives on ordinary soil, in partial shade, at low or medium elevations. It seldom produces seed, and has the habit of rooting at the nodes of the trailing stems. §

Jesuit's Tea, or "Culen." (*Psoralea glandulosa*. Leguminosae). An erect herbaceous shrub, native of Chili, the leaves of which are used to make a decoction known as "Jesuit's tea," which is valued more for its medicinal properties than as a beverage, being a vermifuge and a stomachic.

Coffee.—Kopai, *S.* and *T.*—The coffee of commerce is furnished mainly by *Coffea arabica*, known as "Arabian Coffee," the use of which dates back a long period. In recent years several other species or varieties of Coffee have been under cultivation (see over). The "Arabian Coffee" is a small slender tree, native of Abyssinia, long introduced and cultivated in Brazil, West Indies, South India, Java, Ceylon, etc. Coffee was first known in England in 1652. It appears to have been first introduced into Ceylon about 1690, by Arab traders, but its cultivation on an important scale began in 1825, when Ganaroowa Estate, now the Government Experiment Station, was opened as the first up-land plantation. In 1869 a serious fungus disease (*Hemeleia vastatrix*), known as the "Coffee leaf-disease," appeared. This spread rapidly until, in a few years, it devastated the whole industry and ruined many planters. The export of coffee from Ceylon consequently dropped from nearly one million cwt. in 1874, to 156 cwt. in 1912. It has not, however, quite disappeared from Ceylon's exports, and in 1923, some 10 cwt., valued at Rs. 1,053, were exported. With an improvement in prices and the discovery of sorts more or less resistant to disease, the prospects of coffee have of late improved, and the area under its cultivation in Ceylon is again on the increase, chiefly as a catch-crop, as with young Rubber or Coconuts. Cured "Plantation coffee" is valued at present at from £5 to £6 per cwt.

The Coffee tree thrives in a moderately humid atmosphere, and prefers deep, loamy, well-drained soil and sloping land; it is unsuited to stiff clayey or poor, sandy soils. The "Arabian" type thrives best at medium elevations, say 2,000 to 4,000 ft. in Ceylon, whilst the "Liberian" is best suited to elevations below 2,000 ft. Propagation is by seed, sown in nursery beds or, preferably, in baskets or bamboo pots. (See page 35). The seed germinates in about 5-7 weeks, and the seedlings should be ready for planting out in about 8-10 months later. In planting out in the field, the spacing should not be less than 6 ft. by 8 ft. for the "Arabian," and about 10×12 ft. for the more robust kinds, as "Liberian." Shade must be afforded until at least the plants are established; light permanent shade is required for the "Arabian" and others of that type, though not essential in the case of the "Liberian" and "Excelsa." Different trees (see p. 214) are employed as shade for Coffee, *e.g.* "Dadap", "Bois-immortelle", *Leucaena glauca*, etc. Species of Ficus, as *F. mysorensis*, *F. infectoria*, and *F. hispida*, and of *Acrocarpus* are used as permanent shade in S. India. (See p. 214, &c.) Liberal manuring is indispensable, and farm-yard manure, when obtainable, is considered the best.



ARABIAN COFFEE UNDER DADAP SHADE, IN JAVA

Pruning consists mainly in thinning out superfluous or useless branches and maintaining the bushes in shape. The plants should be topped to 18 in. when about 3 ft. high, so as to form spreading bushes, which may be kept at a convenient height of about 5 ft. In India and Ceylon the bushes blossom chiefly in March or April, the crop being harvested in October-February. The first crop is produced when the plants are about 3-4 years old; under special conditions a small crop may be obtained at the age of 2½ years from planting. When in full bearing, at the age of 5-6 years, a yield of about 1 lb. of clean and dried coffee per tree, or about 6 cwt. per acre, is considered a good average crop, though in some cases 8-10 cwt. or more may be obtained. The berries are picked when they turn red, *i.e.* about 7 months after blossoming, and a good worker can pick 3 bushels or more a day. A bushel of fresh berries will yield about 10 lbs. of dry coffee. Each berry or "cherry" contains 2 seeds ("beans") facing each other by their flat sides. About 850-1,000 fresh seeds go to a pound, so that 1½-1¾ lbs. should be sufficient to plant an acre, allowing for failures.

Pulping (*i.e.*, removing the shell or pulp of the berries) is done by a pulping machine; or it may also be done by pounding the berries in a mortar. The mucilaginous substance surrounding the beans is removed by fermentation, after which they are washed in water and dried in the sun. The "beans" are then known as "parchment" or "plantation" coffee. The parchment or thin shell of the seed is removed by "hulling" machines. A bushel of "parchment coffee" will give only about half that quantity of clean beans. The coffee is then put through a winnowing mill to separate the chaff or broken parchment, etc. Sometimes the berries are simply dried whole, being then known as "native coffee" or "dried berry". In this form the superior qualities of the coffee are said to be retained, but the subsequent processes of pulping, &c., are more troublesome, and transport is more costly.

OTHER SPECIES OF COFFEE.

Liberian Coffee. (*Coffea liberica*). A robust-growing tree, native of West Tropical Africa, introduced into Ceylon about 1870, distinguished by its considerable height (growing to about 30 ft. high if left to itself), large, thick leaves, and large berries. The tree does not require permanent shade, bears fruit almost throughout the year, but the product commands a lower price than the "Arabian". The berries do not drop as soon as ripe, as do those of the "Arabian," and have a tougher and more fibrous skin than the latter, so that the labour entailed in cleaning, etc, is increased. The vigorous constitution of the tree renders it more or less resistant to the leaf-disease. Suited to low elevations only, *i.e.*, up to about 2,000 ft. Planting distances may be about 10 by 12 ft. The plants should be topped to about 2½ ft. when at a height of about 5 ft. Present value about 65*s.* per cwt., against 75*s.* for Arabian."

Excelsa Coffee (*Coffea excelsa*), a handsome vigorous species, indigenous to the French Congo, &c., with large leaves, and "Abeokuta Coffee" (also of Trop. Africa) are both of the Liberian type and,



ROBUSTA COFFEE. *Coffea robusta.*

like the latter, appear to possess considerable powers of disease resistance. The former gave a crop of over 10 lbs. per tree at the Peradeniya Experiment Station, Ceylon, and a similar yield in Trinidad.

Congo- or **Robusta-Coffee** (*Coffea robusta*).—A species indigenous to Central Africa, recently brought into cultivation, with large, handsome, wavy leaves, introduced at Peradeniya in 1900. It has given very satisfactory returns in Malaya as a catch-crop with young rubber; thrives at low and medium elevations, yielding a crop of about 1 cwt. per acre in about 2½ years from planting, 4-5 cwt. in the 3rd or 4th year, and 6-8 cwt. or more in the 4th or 5th year. 700 seeds go to a pound. Other species (or varieties) of this type are: "Uganda Coffee," "Canephora," and "Quillou."

Sierra Leone Upland Coffee. (*Coffea stenophylla*).—A slender-stemmed, small-leaved West African tree, reaching a height of about 25-30 ft. if left to itself; bears a profusion of small ovoid berries, which are black when ripe and reported to have a superior flavour. Introduced at Peradeniya in 1894; flourishes and bears fruit there in abundance, usually in December-January.

Hybrico Coffee.—A Brazilian hybrid whose berry contains 4 to 6 instead of 2 seeds; its quality is well spoken of, but it does not appear to be known in the East.

Maragogipe Coffee, of Brazil, is of a robust habit with large leaves, similar to the "Liberian." This has been established at Peradeniya since 1884, but although the tree flourishes here it bears but scanty crops.

Hybrid Coffee. There are several hybrids of Coffee, among the best being a cross between the "Arabian" and "Liberian," which bears heavy crops of good-sized berries. This has yielded an average of 14 lb. dried berries per tree, for 147 trees, at the Peradeniya Experiment Station, being in bearing, throughout the greater part of the year. The plant is a vigorous grower, and its robust constitution appears to render it to some extent resistant to the coffee-leaf disease. "Kent's Hybrid" is well spoken of in S. India.



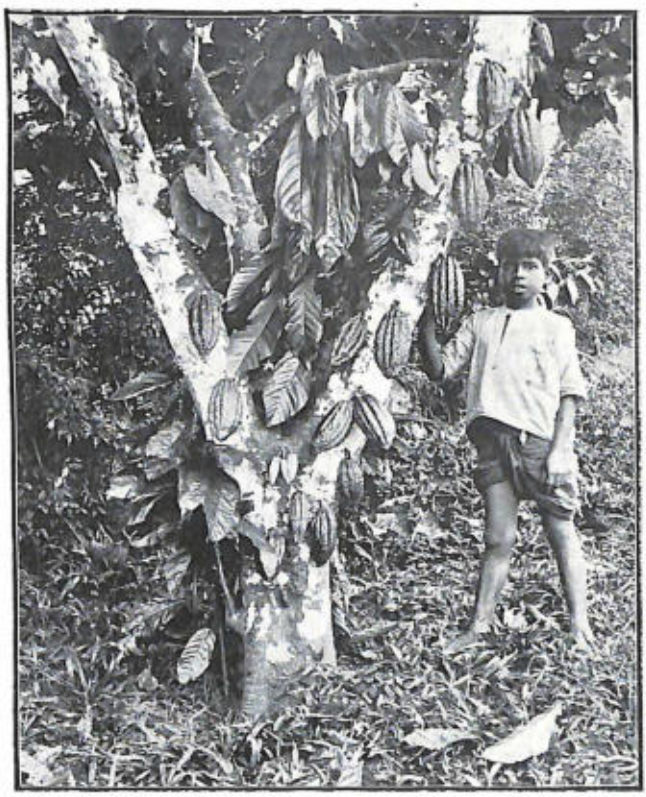
HYBRID COFFEE.

Mocha Coffee. The coffee of Arabia, being exported from the town of Mocha, is generally known in the trade by this name, the best quality being produced only in the province of Yemen. It is a variety of *Coffea arabica*, with rather small berries, and is of a superior flavour and aroma. "Mocha" is the standard coffee grade, and fluctuates somewhat in price, according to quality, etc., from about 70*s* to 80*s* or more per cwt.

Coffee owes its stimulating quality to the presence of *caffeine*, which is also present in the leaves and is similar to the principle of *theine* of tea.

Cacao or **Chocolate Tree**; Chocolath-gas, *S*; Coco-maram, *T*. (*Theobroma Cacao*. Sterculiaceae).—A small tree, 15-20 ft. high, with large

oblong leaves, native of tropical America, cultivated extensively in its native home as well as in the West Indies, Gold Coast, Java and Ceylon. Cacao was first introduced into Ceylon about 1819, but its systematic cultivation was not undertaken till about 1878, when the first export of 10 cwt. was recorded. The tree bears a profusion of small pinkish or yellowish flowers, in bunches on the stem and older branches, followed about 5-6 months later by the fruit. The latter is a large, warty or furrowed pod, 6 to 9 inches long, and is red, yellow,or grey when ripe. Each pod contains from 25 to 40 large seeds, closely packed in a column in the centre and covered with a mucilaginous substance.

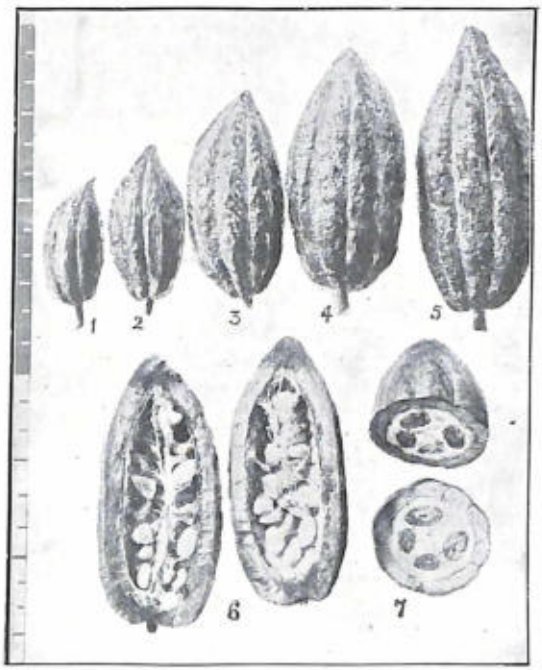


CACAO TREE ("NICARAGUA" VAR.) IN FRUIT.

Climate, cultivation, etc.—The Cacao tree generally thrives best at elevations between 500 and 2,000 ft., with an average rainfall of between 60 and 80 inches a year. It has a long tap-root, and requires deep and well-drained soil, light shade, and shelter from strong winds where these occur. The thornless "Dadap" (*Erythrina lithosperma*) and allied species, planted about 50-60 ft. apart, form very suitable shade and afford a certain amount of protection from wind. In some countries, however, as in Grenada, practically no shade is used. Propagation is by seed (occasionally by budding), which must be sown fresh, preferably in plant-baskets, the seedlings being planted out in the field, with baskets, when about 10 to 12 inches high. The seeds germinate in about 3 weeks, and the seedlings, which grow at a rapid pace, are ready for planting out in about 4-5 months from the time of sowing. Planting distances should be not less than 15 × 15 ft., say 200 trees to the acre. Catch-crops, such as bananas, tapioca, etc., are sometimes grown between the rows for the first two or three years, both for the purpose of yielding an interim return and affording temporary shade to the young Cacao plants. Clean weeding is essential and an occasional application of a suitable fertiliser will help the plants to make good progress and come early to maturity. The ground should be forked up at least once in two years. A round of light pruning should be carried out two or three times a year. Excessive pruning is injurious and exposes the fruit to attack by insects, especially the "mosquito blight" (*Helopeltis*). When young, the plants should be allowed to develop 3 or 4 primaries

from a single stem, and from these, secondaries and tertiaries in consecutive and symmetrical form, keeping in view the object of admitting light and air to the centre of the tree.

Harvesting, Curing, Grading, &c.—In harvesting, the pods must be cut off, not pulled or torn; they are collected into heaps, then cut or broken open (*shelling*). The seeds ("beans" or "nibs") are then carried to the curing house, and placed in a strong wooden box *, to undergo "sweating" or *fermentation* for about 1½ or 2 days (the period varying from about 36 to 48 hours or more in different countries), the beans being turned over and washed once a day. They are then spread out on matting in the day time to dry, and covered with sacks at night, or, if out of doors, placed in bags and brought under cover, to be spread out again the following day. About 6-8 days are thus required to complete fermentation and drying, the time, however, as well as the process, varying somewhat in different countries. Owing to uncertainty of the weather, a drying-or curing-house, heated with hot air and containing tiers or floors covered with matting, is sometimes provided; or a moveable roof over a barbecue may be adopted. Colouring the beans with clay, brick-dust, etc., is sometimes practised in the West Indies and Venezuela in order to give them a fancy appearance and polish; annatto dye is also sometimes employed for the purpose. Polishing the "beans" by rubbing them with the hands, or by "dancing" among them with bare feet, is also commonly done in the countries named for the purpose of giving the beans a good appearance in the trade. After the beans are cured, they are sorted into grades; large, plump, well coloured and smooth beans form *first quality*; flat, wrinkled and small being *second*; and broken, black, or squirrel-damaged, *third*. They are then packed in bags for export, 112 lb. usually going to a bag.



DEVELOPMENT & STRUCTURE OF CACAO FRUIT.
Fig's 1 to 5 show growth of pods from 1 to 5 months.

Yield. A small crop may be obtained in the fifth year from planting, but the trees are not in full bearing until at least 10 or 12 years old. The principal crop, in Ceylon, is produced from October to January, and a smaller crop from May to July. In a plantation, however, no period of the year is entirely without some crop. About 4-5 cwt. cured beans per acre is a good average yield, although as much as 8 or 9 cwt. per acre is sometimes obtained from specially good and well cultivated trees. Fifty pods per tree is considered a good average crop, but some trees under favourable conditions may bear as many as 400 or more. "Forastero" pods contain on an average 32 to 35 "beans" each. 50 average pods, or the average yield of dried beans per tree, should be equivalent to 2½ lb. of made cocoa. Cacao fluctuates in price from about 70*s.* to 100*s.* per cwt., according to quality.

The Gold Coast is now the leading cacao-growing country; its annual export has grown from 80 lb. in 1891 to about 2 million cwt. The area under the product in

*A cement-lined tank is sometimes employed, but this is not generally recommended.

Ceylon is estimated at about 20,000 acres. An estate producing 4 cwt. per acre may be worth from £55 to £68 per acre. Ceylon cocoa, owing to careful preparation in washing, fermenting, and drying, has generally a good reputation in the trade. The export of cocoa from Ceylon in 1923 amounted to some 60,904 cwts., valued at £149,103. This is exclusive of the amount used by local factories for making chocolate, &c.

In the preparation of cocoa powder, the cured beans are subjected to processes of roasting, nibbing, grinding, heating, &c. Certain ingredients are added, and the butter-like fat, known as cocoa-butter or oil-of-theobroma, is extracted. The latter is a valuable by-product used in medicine, etc. To make chocolate, further ingredients, as sugar, milk, and aromatic substances, are added, and the whole ground into a paste, &c. Inferior chocolates are often made, or adulterated, with vegetable fats or nuts.



SHELLING CACAO.

Varieties.—There are numerous more or less distinct types or varieties, which may be classed into two or at most three groups, viz., "Forastero" (=foreign), "Criollo" (=native), and "Calabacillo" (=small calabash). The last named, formerly regarded as a form of Forastero, is now considered a distinct type. The typical Forastero has a thick and deeply furrowed bottle-necked pod, and is either red or reddish-yellow; the seeds, which are large and numerous, are somewhat rounded, and purplish in section; the tree is a vigorous grower and usually a prolific bearer. Owing to cross-pollination, however, this type has become very variable. Some of the best varieties of Forastero are "Cundeamar," "Amelonado," "Ocumare," "Verdilico," and "Cayenne." The Criollo type (known in Ceylon as "Caracas" or "Red Ceylon"), is distinguishable by its smaller, thin-shelled and red pods, with rather globular seeds, which are usually white in section; these were formerly much valued and commanded a high price. The tree is of a rather delicate nature, and though once the principal variety grown in Ceylon it is now almost extinct here. The "Calabacillo" has usually a small and roundish pod with a smooth skin, the beans being flat, and dark-purple in section.



DRYING CACAO BEANS IN THE SUN, ON MATTING.

Theobroma pentagona, or "Alligator Cacao," is a distinct species, introduced to Peradeniya from Trinidad in 1895. The pods are small, with 5 prominent ridges;

seeds large, but few, white in section. The bean appears to be of good quality, but the tree is a scanty bearer in Ceylon.

T.—angustifolia. "Monkey Cacao." A remarkable species, of no commercial value, introduced at Peradeniya in 1895. It fruited there for the first time in 1909, bearing large, hairy, brown and furrowed pods.

Guarana. (*Paullinia Cupana.* Sapindaceae).—An ornamental climber with small pinnate leaves, native of Brazil, introduced at Peradeniya in 1882. The small brown seeds are dried, powdered, and made into dough with water ; this is then formed into cylindrical brown rolls, 5-8 inches long, or in shapes resembling birds and animals, which become very hard when dry. It is used throughout Brazil and other parts of S. America for making a refreshing beverage and in medicine. Every traveller carries a piece of guarana, and, when desired, a small portion is grated off and dissolved in water to form a stimulating beverage like tea. Guarana contains 4-5 per cent. of *guaranine*, an active principle similar to *theine* of tea and *caffeine* of coffee.

Kava ; Yagona. (*Piper methysticum.* Piperaceae).—A shrub, 6-8 ft. high, with fairly large, round or cordate leaves, indigenous to Fiji and other Pacific Islands. An extract from the roots, after undergoing fermentation, is used as a refreshing drink, known as " kava " or " yagona," which forms the national beverage of the countries referred to, being used as a token of good-will and on all ceremonial occasions. Its refreshing effects are highly spoken of by those who have partaken of the beverage, the serving of which is attended with peculiar formalities.

The plant is commonly cultivated in Fiji, &c. For drying, a crop of roots is obtained in 3-4 years from planting, each plant averaging about 3lb. of dried roots, which are worth locally about 1*s.* per lb. Fresh roots may, however, be cut at any time. The plants are then uprooted, and the ground prepared for another crop. Excessive kava-drinking is liable to produce skin diseases and weaken the eye-sight. The usual method of preparing the beverage is by chewing the roots and ejecting the saliva into a bowl, where it is allowed to ferment. The chewing is usually done by boys or girls with good teeth, but this method, I am informed by Mr. Jepson, is now forbidden by law in Fiji, owing to its liability to spread phthisis. In planting, the spacing is about 6 × 6ft., or about 1,200 plants per acre.

Sugar-Cane. Uk-gas, *S* ; Karambu, *T.* (*Saccharum officinarum.* Gramineae).—A tall grass or reed, reaching a height, in cultivation, of 8-12 ft. or more and a diameter of about 2 inches ; considered to be a native of E. Trop. Asia, but found in a cultivated state in all tropical countries, being extensively grown in some for the sake of the sugar obtained from the thick, juicy stems. The cultivation of the plant dates back a long period. The chief countries of cane-sugar production



SUGAR CANE.

now are Mauritius, the Guianas, Java, Hawaii, Cuba, India, Fiji and some of the West Indies. The plant requires a hot humid climate, alternating with dry periods, and thrives best at low elevations on flat or slightly sloping land, with stiff loamy or alluvial soil; it flourishes, however, in any ordinarily good soil, provided the necessary moisture is available. The presence of lime in the soil is considered beneficial, if not essential, for the proper development of the sugar content of the canes. The crop is an exhausting one, and manuring is indispensable. It is generally grown for many years in the same ground, without rotation or rest.

Propagation is by cuttings, which, being usually selected from the upper joints of the canes, are cut in lengths of 8 to 10 in. (including 3-5 joints) and placed in trenches 10 to 12 in. deep and V-shaped in section. The cuttings may be inserted 2 or 3 together, about a foot apart, in a slanting position, and nearly covered with soil. Planting distances vary somewhat according to variety of cane and class of soil, but under average conditions they may be 5 ft. by 4 ft. The cuttings (called "plants") sprout in 10-14 days; the first or "mother" sprout is cut off so as to induce the plant to tiller. Subsequently weeding, forking the soil, and earthing up the plants must be attended to when necessary. All dead leaves ("trash") should be left on the canes in dry weather, but in wet weather they should be removed from the canes and left on the ground to rot and form a mulch, or be buried.

Harvesting commences, according to variety of cane and climate, about 12-20 months from the time of planting, the canes becoming tough and turning a pale yellow colour when ready for cutting. They are cut as close to the ground as possible, for the root end of the cane is the part richest in sugar. The rhizomes ("stools") will continue to crop for at least 3 or 4 years, sometimes for as many as 8 years or more, each crop after the first being known as *ratoons*, as "first," "second," and "third" ratoon, etc.

Yield, etc. Under favourable conditions a good variety will yield 30-40 tons of canes or more per acre; but in ordinary circumstances the yield may not be more than 20-25 tons, varying according to variety of cane and soil. Good varieties should, under good cultivation, give about one ton of sugar for every 9 or 10 tons of cane; thus the crop may vary from 2 or 3, to 4 tons of sugar per acre. The canes are crushed or macerated by machinery. The sweet saccharine juice is afterwards submitted to processes of clarifying (in which lime is used to neutralise the acids), heating, filtering, bleaching, etc. The fibrous material left after the juice is extracted (megass) is used as fuel for the engines, &c. Raw sugar, or muscovado, is boiled and clarified to form crystallized or white sugar, and this is at once ready for the consumer. Molasses and treacle, from which rum is made, are the uncrystallizable product from the muscovado or raw-sugar.

Varieties.—Numerous varieties are known in cultivation, and in recent years many crosses have been raised from seed, which considerably exceed the older sorts in yield, making sugar-planting a more profitable industry. "Otaheite" and "Bourbon" are old favourites in the West Indies. "Yuba" is the principal variety grown in Natal and Portuguese East Africa, where, according to Lyne, it sometimes gives as many as 12 ratoons and stands drought well. Sugar cultivation has been tried at different times in Ceylon, but, though the growth of the cane is excellent, the industry has not developed. Some small areas are, however, still cultivated in the Galle district from which sugar is made locally. A considerable quantity of sugar-cane is grown in peasants' gardens for chewing purposes, being often a stand-by with pilgrims and native travellers. The plant thrives up to 2,500 feet in the moist region.

Palm-sugar or **Jaggery** is obtained from the juice or sap of several species of palms. The methods of extracting the juice vary somewhat with different species and in different countries but the mode of converting it into sugar is practically the same in all cases. In the case of the Kitul, Palmyrah and Coconut palms, which are those generally used in Ceylon, the young inflorescence (spadix) is tapped before it is fully developed. This is first gently beaten with a mallet, and a couple of days later a slice is taken off the end. The operation is repeated each evening (not necessarily the beating), sometimes oftener, a thin shaving being taken off

the cut end of the spadix each time, and the fresh toddy is collected in an earthernware pot or gourd suspended close to the cut, and brought in in the morning. A little lime is smeared on the inside of the vessel to prevent the juice from rapidly becoming sour or fermented. The tapping is thus continued for several months, or until only a stump of the spadix is left. Another spadix may have developed before the first is exhausted, and this is similarly taken in hand. The fresh toddy is sweet and pleasant to drink, but when fermentation sets in it becomes intoxicating and milky-looking, and in about 24 hours is unfit to drink.

If required for making sugar, the fresh juice or "sweet toddy" is boiled down, as a result of which a brown thick syrup ("gur" in India) is obtained. This is placed in baskets of palm leaves to harden, after which it resembles brown toffee, forming palm-sugar or jaggery, which is much used locally for sugar, sweetmeats, etc. One gallon of toddy will usually yield 1½ lb. of jaggery, and each palm may give from 2-4 quarts of toddy a day. By fermenting the toddy for 4 or 5 days and then distilling it, a strong intoxicating spirit (arrack) is obtained, 100 gallons of the former producing about 25 of arrack. This refers to the coconut palm, for arrack is not usually made from the palmyra and kitul toddy in Ceylon. Fermented for 2-3 weeks and spiced with chillies and other ingredients, palm toddy forms an excellent vinegar.

The following are the principal sugar-yielding palms :

Coconut Palm.—See page 389.

Sugar Palm of India ; "Wild Date." (*Phoenix sylvestris*).—A tall palm with stiff feathery leaves, allied to the Date palm, native of India, where it is cultivated for the production of sugar or jaggery. It is estimated there are over 60,000 cultivated acres under the product in India, chiefly in the Madras Presidency. The method of extracting the juice is different from that practised with the Coconut, Kitul, and Palmyrah, the tender portion of the stem near the top being tapped after the removal of some of the leaves. This is the principal source of arrack in India.

A V-shaped cut, about 3 inches wide and ¼ inch deep, is made across the bared portion of stem, and the juice as it exudes is conducted into a pot, suspended underneath by means of a bamboo. The collected juice, when boiled down as already described, yields jaggery (sugar) or, when fermented and distilled, arrack. It is considered a profitable crop to the peasants, the palms being fit for tapping at the age of 8-10 years, yielding when mature as much as 9 tons of jaggery per acre, worth about Rs. 500 to Rs. 600. (Watt's *Commercial Products of India.*)

Sugar Palm of Java and Malaya; Gomuti-palm; "Kabong" of Malaya (*Arenga saccharifera*).—A very large handsome palm, with a stout trunk and very large, handsome, pinnate leaves, 25-30 ft. long, glaucous beneath, native of Malaya, where it is commonly cultivated. The sap or toddy is rich in sugar and is extracted and collected in a manner similar to that practised with the Coconut, &c.

The palm flourishes best in deep soil on sloping land, in the moist low-country and up to about 2,000 ft. It is said to be fit for tapping at the age of about 12-15 years, a single palm yielding 25 lbs. or more of jaggery a year. Practically no cultivation is required once the palms are established. Like many other palms, the stem contains a large quantity of excellent sago or starch ; hence it is sometimes known as the "Sago palm". In the Philippines a single stem, when cut down, is said to give about 200 lbs. of sago. See also *Fibres*, pages 163, 429.

Kitul Palm; Toddy Palm. (*Caryota urens*).—A very handsome palm, 50-60 ft. high, with large, spreading, bipinnate leaves, indigenous to

Ceylon, India, Malaya, etc. From the young inflorescence (spadix) is obtained, after the manner previously described, a copious flow of sweet sap (toddy), which upon boiling yields a quantity of brown sugar or jaggery. When fresh it is known as "sweet toddy," and on becoming sour as "fermented toddy," which is intoxicating. The palm is fit to tap when about 15 to 20 years old, when it commences to flower. Each spadix continues to yield for about 3 months, producing usually from about 4 to 6 quarts of toddy a day, in some cases much more. A single palm, it is estimated, is capable of giving an annual yield of about 180 gallons. The Kitul palm yields excellent sago from the stem, also a commercial bristle-fibre from the base of the leaf-stalks. See under *Fibres*, pages 164, 169, 429.

Nipa Palm ; Gin-pol, *S.* (*Nipa fruticans*). A small aquatic palm inhabiting salt-water swamps near the coast, native of Ceylon, Malaya, etc. In the Philippines and Malaya, it is commonly tapped for sugar or jaggery, and the leaves (attaps) are largely used for thatching houses, etc. See p. 175.

Sugar-or **Wine-Palm of W. Trop. Africa.** (*Raphia vinifera*). A large, very handsome palm, with long, pinnate, arching leaves, reaching a length of 25-35 ft., and producing an enormous bunch of fruit (spadix) from 10-12 ft. long. See p. 462.

Elaeis or **Oil Palm.** See page 391. The tender portion of the stem, near the top, after being bared of leaves, is commonly tapped in Africa for toddy, from which sugar or arrack may be obtained, as described on p. 361

Palmyra Palm ; Tal-gas, *S* ; Panna-maram, *T*. (*Borassus flabellifer*). An erect dioecious palm, 60-70 ft. high, with a stout, erect trunk and a crown of short, rigid, fan-shaped leaves, indigenous to the dry region of Ceylon, India, Africa, etc. It is especially suited to a rather dry climate and sandy soil, and occurs naturally over large areas in India, Burma, Malaya, and in the dry northern parts of Ceylon, taking the place of the Coconut palm, which prefers moister conditions of climate and soil. Like the latter palm, the Palmyrah supplies food and drink and serves numerous uses ; no part of it is wasted, but the fruit and leaves are the most important. The large black fruits (" nuts "), produced in a cluster at the base of the leaves, contain a refreshing sap, much relished as a cooling drink; the soft kernels of the young fruits are much used as an article of food; while the germinated nuts, with the enlarged fleshy embryo (kelengu) furnish a useful vegetable commonly sold in the bazaars.



PALMYRA PALMS AT JAFFNA.

The copious sap (*tari*) obtained from the flower spadix (p. 360) is either used for drinking as toddy (unfermented), or is boiled down, within 5 hours of collection, for making sugar or

jaggery. In India it is fermented for 4 or 5 days and distilled to produce arrack. The period of tapping for toddy extends from 5-6 months in the dry hot season, and the annual yield of the liquid per tree varies from about 50 to over 100 gallons, or from 3-5 bottles a day. The young leaf-blades are used for making mats, fans, baskets, hats, buckets, olas, etc.; while the forked butt end of the leaf-stalk "(karku)" furnishes an excellent bristle-or brush-fibre, which forms an article of export and is valued in London at 25*s*.-30*s*. per cwt. On an average, 20 stalks yield 1 lb. of cleaned fibre, and a man can beat out 7-10 lbs. of fibre per day.

In S. India and N. Ceylon, the Palmyra ranks as the most important of economic palms; the acreage under this product in Ceylon alone is estimated approximately at 40,000 acres, while that in India is considered to be more than double that area. It is propagated from seed sown *in situ* in sandy soil, or frequently from self-sown seed; no cultivation is given beyond protecting the young plants from cattle. In about 15-20 years from sowing, the palms should begin to flower, when, if the fruit is not required, they may be tapped for toddy or jaggery, which may be continued for 30-40 years or more. When grown for the fruit, it is estimated an average annual crop of about 350 nuts per tree may be obtained. The seedlings being, in many cases, allowed to grow up from self-sown seed, the palms often stand but a few feet apart. Thus the total outlay in ten years for bringing the trees into bearing is, on an average, estimated not to exceed about Rs. 15 per acre. Old palms at the age of 80 years or more yield a very hard and durable timber, used for building purposes and formerly exported. See pages 167, 169, 431, 433.

Sugar Sorghum ; Imphee. (*Sorghum saccharatum*).—A tall-growing grass, similar to Guinea-corn, sometimes cultivated for the sugar obtained from its stems, which is chiefly used in the preparation of sugar-candy. The plant, being somewhat hardier than the sugar-cane, may be profitably grown in a climate where the latter would not thrive. It has long been cultivated in India, and more recently in the Southern United States, for the production of sugar and syrup. Numerous varieties are recognised. Like the Guinea-corn, Sugar-sorghum may be grown in any ordinarily good soil, but gives the best yield on a moist sandy loam. In dry weather it is much benefited by irrigation.

Sugar substitutes.—The well known substitute "saccharine" is a coal-tar product, about 300 times sweeter than sugar. It has no food value, and is regarded by some as a deleterious drug.

Sugar Maple (*Acer saccharum*). A tree of North America, the juice of which, obtained by tapping the stem in the spring, yields as much as 2-4 lbs. of sugar per tree in a season. Beet-sugar is grown extensively in Europe.

Rice or **Paddy ;** "Goyan," *S.* "Arisi" or "Arishi," *T.*; "Dhan," *Hind.* (*Oryza sativa*. Gramineae, or Grass family).—Rice is the staple food of the native population of tropical Asia, where the plant is indigenous and has been cultivated from time immemorial. Its cultivation has in recent times been taken up in the warmer parts of South America, West Indies, Southern Europe, &c. The rice plant, known as paddy, is cultivated as an annual, growing, according to variety and soil, from 2-5 ft in height. Its grain ("Vee", *S.*) furnishes a larger proportion of the food of the human race than does any other plant of the vegetable kingdom. The area under rice cultivation in India and Burma is estimated at some 70 million acres, the total estimated output of grain from these amounting to nearly 564 million cwts.

There are numerous varieties, which come under two main types: (1) *Common, swamp* or *aquatic rice*, and (2) *Hill* or *up-land rice*. To these may be added "*Perennial rice*," not cultivated in Ceylon. The first named is the most generally grown; it requires marshy or irrigated land and a hot climate, thriving up to about 3,000 ft., in valleys. Hill rice may be grown on dry land, and thrives up to about 4,000 ft. For aquatic rice, a clayey loam overlying a porous subsoil (to facilitate the percolation of water) is considered by some to be the best, while

others advise a clayey subsoil. Manuring is beneficial, crushed bones or bone-dust, at the rate of about 150-200 lbs. per acre, being especially recommended.

In India, green-manuring by means of quick-growing annual crops is much practised, while in Ceylon leaves and twigs of various species, as *Aleurites triloba* (Rata-kekuna), *Cerbera Odollam* (Gon-kaduru), *Tithonia diversifolia* (Mexican Sunflower), and other kinds which may be convenient are spread on the surface and ploughed in (see page 25). When water cannot be turned on to the land from streams or rivers, it is raised by mechanical means, often very primitive,



TERRACED PADDY FIELDS IN CEYLON.

from wells, etc. In dry regions, immense tanks or artificial lakes are constructed as reservoirs, the over-flow from which supplies large tracts of irrigable land. In Ceylon, sloping or steep land is often rendered irrigable and suitable for rice cultivation by means of an elaborate system of terracing (see p. 31). Here, in preparing the land for sowing, water is first turned on to soften the soil, which is then either ploughed or roughly dug by mamoties or hoes, and afterwards levelled with flat boards; or it is merely puddled by trampling teams of bulls or buffaloes, and then levelled.

Before sowing, the seed, which should be at least 6 weeks old, is usually soaked for 24 hours, then heaped and covered with banana leaves or sacks and left for 5-6 days for initial germination to set in. In Ceylon, the grain is generally sown broadcast, at the rate of about 2 bushels per acre. Transplanted rice, however, yields much greater returns, and only about a quarter the amount of grain used for broadcasting is required to plant an acre; in this case the seedlings are transplanted to the fields when 8-10 inches high (or 3-4 weeks from sowing), at distances of 4-6 inches apart, allowing 2-4 plants to the hole. The chief drawback to transplanting is the increased labour it involves.

When the grain has sprouted well, the water is gradually turned on the field, and the latter is kept flooded until the flowers appear, when the supply of water is reduced. When the grain is well formed, the water is turned off so as to hasten ripening and facilitate harvesting. Harvesting takes place in 3-7 months, according to variety, from the time of sowing, the shorter the period the smaller the crop as a rule. Provided irrigation facilities are available, two crops a year may be obtained in Ceylon, viz: (1) the "Maha" crop (the principal one), usually sown in July-August and harvested in January-February; and (2) the "Yala" crop, generally sown in April-May and reaped in August-September. When the grain turns yellow, the crop is cut down with a sickle, dried in the sun, and tied in sheaves. Threshing in Eastern countries is often, if not usually, done by the trampling of bulls or buffaloes tied in teams and made to walk in a circle, the rice straw being

thrown under their feet until threshed. The grain is afterwards winnowed in the wind, then stored. Hulling is done in wooden mortars, as required for consumption. Where, however, rice is cultivated on a large scale or for export, machinery takes the place of hand labour to a large extent.

Yield.—This varies considerably according to variety and mode of cultivation. The average yield for Ceylon is probably about 25 bushels per acre, though in some districts an average crop of 50-80 bushels is obtained. The countries with the highest average yields are: Spain (101 bushels per acre), Japan (77), Egypt (73), Italy (63), British Guiana (54), Java (40), and India (30-40). One bushel of paddy weighs about 45 lbs., and when hulled gives about ½ bushel of clean rice weighing about 30 lbs. The whole production of rice in Ceylon, which is almost entirely in the hands of Ceylonese peasants, is about 5½ million bushels per annum (from an area of approximately 850,000 acres), against an import of about 10 million bushels (valued at about 60 million rupees) from India and Burma.



THRESHING RICE (PADDY) BY MEANS OF TRAMPLING BUFFALOES.

Imported rice comes under two heads, "raw" and "steamed." The former is imported chiefly from Burma, and the latter, which is steamed or par-boiled and afterwards dried in the sun or in drying factories, mostly from India. Raw or "milled" rice takes longer to cook and soon turns sour; it thus becomes unpalatable and is considered to predispose the consumer to the disease of beri-beri.

Varieties.—These are innumerable, there being about 500 reputed varieties in Ceylon alone. They are distinguished chiefly by size, form and colour of grain, height of plant, and cropping period. The last is an important character, some varieties producing a crop in 60 days, while others take 6 to 7 months. Extra early maturity, however, is at the expense of yield, so that the medium between these is usually preferred. The following are some of the principal varieties grown in Ceylon:—

Cropping Period of 6-7 months:—Ma-vi, Muttusamba, Sudu-vi, Hatali.

5-6 months:—Handeran, Honderawala, Hatiel, Sulai, Rata-vi, Puluk-samba, Madael.

4 to 5 months:—Kalu-vi, Kuru-vi, Seenadi, Galkada, Giressa, Rathkundu, Sudu-hatiel.

3 to 4 months:—Kalukanda, Kotiyaran, Kiri-kurumba, Sitharakali. Suwandel.

2½ to 3 months:—Heenati, Kalu-heenati, Sudu-heenati, Bala-vi, Hetada-wi.

Hill rice or *El-vi*, which requires no irrigation, takes 4-5½ months to harvest and yields from 25-40 bushels or more per acre, according to locality and soil.

Sago Palm; Rumbia; Sago.—The sago of commerce is obtained chiefly from the mature stems of *Metroxylon Sagu*, a palm with large pinnate leaves and a creeping or erect stem, 12 - 15 ft. high, native of Malaya, and usually occupying fresh water swamps. The palm is often cultivated, being propagated by suckers, which are generally found in various stages of development around the base of the older stems. Fertile seeds are seldom produced. The palm if left to itself will live about 15

years or more, dying down after flowering. To obtain the sago it is felled when it begins to flower, usually at about 10 years of age.



SAGO PALM, showing suckers, also creeping stem behind man.

The stem or trunk is then cut into sections 3 or 4 ft. in length, which are split lengthwise. The farinaceous matter is then extracted from the centre of these, and by a process of repeated washing in water and straining, the starchy matter is separated from the fibre, then dried and made into sago meal, which by mixing with water is made into a paste. By pressing the latter through sieves with special meshes, the granulated or "pearl" sago of commerce is obtained. England alone imports some 4,000 tons of sago annually, chiefly from Singapore and Sumatra. "Pearl sago" fetches about 24*s* to 32*s* per cwt.

Yield.—A single palm is said to yield from 120 to 200 lb. of marketable sago. In a properly managed Sago swamp, where the palms are kept at suitable distances apart and all unnecessary suckers and stems are removed, a continuous yield should be obtained without much, if any, replanting. The Sago palm was introduced at Peradeniya in 1880, and flourishes there, being grown in moist, rather deep, alluvial soil. There the trees flower freely and set fruit, but have not yet produced fertile seeds. Several varieties are recognised, these the latter are generally considered being either thorny or smooth-stemmed; to be the best and most prolific trees. §

Sago plant of Ceylon ; Madu, *S.* (*Cycas circinalis.* Cycadeae).—A palm-like plant, 8-15 ft. high or more, with very handsome, long, feathery leaves. The large farinaceous seeds are ground and made into a useful sago by the low-country peasants of Ceylon. See pages 119, 120. §.

Tapioca. (Manihot utilissima).—See page 299. Commercial "Tapioca flake" fetches at present from about 25*s*. to 30*s*. per cwt. in England.

CHAPTER XXV.

DRUGS, MEDICINAL PLANTS, MASTICATORIES & POISONS

1.—*DRUGS.*

2.—*OTHER MEDICINAL PLANTS.*

3.—*PRINCIPAL PLANTS USED IN NATIVE MEDICINE IN CEYLON.*

4.—*MASTICATORIES.*

5.—*POISONOUS PLANTS* :—

(*a*) *HISTORICAL OR ORDEAL POISONS.*

(*b*) *OTHER POISONOUS PLANTS.*

1.—DRUGS.

Tobacco ; Dhum-kola, *S* ; Poyile, *T*.—The tobacco of commerce may be said to consist of the dried and cured leaves of *Nicotiana Tabacum* and *N. rustica* (or varieties of these), both of South American origin and belonging to the Natural Order *Solanaceae*. The cultivated tobacco plant is an erect annual, growing 5-6 ft. or more in height, and bearing large, lanceolate, alternate leaves, characterized by viscous glandular hairs. The principal tobacco-growing countries are Cuba, Sumatra, South America, India, Turkey and South Africa. Tobacco-growing forms a minor industry in Ceylon, chiefly in the dry region, the produce being largely used locally for chewing with betel and for making cheroots. Nearly 4½ million pounds of tobacco leaf, valued at Rs. 965,266, were exported from Ceylon in 1923, chiefly to South India.

The best soil for Tobacco is alluvial or rich sandy loam ; clay or gravelly soil is unsuitable. A warm humid climate with a well defined dry season is best, the latter being essential for harvesting. Flat or slightly undulating land is desirable. The plant is an annual and, generally speaking, a gross feeder, requiring good cultivation and liberal manuring. Cattle manure is the best, except when special qualities, as fine wrapper, is desired.

Plants are raised from seed,* which is very small and should be sown in boxes under cover, or in well prepared and covered beds. An ounce of seed should produce more than sufficient plants for an acre. When sowing, it should be mixed with sifted ashes or fine dry earth so as to enable its being sown evenly and thinly. The seedlings are planted out when quite small, that is at 6-8 weeks from sowing, when they should be 3-4 inches high. Planting out should be done late in the afternoon, the spacing being about 3 ft × 3 ft., giving about 4,840 plants per acre; or 3 ft. × 2 ft., equalling about 7,260 plants to the acre, the closer spacing being preferred for the

*1 oz. contains about 400,000 seeds, but a considerable proportion are usually sterile.

production of fine qualities. The young plants are delicate, and should be shaded with small twigs, fern-fronds, or grass, also watered if the weather be dry, until well established, after which no shade of any kind is required. In about 6 weeks from planting, the flower buds will appear at the top of the plants; these as well as any side-buds must be nipped off, the operation being known as "suckering" or "disbudding," which has the effect of diverting the vigour of the plant into the leaves. *Moulding*, or earthing up the plants, becomes necessary when the latter are about 3 weeks old.



FIELD OF "WHITE BURLEY" TOBACCO AT JAFFNA, CEYLON.

Harvesting. About 3½-4 months from the germination of the seed the first leaves should be ready for cutting, this being indicated by their turning a yellowish green with brown spots, the edges and tips curling downwards. Cutting should not be done when rain is on the plant nor when the sun is hottest. There are two methods of harvesting: (1) The whole plant may be cut, near the ground, when the larger number of leaves are mature, the stems, with leaves attached, being left on the ground for a few hours, so that the leaves may become pliable and less liable to be torn or broken; (2) or the leaves may be cut separately as they ripen, in order of age, the two lower being removed at each round, say once in 5 or 6 days. Under good cultivation the plants should produce an average of 15 leaves each; when planted closely and under favourable conditions the average may, however, be as much as 26 or more leaves. For wrapper purposes the first 8 or 10 leaves form the best quality, the second lot middle quality, the top leaves (6 or more) being less valuable. The three grades are kept separate. For "filler" or chewing tobacco the reverse is the case, the top leaves being the more valuable. After the plants are cut down, a ratoon or "sucker" crop may be obtained, which may almost equal the first in yield.

Withering. The leaves being carried to the drying shed, they are threaded on a string fastened to a lath about 4 ft. long, each lath carrying 30-40 leaves. These are hung up in tiers in a specially constructed drying house to become partially dried. When the whole plants are cut down at once, the leaves are cut in pairs with a piece of the stem attached, and afterwards placed astride the drying lath. Drying or withering takes about 3 weeks, when the midrib becomes brown and soft.

Fermenting or *Curing*, a most important process, follows, and upon this the proper development of the narcotic principle of tobacco largely depends. The leaves are tied in small bundles of about 50, and placed in piles on a wooden floor covered with dry leaves or sacks, all the butt ends pointing outwardly and the tips toward the centre. The piles are left for about 5 or 6 days to ferment, when the temperature will have reached about 125° Fah. The pile should be turned at intervals ("breaks") of about 6 or 8 days for about 3 weeks, so as to equalize fermentation. Curing should be finished in about 22 days, but 5-6 weeks more are often allowed to complete the process of fermenting and drying.

Grading. The leaves are next sorted according to length, colour, texture, etc. Various types of leaf are recognised, each being adapted to special requirements of the trade, as for wrapper, binder, filler, chewing, etc. Different qualities are often dependent on special conditions of soil and climate, as well as on botanical variations in the plant. Wrapper-leaf, valued for cigars, rolls, etc., should be thin, silky, and almost tasteless, whilst for filler purposes a heavy succulent leaf is preferred.

Yield. 700-800 lbs. of cured leaf per acre is a fair average yield, though in some cases it may be as much as 1,200 to 1,600 lbs. In Ceylon the average yield is probably not more than 500 to 600 lbs. per acre. In India the yield is reckoned in maunds, about 1,000 leaves forming a maund (80 lbs.).

Varieties—.There are numerous varieties in cultivation, each tobacco-growing country having its own special sorts. In Ceylon, "Jaffna" and "Dumbara" are regarded as distinct types, of which there are again recognised varieties, as "Netti-dhunkola" (distinguished by marked stalkiness), grown more especially in Dumbara; and "Kondhunkola," found chiefly in the Negombo district. The Dumbara tobacco, grown on dry land, is the best type of Ceylon tobacco and is used for making cigars and for wrappers for the Jaffna tobacco. The latter is produced under irrigation, the water for which is raised by means of "well sweeps,"—see page 31. "White Burley", valued especially for making high quality cigarettes, has given good results in Ceylon, also "Mexican," a filler variety. Other well-known sorts are "Zimmer Spanish" (filler tobacco), "Virginian dark-leaf," "Sumatra," "Turkish," etc.

Buchu.—A hardy, perennial, evergreen shrub of the order *Rutaceae*, native of South Africa, where it is cultivated. The aromatic leaves yield a volatile greenish oil, used as a diuretic and for kidney trouble. The principal species thus employed are :—*Barosma serratifolia* (Kloof Buchu), *B. crenulata*, and *B. betulina* (Mountain Buchu). The last named is the most valuable. The plants appear to grow best on sandy loam.

Cassia Fistula. "Purging Cassia"; "Pudding Pipe," "Ehela," *S.* (Leguminosae).—A large tree, indigenous to the semi-dry region of Ceylon, also to India and Malaya. The long, cylindrical, black or brown pods (1½-2½ ft. long) are valued in medicine for their laxative properties, and exported from Java and the West Indies (chiefly Dominica), being sold in London at about 25s. per cwt. The bark of the tree is esteemed in native medicine in India and Ceylon. See p. 85.

Cascara Sagrada. See page 376.

Castor Oil. See page 388.

Cinchona, Peruvian or **Quinine Bark** ;—also known as Jesuits' Bark. Quinine and the alkaloids *cinchonine, cinchonidine, and quinidine* consist of the active principle of the bark of several species of *Cinchona* (*Rubiaceae*), which are small, erect trees, 25-40 feet high, all natives of the mountains of Bolivia, Peru and other parts of S. America. The valuable curative effects of quinine in malarial fevers were first made known in 1639, when a preparation of the bark cured the Countess of Cinchon, wife of the then Viceroy of Peru, of malaria, the plant being afterwards named in her honour. Cinchona was introduced at Peradeniya in 1861, but not until about 1870 were the Ceylon planters induced to take up its cultivation, the Government first establishing nurseries of Cinchona at Hakgala Gardens, and issuing plants free of charge or at a nominal price.

The area under Cinchona, however, rose rapidly from 500 acres in 1872 to 64,000 acres in 1883, the export of bark at its maximum output (1887) being nearly 16,000,000 lbs. The result was great over-production and a drop in the price of the

drug from 15*s.* to 1*s.* 3*d.** per oz.—an immense boon to the public, though a disaster to many planters. Cinchona bark has now practically disappeared from Ceylon's export list. The export of the bark in 1923 was 64,512 lbs. valued at £2,044, averaging about 9½d. per lb. In Java, now the chief producing country, the Cinchona industry is still flourishing and quinine sulphate and other forms are prepared locally. There are also small plantations in India, worked by Government for the benefit of the peasants, to whom the drug is supplied, in small packets, at cost price. The product is now being taken up by the Government in Burma.



QUININE OR CINCHONA BARK.
Cinchona succirubra.

The plant thrives best in a rich humous soil on a porous subsoil, preferring a cool mountainous climate (4,000 to 6,000 ft.), with a moderate rainfall and shelter from strong winds. *C. succirubra* is, however, an exception, and thrives best at elevations of 2,000 to 4,000 ft. Propagation is by cuttings, layering, or seed, the latter method being usually adopted. The seed is very minute, and should be sown thinly in boxes or on smooth nursery beds under cover, finely sifted soil being sprinkled over the surface before and after sowing. Watering should be done carefully through a fine rose. In about three weeks from sowing, the seedlings should be up, and when 2 inches high these should be transplanted to well-prepared nursery beds, so as to harden them, the shade being gradually reduced; when 8-9 inches high, they may be planted out in their permanent places. The proper distances for planting vary according to variety and locality. Close planting (4 ft. by 4 ft.) at first, and gradually thinning out the weaker plants until only about half the original number are left, *i.e.* with spacing of about 6 × 6 ft., is considered preferable to wider planting at the commencement. The uprooted trees afford a return, the bark being stripped from the stem and roots. Root-bark is considered the most valuable.

To obtain the bark from the standing trees, different methods are employed: (1) *lopping*, by which the branches are lopped and the bark removed from these in longitudinal strips; (2) *coppicing*, the trees being cut down to the ground when about 6 years old, and the stems barked; this induces the production of upright shoots, which in turn are cut down and barked; (3) *shaving* the stem by means of a spoke-shave, care being taken not to reach the cambium; only two sides of a tree are shaved at once; (4) *mossing*, after the bark of trees 7 or 8 years old is removed in alternate strips, each 1½ in. wide, the stem being protected by a covering of moss tied on; thus in about two years the renewed bark, which is richer in quinine than the first bark, is again ready for removal. Of these, the second method is perhaps the most favoured. The peeled bark is dried gradually in the sun, and exported in bales, the various forms being kept separate, as "root-bark," "flat-bark," "quill-bark," and "shavings." 600 lbs. of dry bark per acre a year, or 2 lbs. per tree (at 7 years old), is considered a good average yield.

Species, &c.—*Cinchona succirubra* ("Red Bark") has large, broad leaves; is hardy, easily established, suited to a wide range of climate, and semi-naturalised on some up-country estates in Ceylon; *C. officinalis* ("Crown Bark"), a slender tree, 15-20 ft. high, with narrow leaves; *C. Calisaya* ("Yellow Bark"), a valuable species, with a stout stem when full grown, not easily established; *C. Ledgeriana* ("Ledger's Bark") is rich in quinine, but the tree is comparatively small and best suited to medium elevations; it is rather delicate and requires

* Present price about 2*s.* 3*d.* per oz.

special care in the young state; largely grown on Government cinchona Plantations, Bengal. To these may be added certain superior hybrids.

Coca, or **Cocaine-plant.** (*Erythroxylon Coca*, Linaceae).—A small shrub, 6-8 ft, high, indigenous to Peru and Bolivia, being found at elevations of 4,000-5,000 ft., introduced into Ceylon in 1870. It is extensively cultivated in its native country, where the leaves are largely used as a masticatory (see below), or exported for the extraction of cocaine. The plant thrives best at elevations of 1,000-3,000 ft. in Ceylon, *where small areas have been successfully established, the dried leaves and twigs being exported. The best conditions for cultivation are similar to those suited to coffee, viz., good friable or humous soil (preferably that of virgin forest), gently sloping land, and an annual rainfall not under 70 inches. Good natural drainage is important and shade is essential until the plants are well established, but not afterwards.



COCAINE OR COCA PLANT.
Erythroxylon Coca.

The seed, which is rather difficult to germinate, must be sown fresh, preferably under cover and in baskets, the seedlings being afterwards planted out at distances of about 4 ft. by 4 ft. In South America, a method sometimes adopted in germinating the seed is to place them when fresh in a heap covered with wet sacks, thus setting up fermentation and inducing germination, being afterwards sown in the field *in situ*; in other cases they are sown at once in rows, the ground being then covered with grass-litter or leaves, and the seedlings afterwards thinned out as desired.

The first plucking of leaves may be obtained when the plants are about 2½-3 years old from seed. Several pluckings are afterwards made in the year, the mature leaves only being, as far as practicable, selected. These are best dried in the shade, as in open airy sheds, so as to retain their green colour as much as possible. Sun-dried leaves become too shrivelled and lose a large proportion of their alkaloids. The dried leaves are said to be best packed for export in zinc-lined, air-tight cases. Usually, however, the dried twigs with leaves (the bushes being clipped with shears) are made up in pressed bales, which are covered with hessian, for export. An annual return of about 1,200 to 2,000 lbs. of dried leaf per acre may be obtained.

The chief commercial use of the plant is for the extraction of cocaine from the leaves. In its native home, however, the leaves are, as already stated, very largely used as a masticatory, being chewed with a little unslaked lime; the immediate effect is said to be a "gentle excitement, with sensations of high enjoyment, lessening the desire for food, and enabling the consumer to undergo considerable fatigue." The leaves are also sometimes infused as tea, the infusion being taken as a stimulating drink. Since the restrictions on opium consumption in India, cocaine has occasionally been smuggled into that country for use as a substitute for opium. The value of the dried leaves, though largely judged by appearance, depends on the percentage of alkaloid they contain. It is estimated that 100 lbs. of dry leaf should yield about **1 lb. of alkaloid (=about 1 per cent.). The price of the dried leaf fluctuates, according to quality and demand, from about 1*s*-1*s* 6*d*.

*The cultivation of the plant has been prohibited in all British Colonies since 1914. **Valued at about 30*s*-40*s* per ounce.

per lb. in London. The export of Coca leaves from Ceylon in 1911 was 1,432 cwt., valued at £1,654. Since the prohibition of the cultivation of the plant in British colonies, the area under the product in Java has more than trebled, the chief customers being Great Britain and the United States.

Varieties.—The plant occurs under two distinct types, of which there are different forms, distinguished chiefly by the leaves, viz. (1) var. *nova-granatense* (Huanaco or Bolivian Coca), characterized by pale-green obovate leaves and a free bushy habit, producing a good quantity of leaves; (2) var. *truxillense* (Peruvian type), with narrower and darker leaves. The former type was the one chiefly grown in Ceylon, and was especially esteemed in commerce, under the name of "Ceylon-Huanaco." Var. *spruceanum*, which closely resembles var. *truxillense*, is said to be the one chiefly grown in Java. The leaves of *Erythroxylon lucidum* ("Bata-kirilla," *S.*), a large shrub of Ceylon, are used in native medicine in Ceylon. See p. 378.

Calumba or **Colombo-root.** (*Jateorhiza palmata.* Menispermaceae).—A climber with palmate leaves, producing annual herbaceous stems, native of Portuguese East Africa, being abundant in the Zambesi region. The fleshy tuberous roots, produced in clusters and yellow in section, are commonly used by the local inhabitants as a remedy for dysentery. Cut across into slices and dried, they are exported, being used in European medicine for their tonic and astringent properties.

The common name is considered to have been derived from the fact that the root was first imported into Europe through Colombo. The plant was introduced at Peradeniya about 1890, but failed to become established. Efforts made in 1805 and at other dates to introduce it into Bengal, Bombay, etc., also failed.

False-, or Ceylon Calumba-root. "Weni-wel," *S.* (*Coscinium fenestratum.* Menispermaceae).—A woody climber with smooth bark, large roundish leaves with prominent 5-7 nerves, native of Ceylon and Malacca. The wood is of bright yellow colour, and is valued as a bitter tonic by the Sinhalese; it is also used as a cure for tetanus, and a yellow dye is obtained from it. The stems, cut into transverse slices or in short lengths, are sometimes exported from Ceylon. They can be distinguished from the true article by the sections being flat on the surface (not depressed) and woody, instead of being starchy as in *Jateorhiza.*

Croton-Oil; "Purging Croton;" "Jayapala," *S.*—This powerful purgative and vesicant, commonly used in medicine, is extracted from the seed of *Croton Tiglium* (Euphorbiaceae), a small tree, considered to be a native of India and China.

The plant thrives on poor soil and begins to bear in 3 years from planting. Its cultivation was undertaken in Ceylon a few years ago, when the seeds were sold in London for 70*s*-80*s* per cwt., but a large shipment speedily reduced the price, and the cultivation soon declined. The product is, however, still cultivated here to some extent, the export of the seed in 1923 being given as 835 cwt., valued at Rs. 14,203. The principal season is Nov.-Dec. The present price of the seed in London is about 30*s*-33*s*. per cwt., varying according to quality and demand. See also page 395.

Cubebs. (*Piper Cubeba.* Piperaceae).—The cubebs of commerce, which are of importance chiefly in medicine, are the berries of a species of a pepper-vine, easily distinguished from the ordinary pepper by the stalked and rather larger berries or "corns." The plant is indigenous to Java, Sumatra, etc., and was introduced into Ceylon in 1885.



CUBEBS. *Piper Cubeba.*

It thrives under similar conditions to Pepper, requiring live or artificial sup-

ports and a certain amount of shade. The demand for cubebs is limited and supplied by Java, where the plant is cultivated. The crop thrives at Peradeniya, where the vines are grown on trees of *Erythrina indica* and bear fruit freely. Propagation is by cuttings taken from the top or fruitful shoots, the plants thus raised being more productive than those taken from near the base.



GINSENG. *Aralia quinquefolia.*

Ginseng.—The Chinese name for *Aralia* (*Panax*) *quinquefolia.* (Araliaceae).—A small herbaceous plant with palmate leaves, native of North China, cultivated as a Government monopoly in Corea, where the dried root forms one of the principal articles of export to China. The crop is grown under the protection of a light frame-work, and the roots are prepared for export by steaming for about four hours in wicker baskets placed over boiling water. Ginseng root is highly valued in China as a tonic and stimulant, and is sometimes sold at from "250 to 500 times its weight in silver."

Chinese doctors ascribe miraculous powers to it, possibly from its supposed resemblance to the human form, claiming that it wards off disease and restores exhausted animal powers, even "making old people young." The root is slightly bitter and aromatic, but is not regarded by European medical men as having any medicinal value. A form of Ginseng is furnished by a similar species found in North America which is cultivated to some extent in the United States, where the roots are sold at from 2-4 dollars per pound for exportation to China as a substitute for the Eastern product. This variety is ranked by the Chinese as 3rd or 4th quality, next to which being Japanese Ginseng, which is the least esteemed. The best quality is "Manchurian Imperial," next to it being the "Red Ginseng" of Corea. The plant thrives best in a rich, loamy, loose soil, and requires light shade as well as a moderate amount of moisture.

Ipecacuanha. (*Psychotria Ipecacuanha.* Rubiaceae. Sometimes placed under the generic names *Cephaelis* and *Uragoga*).—A small perennial plant with semi-creeping stems, 12-15 in. high, indigenous to dense humid forests of Brazil. From its annulated roots an extract is obtained which is



IPECACUANHA.
Psychotria (*Uragoga*) *Ipecacuanha.*

valued in medicine as an emetic, also as a specific (*emetine*) for dysentery and for other ailments.

The plant is of very slow growth and does not respond readily to cultivation. The best conditions for it are a moist and hot climate, permanent jungle shade, protection from strong winds, and a loose loamy or humous soil. In planting, the ground should be dug to a depth of at least 15 to 18 inches, and well broken up near the surface. Propagation is by roots, stem-cuttings, or seed. It is best to plant in raised beds, spacing being about 10 by 10 inches. The roots are ready for harvesting about 1½-2 years from planting, and the yield should be from 2-3 oz. of marketable root per plant. The roots should be carefully dug from the ground, then thoroughly washed and sun-dried. The supply of the root comes chiefly from Brazil, and is said to be frequently adulterated with other roots of similar appearance. England alone takes 60,000 lbs. a year of the root, which fluctuates in price from about 6*s* to 10*s*. per lb. The price at present is about 8*s*. per lb.

The Ipecacuanha plant, which was first introduced into Ceylon in 1866, thrives in Henaratgoda Gardens, near sea-level, under the natural shade of jungle. It is sometimes grown successfully on young rubber plantations in Malaya, where it has been estimated to give a yield of about 50 to 60 lb. of roots per acre.

Ipecacuanha, False, see page 371.

Menthol ; Peppermint, or "Peppermint Camphor." (*Mentha piperita*. Labiatae).—A dwarf, creeping herb with a strong aromatic odour. A volatile oil obtained from the plant is well-known in medicine for its antiseptic, stimulant, and carminative properties; this yields the crystalline camphor-like substance known as "menthol," commonly used for neuralgia, etc. Menthol and menthoil-oil are exported from Japan, the former being worth from 16*s*. 6*d*. to 17*s*. 6*d*. per pound, and the latter about 50*s*. per lb. The plant thrives at Hakgala Gardens, forming a dense carpet on the surface of a raised bed of rich soil.



NUX-VOMICA. *Strychnos Nux-vomica.* (1, fruit ; 2, unripe fruit in section ; 3, dried seeds.)

Nux-vomica. "Goda-kaduru," *S*; "Kanchurai," *T* ; "Kuchla" of India. (*Strychnos Nuxvomica*. Loganiaceae). A moderate-sized tree with opposite, shiny, 5- nerved leaves, indigenous to Ceylon (chiefly in forests of the dry region), India, and Burma. The flat, circular, ash-grey, poisonous seeds, produced chiefly from August to November, are collected from wild trees and exported for the purpose of extracting the alkaloid strychnine, a powerful poison, but valued in medicine as a tonic and stimulant. 1,307 cwt. of the seeds were exported from Ceylon in 1923, valued at Rs. 22,053. The price of the seed in London is about 50*s* per cwt. The globular fruit is of the size of an orange, yellow when ripe, and contains a mass of soft pulp, upon which monkeys and certain birds feed. See page 387. $

Opium.—This well-known and valuable narcotic drug is obtained from the milky juice of the unripe fruit capsules of the Opium Poppy

(*Papaver somniferum*, Papavaraceae), an annual plant, native of India and Asia Minor, where, as well as in China, it is extensively cultivated.

The drug is obtained by making slight incisions or scratches in the green, unripe fruit, from which the milky, white juice exudes; this should be done in dry weather, in the evening; by the morning the milky juice will have coagulated on the fruit, and is then collected and made into balls, which form the ordinary opium of commerce. From this, morphia, the active principle, is obtained. The yield of opium, under cultivation, averages about 20 lbs. per acre. The price of the article fluctuates considerably, as from about 12*s* to 30*s* or more per lb., according to quality, etc. The small seed is sown in drills 2 ft. apart, with 9 in. between the plants in the drills. The plants blossom in 2½-3 months from planting; the petals are removed from the flowers, and about 10 days later the fruit capsules are ready for "tapping," as above described, for the collection of opium.

There are two distinct varieties of the Opium-poppy, viz., *var. glabra*, which furnishes medicinal opium and is chiefly grown in Turkey and Asia Minor; and *var. alba*. The latter is cultivated mainly in India and China, and furnishes the opium used for eating, drinking, or smoking, whilst the former is the principal source of morphia. Considerable restrictions have in recent years been placed on the consumption of opium in Eastern countries, and only registered consumers can now be supplied with the article, except as prescribed by a medical man. A large number of consumers, however, take the drug habitually.

Sarsaparilla.—A drug used especially for rheumatism, gout, etc., obtained from the roots of various species of *Smilax* (Liliaceae), climbing plants, characterized by more or less prickly stems and large, ovate, 3-nerved, net-veined leaves, found in a wild state in the W. Indies, Cent. America, Mexico, etc. *Smilax officinale* furnishes the Jamaica Sarsaparilla, while other different species supply the Brazilian and Mexican product. The former thrives at Peradeniya, where it was introduced in 1880. Several species of *Smilax* are indigenous to the moist region of Ceylon, up to about 4,000 ft., but none of these appear to be used medicinally. Propagated by suckers or seed. See p. 130.

The collection of Sarsaparilla is effected by scraping away the earth covering the roots, which run, horizontally under the ground; when laid bare, these are cut off near the crown, a few slender roots being allowed to remain to assist the plant in carrying on the growth of the plant. The collected roots are then dried and packed in bundles for exportation. The present price of Sarasparilla in London is about 1*s* 6*d*. to 2*s*. 6*d*. per lb.

Indian Sarsaparilla; "Iramusu," *S.* (*Hemidesmus indicus*. Asclepiadeae).—A small, slender, twining plant, found wild in the moist low-country of Ceylon, also in India, &c. The roots are much used as a tonic, being included in the British and Indian official pharmacopoeias.

Senna Leaves or **Pods.**—The dried leaves or pods of certain species of Cassia are much used in medicine, being well-known for their mild laxative properties. "Tinnivelly Senna," the best known in commerce, is furnished by *Cassia angustifolia*, a small shrub, native of Arabia and East Africa largely cultivated in Sudan, parts of S. India, &c. It yields from 700 to 1,400 lb. of dried leaves per acre, according to soil, &c. "Alexandrian" or "Nubian" Senna is obtained from *Cassia obovata*, a shrubby plant of Egypt, now naturalised in Jamaica. Senna leaves fetch at present from 4*d*-6*d* per lb. in London.

Tamarind. "Siyambala," *S*; "Pullium," *T.* (*Tamarindus indica*. Leguminosae)—A large, handsome, upright tree, with fine feathery foliage, native of tropical Asia and Africa, commonly cultivated throughout the warmer parts of India, Ceylon and Malaya, both as a shade-tree and for its fruit.

The latter consists of a brownish pod, 3-4 inches long, containing a mass of sweetish acid brown pulp. This forms the "Tamarind" of commerce, which is largely

used in the preparation of cooling beverages, also in European as well as in Native medicine and for flavouring preserves, etc. The pulp is pressed and preserved in large masses, being commonly sold in the kaddies or bazaars by weight. In the northern part of Ceylon, it is made into a brine for preserving fish. The principal season for the fruit is from December-February. See pages 207, 213.

Thymol.—A valuable antiseptic crystalline substance, obtained in the process of distillation of the "Oil of Ajava," furnished by "Ajowan seeds." The latter are produced by *Carum copticum*, a small Umbelliferous plant, cultivated throughout India, but more especially in Bengal, generally as a cold-weather crop. Thymol is used in the treatment of hookworm disease and in anti-typhoid vaccine. Ajowan or "Ajwan" seeds fetch about 50*s*. per cwt., and thymol is quoted at about 20*s*. per lb. The plant is not grown in Ceylon, and efforts made to establish it here as well as in the West Indies have not been a success. The "seeds" (fruits) are commonly used in India for flavouring as well as for medicinal purposes, being esteemed as a cure for indigestion.



TAMARIND. *Tamarindus indica.*

(2)—OTHER MEDICINAL PLANTS.

Angostura Bitters. (*Galipea officinalis*. Rutaceae). A Brazilian tree, 15-20 ft. high, the bark of which yields the well-known aromatic bitter tonic of this name. Formerly supposed to be produced by *Cusparia*. The bark is said to be sometimes used in place of Cinchona bark.

Asafoetida. (*Ferula Assafoetida*. Umbelliferae). A gum-resin with an offensive odour is obtained from the root, and commonly used in medicine as a tonic; also employed in Persia, etc., for flavouring food.

Canella Bark; "White," "Wild," or "Jamaica" Cinnamon. (*Canella alba*. Canellaceae.) Bark imported into Europe to some extent for medicinal purposes, being prepared in long quills like cinnamon. See p. 330.

Cascara-sagrada. (*Rhamnus purshiana* and *R. californica*. Rhamnaceae). North American shrubs; an extract from bark forms a well known aperient. New bark is worth at present in London about 100*s*. per cwt., and old bark about 125*s*.

Cassia beariana. (Caesalpineae). Small tree of Central Africa, where the roots are used by the natives as a cure for black-water fever.

Cascarilla Bark. *Croton Cascarilla* and *C. Eleutaria*. Euphorbiaceae). Shrubs or small trees of the Bahamas. The aromatic bark is a well-known bitter tonic, without astringency. See p. 398.

Ficus doliana and **F. laurifolia.** (Urticaceae). Extract from bark used in Brazil, Venezuela, etc., for hookworm (anchylostomiasis).

Henbane. (*Hyoscyamus niger*. Solanaceae). Native of Europe, N. W. India, N. Africa, etc. Annual or biennial, 2-3 ft., very narcotic and poisonous. Leaves and green tops yield *hyoscyamin*, used as a sedative drug and, externally, for ulcers, sores, etc. Indian Henbane (*H. muticus*), a Himalayan species, is used in India as an intoxicant.

Ipecacuanha, False. (*Asclepias curassavica*). An erect, perennial, herbaceous shrub. Root emetic and cathartic, used in W. Indies for piles and gonorrhoea. (See p. 108). The roots of *Ionidium Ipecacuanha* (Violaceae), known in Brazil as "White Ipecacuanha," are also used as a substitute for ipecacuanha, while those of *Tylophora asthmatica* have similar properties.

Jaborandi. (*Pilocarpus Jaborandi* and *P. pinnatifolius*. Rutaceae). Shrubs with pinnate leaves, natives of Brazil. The dried leaves yield the alkaloid *pilocarpine*, used in opthalmic surgery, etc., also in medicine to increase perspiration and salivation.

Jalap. (*Ipomoea Purga*. Convolvulaceae). Mexico. Climbing shrub; tuberous roots yield the powerful purgative known by this name.

Jalap, False; "Turbith." (*Ipomoea Turpethum*). See page 379.

Koso. (*Brayera sp.* Rosaceae). A shrub, the dried flowers of which are used in Abyssinia, E. Africa, &c., as a purgative and for expelling tapeworm.

Macassar Kernels. (*Brucea sumatrana*. Simarubaceae). Kaputu-gedi, *S.* Slender shrub of Assam, Malaya, etc., 4-5 ft. high. Whole plant bitter. Seeds known as "Macassar Kernels," much used in Java as a cure for dysentery. Naturalised in Ceylon.

Musenna- or **Bisenna-bark.** (*Albizzia anthelmintica*. Leguminosae). Small tree. Bark commonly used in Arabia, etc., as a vermifuge.

Strophanthine; "Kombe." *Strophanthus hispidus*. Apocynaceae). Climber of Central Africa. Extract from seed used for cardiac affections.

Wormseed. (*Chenopodium ambrosioides,=C. anthelminticum*. Chenopodiaceae). Annual herb. Oil obtained from seed used in hookworm (anchylostomiasis) treatment. See pages 308, 398.

(3).—PRINCIPAL PLANTS USED IN NATIVE MEDICINE IN CEYLON.

Abrus precatorius. Olindawel, *S*; Indian-liquorice. (*Leguminosae*). Juice of green leaves taken for " purifying the blood "; root taken for sore throat and rheumatism. See page 383.

Abutilon asiaticum. Anoda, *S*. (*Malvaceae*). Root a tonic, also used for piles.

Acalypha indica. Kuppameniya, *S*. (*Euphorbiaceae*). Vermifugal and carminative, also applied to sores.

Achyranthes aspera. Karal-sebo, *S*. (*Amarantaceae*). Juice of leaves taken for dysentery.

Acorus Calamus. Sweet Flag; Wada-kaha, *S*; "Jeringu" of Malaya. (*Aroideae*). Aromatic rootstock used in bowel complaints; an oil is obtained from leaves. Naturalised in the low-country. See p. 480.

Adhatoda Vasica. Wanepala, *S*; Pavettai or Adatodai, *T*. (*Acanthaceae*). Whole plant used in treatment of excessive phlegm; also in menorrhagia.

Aegle Marmelos. Bael-fruit; Beli, *S*. (*Rutaceae*). See *Fruits*, page 251. The ripe fruit is a well-known specific for diarrhoea or dysentery, acting as a tonic to the bowels; taken also for piles. The unripe fruit, boiled, freed from fibre and sweetened, is considered to be more effective, though not so palatable.

Aerva lanata. Pol-kudupala, *S*. (*Amarantaceae*). Valued for coughs; also as a vermifuge for children.

Ageratum conyzoides. Pum-pillu, *T*; Hulan-tala, *S*. (*Compositae*). Leaves commonly used for cuts or sores.

Aloe vera, var. littoralis. Kattalai, *T*. (*Liliaceae*). Fresh juice of leaves cathartic and cooling; used in fever, spleen and liver troubles, also in eye diseases.

Alternanthera triandra. Mukunuwenna, *S*. (*Amarantaceae*). A local application for giddiness.

Areca Catechu. Puwak, *S*. (*Palmae*). The nut is scraped and applied externally to ulcers; strengthens the gums, as in betel-chewing; also given for worms in animals. See page 380.

Asparagus falcatus. Hathawariya, *S*. (*Liliaceae*). Tuberous roots commonly used in cooling medicines, also for venereal diseases, etc.

Azadirachta indica. Margosa; Kohomba, *S*. (*Meliaceae*) Leaves and fruit vermifugal; fruit purgative; oil (from seed) taken for rheumatism. See p. 394.

Brassica juncea. Aba, *S*; Mustard. (*Cruciferae*). Seeds pungent, used as poultice in gout and inflammation; leaves promote appetite. See page 395.

Caesalpinia Bonduc. Kumburu-wel, *S*. (*Leguminosae*). Tender leaves applied for toothache; also given for worms in children.

Calophyllum Inophyllum. Domba or Domba-tel, *S*. (*Guttiferae*). Oil from fruit kernels used for ulcers and hoof disease of cattle; root and bark for rheumatic pains. See page 395.

Calotropis gigantea. Wara, *S*. (*Asclepiadeae*). Green leaves applied to dispel swellings. Root a tonic. Milk (latex) from stems used for leprosy.

Canscora decussata. (*Gentianaceae*.), Herb with yellow flowers, found in wet places up-country; valued as a tonic.

Cardiospermum Halicacabum. Penela-wel, *S*; Muda-cottam, *T*. (*Sapindaceae*). Roots and leaves aperient; also used as hair-wash.

Cassia auriculata. Rana-wara, *S*; Matara Tea. (*Leguminosae*). Bark and root astringent, used as an alterative; dried leaves used as tea. See pp. 109, 443.

C.—Fistula. Ehela, *S*; Pudding-pipe. Fruit purgative; bark astringent, used with other medicines for rheumatism. See pages 85, 369.

Celastrus paniculatus. Duhudu, *S*. (*Celastraceae*). Bark considered to "strengthen the brain and purify the blood"; oil from seeds used to cure sores.

Centranthera procumbens. Dutu-satutu, *S*. (*Scrophulariaceae*). Small plant, used in fevers and externally for sore eyes. Roots bright orange-yellow.

Cissampelos Pareira. Diyamitta, *S*. (*Menispermaceae*). Roots used in fever and diarrhoea.

Cocos nucifera. Coconut; Pol, *S*; (*Palmae*). Oil applied to head for cooling. Pulp of young fruit given in sun-stroke; root strengthens the gums. See p. 389.

Coleus aromaticus. Kappra-walliya, *S*. (*Labiatae*). Decoction of leaves given for asthma, chronic coughs, etc.

Coscinium fenestratum, see *Calumba Root*, p. 372.

Crataeva Roxburghii. Lunu-warana, *S*. (*Capparideae*). Leaves used for gouty swellings; bark sharpens the appetite.

Curcuma domestica (=C. longa). Kaha, *S*; Turmeric. (*Scitamineae*). Root used in skin diseases, also for sore eyes. See p. 342.

Cyperus rotundus. Kalanduru, *S*. (*Cyperaceae*). Decoction of tubers given in fever, diarrhoea, dyspepsia and stomach complaints. See *Weeds*.

Daemia extensa. Meda-hangu, *S*; Veliparatti, *T*. (*Asclepiadeae*). Emetic; given as an expectorant in bronchitis.

Datura fastuosa. Attana, *S*. (*Solanaceae*). Roots used in bites from mad dogs; supposed to cure insanity; whole plant dried and smoked as tobacco for asthma. See page 385.

Eclipta alba. Kikirindi, *S*. (*Compositae*). Used to purify the blood.

Embelia Ribes. Wal-embilla, *S*. (*Myrsineae*). Bark and leaves acid and astringent, taken for boils and skin diseases.

Emilia sonchifolia. Kadupara, *S*. (*Compositae*). Used for cuts and wounds.

Erythroxylon lucidum. Bata-kirilla, *S*. (*Linaceae*). Leaves chewed to expel worms, also to appease hunger. See page 372.

Euphorbia hirta. (=E. pilulifera). Dada-kiriya, Bu-dadakiriya, or Kiri-tala, *S*; Palavi, *T*. (*Euphorbiaceae*). A small, annual, semi-creeping weed, common in cultivated ground, especially in dry sandy soil. Whole plant considered medicinal. Sometimes enquired about for export.

Evolvulus alsinoides. Visnukranti, *S*. and *T*. (*Convolvulaceae*). Whole plant a bitter tonic and febrifuge.

Feronia elephantum. Diwul, *S*; "Wood-apple." Green fruit checks diarrhoea; ripe fruit taken for kidney and throat affections. See pp. 251, 262, 511.

Ficus religiosa. Bo-gaha, *S*. (*Urticaceae*). Juice of bark used as a mouth-wash for tooth-ache and for strengthening the gums.

Garcinia Cambogia. Goraka, *S*. (*Guttiferae*). Bark, leaves and fruit used as laxative: also for cuts and wounds. See page 263.

Gynandropsis pentaphylla. Wèla, *S*. Reputed cure for cobra-bite. See p. 312.

Gynura pseudo-china. Ala-beth, Chena-ala, Mul-beth, *S*. (*Compositae*). Tuberous roots used as a cooling medicine, also for leprosy.

Hemidesmus indicus. Iramusu, *S*; Indian Sarsaparilla. (*Asclepiadeae*). Roots purify the blood. See p. 375.

Herpestis Monnieria. Lunuvila, *S.* (*Scrophulariaceae*). Whole plant used as a mild purgative for children ; also as fomentation for erysipelas and elephantiasis.

Hibiscus micranthus. Perumaddi, *T.* (*Malvaceae*). A valuable febrifuge. (Trimen).

Hydrocotyle asiatica. Heen-gotukola; and *H. javanica*, Maha-gotukola (*Umbelliferae*). Leaves taken as tonic and blood-purifier ; also for indigestion, nervousness, and dysentery. Small herbs, in moist places ; the former up to 7,000 ft.

Hygrophila spinosa. Katu-ikiri, *S.* (*Acanthaceae*). Whole plant used in diabetes treatment.

Ipomoea (Operculina) Turpethum. " Turbith" or "Turpeth "; "False Jalap"; Trasta-walu, *S.* (*Convolvulaceae*). Twining creeper with 3-or 4-winged stems ; the tuberous roots are used as a purgative and considered a good substitute for Jalap. Cultivated in peasants' gardens. "Doubtfully wild ".—Trimen.

Ixora coccinea. Ratmal or Ratambala, *S.* (*Rubiaceae*). Flowers and bark used for blood-shot eyes ; leaves for sores, ulcers, etc.

Justicia Betonica. Sudhu-puruk, *S.* (*Acanthaceae*). Leaves used as a poultice for boils.

Kaempferia Galanga. Hinguru-piyali, *S.* (*Scitamineae*). Aromatic and stimulant, like ginger ; much used in decoctions.

Lasia spinosa. Kohila, *S.* (*Aroideae*). A common remedy for piles

Limonia alata. Tumpat-kurundu, *S.* (*Rutaceae*). Leaves and bark used in fomentations for rheumatic pains.

Mimusops Elengi. Muna-mal, *S* ; Mukalai, *T.* (*Sapotaceae*). Large tree. Bark bitter and tonic, used in distillation of arrack, also for snake-bite.

Modecca palmata. Hondala, *S.* (*Passifloraceae*). Juice of the leaves and roots used externally for skin diseases. See page 386.

Moringa pterygosperma. Horse-radish Tree ; Murunga, *S.* (*Moringeae*). Bark, leaves and root acrid and pungent, taken to promote digestion ; used externally as a rubefacient. See page 305.

Mucuna pruriens. Achariya-pala, *S.* Climber. Seed believed to absorb the poison from a scorpion wound.

Munronia pumila. Bin-kohomba, *S.* (*Meliaceae*). Whole plant very bitter and tonic ; a good substitute for the tonic " Chiretta."

Musa sapientum. Plantain or Banana. (*Scitamineae*). Juice from leaves taken as antidote for snake-poison. See p. 244.

Nelumbium speciosum. Nelun, *S* ; Tamarai, *T.* (*Nymphaeaceae*). Stamens used for bleeding piles and in parturition. See pp. 174, 312, 466, 515.

Ocimum sanctum. Maduru-tala, *S.* (*Labiatae*). Fragrant and aromatic herb, used in decoctions for cough and catarrh, sometimes chewed as a substitute for betel.

Operculina, see Ipomoea Turpethum.

Oroxylum indicum. Totila, *S.* (*Bignoniaceae*). Tree. Bark a bitter tonic.

Oxystelma esculentum. Kulappalai, *T.* (*Asclepiadeae*). Twiner ; used as a cure for hydrophobia.

Phyllanthus Emblica. Nelli, *S.* (*Euphorbiaceae*). Fruits a cooling laxative, taken for dyspepsia. See page 268.

Piper Betle. Betel-leaf ; Bulat-wel, *S.* (*Piperaceae*). See page 381.

P.—longum. Tippili, *S.* Creeper ; roots and dried flower-spikes used in coughs, dyspepsia, etc.

Plectranthus zeylanicus. Iri-veriya, *S.* (*Labiatae*). Whole plant aromatic, carminative, etc.

Pongamia glabra. Magul-karanda, *S.* (*Leguminosae*). Large tree. Juice of roots used for sores ; also for cleaning the teeth and strengthening the gums.

Punica granatum. Pomegranate ; Delun, *S.* (*Lythraceae*). Fruit astringent, taken for diarrhoea and other ailments. See page 269.

Randia dumetorum. Kukuruman, *S.* (*Rubiaceae*). Root decoction taken for diarrhoea and biliousness.

Ricinus communis. Castor Oil ; Tel-endaru, *S.* See page 388.

Saccharum officinarum. Sugar-cane. (*Gramineae*). Juice commonly used in decoctions. See page 359.

Salacia reticulata. Himbutuwel, *S.* (*Celastraceae*). Decoction of roots given in diabetes.

Sesamum indicum. Ella, *T* ; Tel-tala or Wal-tala, *S.* (*Pedaliaceae*). Oil used for cooling the body. Seeds, pounded with jaggery, taken to purify the blood.

Solanum indicum. Tibbatu, *S.* (*Solanaceae*). Root much used for bronchitis, asthma, etc. Fruit sometimes eaten as a vegetable.

S.—xanthocarpum. Ela-batu, *S.* Used for catarrhal fever, asthma, etc.

Spilanthes Acmella. Akmella, *S.* (*Compositae*). Leaves and flowers used for toothache and sore throat; also given to women at child-birth.

Strychnos Nux-vomica. Nux-vomica; Goda-kadaru, *S.* (*Loganiaceae*). Bark and seeds a powerful tonic; seeds very poisonous. See page 374.

S.—potatorum. Clearing Seeds; Ingini, *S.* Seeds not poisonous; rubbed on inside of vessels, they are said have the effect of clearing muddy water.

Tamarindus indica. Tamarind; Siyambala, *S.* (*Leguminosae*). Tender leaves used as poultices for boils, also as fomentations; seeds used for diarrhoea. See p. 375, &c.

Tephrosia purpurea. Pila, *S*; Kavilai, *T.* (*Leguminosae*). Common village medicine for children. See page 26.

T.—spinosa. Mukavaliver, *T.* Popular bazaar drug.

Terminalia Chebula. Chebulic-myrobalans; Aralu, *S*; Kadukkay, *T.* (*Combretaceae*). Bark and nut valued in treatment for fever, asthma, chronic diarrhoea, skin-diseases, etc. See page 444.

T.—belerica. Bulu, *S*; Beleric-myrobalans. Nuts very astringent; used in eye diseases, etc. See page 444.

T.—glabra. Kumbuk, *S*; Marutu, *T.* Very large tree. Bark astringent, rich in lime, commonly burnt for the latter for use in betel-chewing.

Tinosperma cordifolia. Rasa-kinda, *S.* (*Menispermaceae*). Stems used in fever, skin diseases, jaundice, and syphilis.

Trichadenia zeylanica. Tolol, or Titta-totol, *S.* (*Bixaceae*). Oil from seed used in skin diseases and for burning.

Trichosanthes cucumerina. Dummella, *S.* (*Cucurbitaceae*). Root decoction taken to expel worms; leaves and stems used in decoction for bilious disorders, cutaneous diseases, and as an emmenagogue.

Tylophora asthmatica. Bin-nuga, *S.* (*Asclepiadeae*). Roots possess similar properties to those of ipecacuanha.

Vernonia anthelmintica. Sanni-nayan, *S.* (*Compositae*). Used for fever convulsions.

V.—cinera. Monara-kudumbia, *S.* Used for wounds and sores; taken internally to promote perspiration.

Vitex Negundo. Nika, *S.* (*Verbenaceae*). Leaves, bark and roots used for toothache, rheumatism, eye disease, and as a tonic; also carminative and vermifuge.

Withania somnifera. Amukkara, *S.* (*Solanaceae*). Used for cough and asthma.

Zinziber officinale. Ginger; Inguru, *S.* (*Scitamineae*). A well-known stimulant and aromatic; taken for indigestion, fever, etc. See page 337.

(4).—MASTICATORIES.

Areca-nut or **Betel-nut;** Puwak, *S*; Pak-ku, *T*; "Pan" of India. (*Areca Catechu.* Palmae). A tall, slender, erect palm, 30-40 (sometimes up to 50) feet high, with a straight stem, native of Malaya, extensively cultivated in Ceylon and elsewhere throughout tropical Asia for its "nuts" (seeds), which in the husk are each about the size of a hen's egg, and usually yellow or orange-yellow when ripe. The brown, conical "nut" is commonly used throughout the Eastern tropic as a masticatory. In preparing the latter, a few thin slices of the nut are taken, to which is added a dash of lime-paste, a small portion of tobacco leaf, and a few cardamoms or other spice; these are wrapped up in a leaf of the Betel vine (see *Betel-leaf*) to form a pellet for chewing. The nut, ground into powder, is commonly used as a vermifuge for dogs and other animals; also used in the preparation of dentifrices. In addition to local consumption, about 6,000 to 7,000 tons of arecanuts are exported annually from Ceylon, chiefly to India. The usual price is about Rs. 40 to Rs. 45 per cwt.



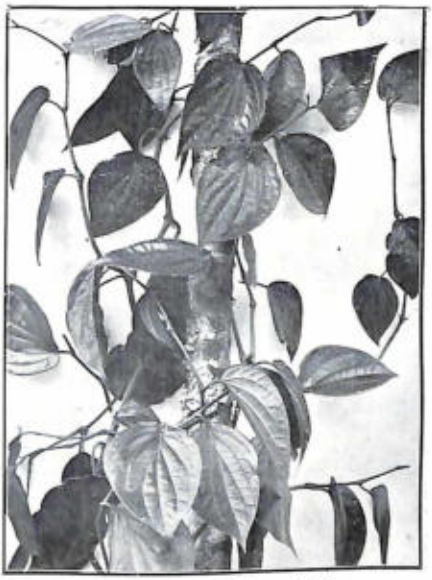
ARECA-NUT. *Areca Catechu.*

into thin slices, are known as "Kali" and, being more astringent than the ripe nut, are sometimes preferred for chewing; these are used in medicine.

Betel-leaf ; "Bulath-vel," *S*; "Veth-thilé," *T* ; "Pan," *Hind.* (*Piper Betle.* Piperaceae).—A perennial, evergreen climber or creeper, with large heart-shaped leaves, indigenous to Ceylon, India,and Malaya, cultivated throughout tropical Asia for the sake of the leaves. The latter are universally used in the Eastern Tropics for chewing in a green state, forming the masticatory commonly known as "betel" ("bulath," *S.*), the other ingredients being lime, arecanut, &c. (See *Arecanut,* opposite). The leaves have a sharp pungent taste and sustaining properties.

The habit of betel-chewing is considered advantageous to a people whose ordinary food includes but little or no flesh, providing the antacid, tonic, and carmi-

In Ceylon, the Arecanut palm thrives in the moist low-country, up to about 3,000 ft. in moist valleys. It requires little or no cultivation when once established, seedlings being planted closely or allowed to grow up spontaneously, like the Palmyra, generally mixed with other trees or crops. The palm requires but little space, and an acre may contain as many as 5,000 trees or more, *i.e.* planted 5 × 5 ft. It takes 6-7 years to come into bearing, and at maturity an average annual yield of about 200 to 250 "nuts" per palm,or about 4 bunches, may be obtained. Trees in bearing should be worth an average of about 50 cts. each a year, according to crop, locality, etc. The trees continue productive for 20-30 years, and may live for several years afterwards. The area under Arecanuts in Ceylon is estimated to be equivalent to about 70,000 acres, practically all owned by peasants. The palm may be seen in almost every native garden, and is often planted closely in boundaries, for which purpose it is well adapted. Among varieties "Hamban-puwak," with a longish ovoid nut, and "Rata-" or "Batavia-puwak," with a large roundish nut, are well known. "Karunka" is the dried, ripe, husked nut, about 10,000 to 12,000 of which go to a cwt. Tender unripe nuts, cut



BETEL VINE. *Piper Betle.*

native which they require.* The plants require a rich, humous, moist soil and a partially shaded situation. They are readily propagated by cuttings, which may be planted against poles, trellises, or tree-trunks for supports, and are generally grown in enclosed "gardens" or squares, which are strictly guarded. In Bengal and Northern India, the plant is cultivated in low sheds or "betel houses."

Varieties.—In addition to the ordinary type, the following varieties are known in Ceylon: "Rata Bulath-vel" or "Siribo Bulath;" "Naga walli-bulath" (with variegated leaves); "Getatodu-bulath;" "Mala-bulath;" "Gal-bulath;" "Gas-bulath;" and "Dalu-kotu-bulath."

Kola-nut; Bissy- or Gooroo-nuts. (*Cola acuminata*. Sterculiaceae). A tree of W. Trop. Africa, about 40 ft. high, with large ovate-acuminate, leathery leaves, introduced and sometimes cultivated as a minor crop in the West Indies, Ceylon, Malaya and other tropical countries. It bears stout, warty, green pods, 4-6 inches long, containing from 4-5 or more large pink or purplish (sometimes white) seeds, which become dark-brown on drying. The "nuts" (seeds) have stimulating and sustaining properties, due to the presence of the alkaloids, caffeine and theobromine, and are a popular and universal masticatory throughout Central and Northern Africa. They are imported to some extent into Europe and other countries, and used in various preparations, as kola-wine, kola-chocolate, &c., also in medicine, but the demand is at present limited. The Kola-nut ranks next in importance to the Oil-palm (*Elaeis*) in W. Trop. Africa, the export of the nuts from the Gold Coast to adjoining territories being over 16 million pounds a year.



KOLA-NUT. *Cola acuminata*. 1, flowers; 2, unripe pods; 3, ripe fruit showing nuts (seeds).

Several species or varieties of *Cola* are recognised, and there seems some doubt as to whether the true Kola-nut is furnished by *C.—acuminata*, †*C.—nitida*, or *C.—vera*. Most authorities, however, accept the first named species, of which the others may be only forms, as the source of the commercial article. Some trees produce a few or all white seeds, which are the most highly valued for chewing and command the highest price locally. Where both white and red "nuts" are produced on the same tree, the proportion of the former is said to increase as the tree gets older. Trees raised from white nuts only do not always come true. Thus a plot of 68 trees raised from white "nuts" at Aburi gave 15,339 *white* and 3,189 *red* nuts, *i.e.* 82.8 per cent. white; nine trees gave *white* nuts exclusively, *i.e.*, about 13 per cent. pure. Normally the seed consists of 2 stout cotyledons, which separate on drying, forming the so-called "nuts". In some cases each cotyledon is divided, forming "quarter nuts," which fetch a lower price than "halves," and are said to contain a smaller proportion of caffeine. The cotyledons of *C. Ballayi* are said to be each divided into 6 parts.

* Sir Emerson Tennent.

† Mathieus, in *Gardens' Bulletin*, Straits Settlements, Nov. 1918; Rutter, at Tropical Congress, Agricultural Hall, London, 1921; and Administration Report, Director of Agriculture, Gold Coast, 1920.

The Kola tree is propagated from seed, which must be sown perfectly fresh; it begins to bear when 5-6 years old, and should be in full bearing when 12 years old, producing, in Ceylon, two main crops a year, usually June-July and December-January. The yield is very variable, 400 to 500 pods per mature tree being considered a good average, this being equivalent to about 40-50 lbs. dried nuts. Cultivation is simple; only light shade, if any, is required after the trees are 3 years old. Planting distances may be about 25 feet each way. The tree has become more or less naturalised in some of the West Indian Islands. It was introduced into Ceylon in 1879, and may be seen in small patches on estates in the Matale District and elsewhere in the moist low-country.

In the Gold Coast, practically the whole trade consists in supplying fresh "nuts" to adjoining states, the prices on the spot ranging from 6*d.* to 1*s.* per 100 for full-sized "nuts", according to locality. The "nuts" are prepared for export by merely drying in the sun or in a drying shed, being then put into strong bags. In 1890, kola-nuts were worth 2*s.* 9*d.* per lb. in London; before the war, the price ruled at about 2*d.* to 4*d.* per lb., and advanced to about 1*s.* during the war. At the present time they fetch about 4*d.* per lb. in London. The export of kola-nuts from Ceylon in 1922 was 68 cwt., valued at about £86.

Other Masticatories.—Among the best known of these are *Coca* (see p. 371) and *Cutch* (see pages 437, 442).

(5).—POISONOUS PLANTS.

Certain families of plants are generally characterized by distinct poisonous characters, while others, as the *Cruciferae* (to which belong the Cabbage, Cauliflower, etc.) are remarkably free from any poisonous traces. To the former belong the orders *Aroideae, Euphorbiaceae, Apocynaceae, Asclepiadeae, Urticaceae, Solanaceae, Umbelliferae, Loganiaceae* and others. Some of these, however, as *Solanaceae* and *Umbelliferae*, also furnish wholesome food products. Any plant which possesses a milky juice should be treated with caution until more is known about it. Poisonous plants differ in degree of harmfulness, and the poisonous properties are sometimes affected by conditions of soil and climate, and even by cultivation. They may also vary according to season. Certain parts of a plant may be highly poisonous, while others are innocuous, *e.g.* Nux-vomica, Opium-poppy, &c. The poisonous properties may consist in stinging hairs, *i.e.*, hollow siliceous hairs filled with formic or other acid, as *Laportea*; small sacks containing minute spicules of calcium oxalate, *e.g.* many *Aroideae*; a heavy acrid oil in leaves, bark, etc., as *Semecarpus* and other *Anacardiaceae*; or alkaloids contained in the seed, as Nux-vomica, or in the cell sap, *e.g.*, Upas-tree and species of Strychnos, as used in making arrow- or dart-poison.

Ordeal Poisons. In former times, and even till this day in certain uncivilised countries, persons suspected of witchcraft or crime were made to swallow portions of certain poisonous plants, or confess the alleged offence; if the persons died from the effects, they were considered to be guilty, while if they vomited the poison they were held to be innocent. The following are well-known ordeal and other poisons.

HISTORICAL, ORDEAL, AND ARROW POISONS.

Abrus precatorius. "Olinda-wel;" "Indian liquorice." (*Leguminosae*)—A slender, perennial climber, the bright red and black seeds of which furnish an acrid poison, and are often used criminally in India for killing cattle. The seeds are powdered and formed into a paste, with which the darts or arrows are dressed. An arrow-wound is thus generally fatal within 24 hours. The poisonous property is believed to be in the red covering of the seed. Boiling renders the seed harmless. Roots and leaves much used in native medicine. See pages 377, 460.

Acokanthera spectabilis. (*Apocynaceae*). African arrow-poison. A large shrub of tropical Africa, with white, scented flowers. The milky juice obtained from the roots and wood are used by natives in West Tropical Africa for poisoning their arrows.

Antiaris toxicaria. Upas Tree; Riti, *S.* (*Urticaceae*). The celebrated ordeal-poison tree of Java, at one time supposed to give off poisonous fumes fatal to animal life. The sap of the bark contains a virulent poison, known as "ipoh," which is effectively used for poisoning darts or arrows.

Cerbera Tanghin (*Apocynaceae*). "Tanghin Poison." A small tree with a milky juice, whose fruits are the famous ordeal poison of Madagascar. S

Curare. A famous poison obtained in South America from several species of *Strychnos* (Loganiaceae). It was formerly used as a remedy for hydrophobia and tetanus, and by the natives as arrow poison. See under *Strychnos*.

Dioscorea doemona. (*Dioscoraceae*). A climber belonging to the yam family. The juice of the tuber, obtained by boiling, is said to be used with that of the Upas-tree (*Antiaris*) in Java for making arrow-poison.

Erythrophleum guineense. "Sassy Bark." (*Leguminosae*). A well-known poisonous tree of Sierra Leone; introduced at Peradeniya in 1888. The very poisonous bark was formerly used in ordeal trials in West Trop. Africa.

Excaecaria Agallocha. Agallocha; Blinding-tree; Tala-kiriya, *S.* (*Euphorbiaceae*). A small tree with milky acrid juice, which blisters the skin. The tree is held in fear by the natives of Fiji, where the juice is used as a cure for leprosy. Common on the coast of Ceylon and other Eastern tropical countries.

Hippomane Mancinella. Manchineal Tree. (*Euphorbiaceae*). A well-known poisonous swamp tree, common near the coast in tropical S. America and some W. Indian islands. The acrid, milky juice is poisonous, and has earned for the tree a reputation almost as notorious as that of the Upas-tree of Java, it being considered that "even grass will not live under it."

Physostigma venenosum. Calabar Bean. (*Leguminosae*). A large twining climber, whose large, ovoid, dark-brown seeds are the famous ordeal-beans of Old Calabar. The tree is now comparatively rare, its destruction having been ordered by Government.

Strophanthus hispidus and other species. Ripe seeds contain an active poison (strophanthine), long used for poisoning arrows in Trop. Africa.

Strychnos. The poisonous seeds of various species are used in Africa for making ordeal decoctions, also in Malaya for arrow poisons. The root-bark of *S. Tieute* of Java yields a virulent poison called "tjettik" or "upas-radja". *S. Nux-vomica* yields the powerful poison strychnine, and *S. toxifera* and others the famous "curare" or "wourali" poison of S. America, obtained from the bark by maceration in water. See *Curare*, page 383.

Tabernaemontana malaccensis. "Prachek." (*Apocynaceae*). A shrub with white flowers and orange-red fruits. The milky juice is used in the preparation of arrow-poison in Malaya.

OTHER POISONOUS PLANTS.

Acokanthera spectabilis. Arrow-poison. (*Apocynaceae*). A large shrub. Root and wood used by natives in Africa for poisoning arrows. See p. 383.

Alyxia zeylanica. "Wal-kaduru" or "Wasa-kaduru," *S.* (*Apocynaceae*). A shrub found in semi-dry regions of Ceylon; the milky juice is poisonous.

Cannabis sativa. Hemp; Ganja; Kansa; Bhang. (*Urticaceae*). An annual, usually 4-5 ft. high (sometimes 6-8 ft.), native of Cent. Asia, largely cultivated in some countries for fibre; also in parts of India, etc., for the oil-seed and well-known drug. The latter, which exudes from the plant in the form of a resin, is a powerful narcotic, but in small doses may be used as a stimulant. It occurs in 3 forms,—"ganja" (flowering tops with resin), "charas" (resin only), and "bhang" (mature leaves with their resin). All parts are used as a narcotic, often smoked with tobacco, and an intoxicating liquor ("hashish") is also prepared from the plant. The effect of the drug is most injurious to the system, producing delirium and catalepsy, and its sale and consumption is as far as possible stringently prohibited, as is



GANJA OR BHANG. *Cannabis sativa.*

also the cultivation of the plant in the Colonies. It is cultivated in parts of India under licence. See *Fibres*, page 421.

Cerbera Odollam. "Gon-kaduru," *S.* (*Apocynaceae*).—A small tree with acrid, milky juice and white, scented flowers; common in low-country of Ceylon, chiefly near the sea. The seeds are an irritant poison.

Datura fastuosa. Thorn-apple; "Attana," *S.* (*Solanaceae*). Small shrub, with large leaves and white or purple, trumpet-shaped flowers; fruit round, covered with numerous prickles; very poisonous. See page 378.

Datura suaveolens. Trumpet-flower; "Rata-attana," *S.* (*Solanaceae*).—A shrub with large, white or purple flowers, native of Mexico. The round, green, prickly fruits are a well-known poison.

Derris elliptica. "Tuba" of Malaya (*Leguminosae*). Large climber of India and Malaya. Bark and flowers commonly used as fish-poison, and juice as arrow-poison. Roots, pounded up in water, used in Malaya against termites, crickets, &c. Cultivated in Malaya for insecticidal purposes. See p. 480.

Dieffenbachia, many species and varieties. Dumb-cane. (*Aroideae*). Herbaceous, branchless, succulent plants, bearing a crown of large variegated leaves, commonly cultivated for ornament. The juice is highly acrid and poisonous; the slightest contact of a portion of it with the tongue will cause the latter to swell, making speech al ost impossible for some days. See p. 152.

Euphorbia Antiquorum. "Daluk," *S.* (*Euphorbiaceae*).—A spreading, leafless tree, 15-30 ft. high, found in rocky places in the low-country; branches 3-angled, very prickly. The acrid milky juice is poisonous and sometimes causes blindness.

Euphorbia tortilis. "Sinuk," *S.* (*Euphorbiaceae*).—A small leafless tree, found in similar places to "Daluk"; milky juice acrid and poisonous.

Girardinia heterophylla. Elephant-or Nilgiri-Nettle; "Gas-kahambiliya," *S.* (*Urticaceae*).—A tall herb, covered with stinging, poisonous hairs; found in forests of montane zone.

Gloriosa superba. "Niyangala" or "Ventonti," *S.* (*Liliaceae*).—A beautiful herbaceous climber with whorled leaves, whose tips end in a spiral tendril; the large, fleshy tubers are poisonous and not infrequently eaten by the poorer classes in mistake for edible yams, often with fatal results. The tubers, however,



Gloriosa superba, SHOWING POISONOUS, FLESHY TUBERS.

Cerbera Tanghin. ORDEAL POISON OF MADAGASCAR.

are said to possess important medicinal properties, and are occasionally enquired about from Europe, &c. See page 124. §

Hyoscyamus niger. Henbane. N. Africa, Europe, &c. (*Solanaceae*). Yields a powerful poison, used by oculists, etc. See p. 376.

Hura crepitans. Sandbox Tree. (*Euphorbiaceae*). A large upright tree of Trop. S. America and W. Indies, with thorny stem, characterised by acrid poisonous milky juice, which causes blindness if it gets into the eye. Introduced at Peradeniya in 1848. See p. 462.

Hydnocarpus venenata. "Makulu," *S.* (*Bixaceae*).—A medium-sized tree with smooth bark, common in low-country of Ceylon; fruits poisonous, used for poisoning fish. See also page 462.

Isotoma longiflora. (*Campanulaceae*).—A small annual plant, 1-2 ft. high, with white flowers. Native of the W. Indies, introduced and naturalised in Ceylon, being now a common roadside weed. It has an acrid, poisonous, milky juice, and has been considered to be the cause of deaths amongst ponies on the Delft Island, north of Ceylon. §

Laportea crenulata. Fever-, or Devil-nettle; "Maussa," *S.* (*Urticaceae*). A large shrub with large oval leaves; whole plant clothed with minute, stinging irritant hairs, which sting severely, the distressing effects often remaining for many days.



Isotoma longiflora. *Plumbago zeylanica.* ELA-NITUL, *S.*

Lobelia nicotianaefolia. "Wild Tobacco;" "Rasni," *S.* (*Campanulaceae*). A large herbaceous perennial, 6-10 ft. high, with large oblong leaves, found in open ground at 4,000-6,000 ft. The leaves and seeds are acrid and poisonous. §

Mirabilis Jalapa. Marvel-of-Peru; Four o'clock Flower; "Sendrikka," *S.* (*Nyctagineae*). Annual, 2 ft. high, with white or pink flowers, commonly cultivated for ornament. Roots and seeds poisonous. At one time erroneously supposed to be the source of the Jalap of commerce.

Modecca palmata. "Hondala" or "Potu-hondala," *S.* (*Passifloraceae*). Small perennial climber with large, palmate shiny leaves, common in moist low-country; the round scarlet fruit, of the size of a small orange, is poisonous and has been known to cause death. See p. 387. §

Nerium Oleander. Oleander; "Arali" or "Araliya," *S.* & *T.* (*Apocynaceae*). Shrub or small tree, with large, showy pink or white flowers. The milky juice is poisonous and used in remedies for skin diseases. Roots also poisonous.

Ochrosia borbonica. "Mudu-kaduru," *S.* (*Apocynaceae*). Small tree with greenish white flowers, common near the sea-coast; the bright red fruit is considered poisonous.

Plumbago zeylanica. "Ela-nitul," *S.* (*Plumbagineae*).—A perennial herb or small shrub, with white flowers and long succulent roots, which are acrid and poisonous and sometimes used for illegal purposes. §

Polygala venenata. (*Polygalaceae*). An erect, slender herb of Java; reputed to be intensely poisonous.

Rhus venenata and other spp. "Poison Sumach." (*Anacardiaceae*). A tall shrub of S. America, possessing a very poisonous juice.

Sapium indicum. Kiri-makulu, *S.* (*Euphorbiaceae*). Small tree with smooth, white bark and narrow willow-like leaves; the acrid milky juice is very poisonous.

Solanum verbascifolium. "Hekarilla," *S.* (*Solanaceae*).—Large shrub, covered with a dense yellowish-grey tomentum; moist region up to 6,000 ft. Fruit poisonous.

Streblus asper. "Geta-netul," *S*; Pirasu," *T.* (*Uriticaceae*). A large shrub or small tree, with small, scabrous leaves, common in the low-country of Ceylon. The yellow fruit is edible, but the bark is an irritant poison. See p.

Strychnos Nux-vomica. Nux-vomica; "Goda-kaduru," *S.* (*Loganiaceae*). A fairly large tree, common in the forests of the dry region of Ceylon and parts of India, &c.; the seeds are the source of the alkaloids strychnine and brucine, and are powerfully poisonous. See Curare; also page 374. §.



Tabernaemontana dichotoma.
DIVI-KADURU, *S.*

Modecca palmata.
HONDALA, *S.*

Tabernaemontana dichotoma. "Eve's Apple," "Forbidden Fruit." See page 463.

Yucca gloriosa. Adam's Needle. (*Liliaceae*).—A semi-woody, branchless plant, 6-8 ft. high, with long, rigid, sharply pointed leaves; the roots are poisonous. §.

CHAPTER XXVI.

OILS AND FATS

1.—*FIXED OILS.* 2.—*ESSENTIAL OR VOLATILE OILS.*

Vegetable oils are of two distinct kinds, viz. *fixed oils*, as coconut, gingelly, and castor oils, which do not evaporate on exposure to air, and *volatile* or *essential oils*, *e.g.* citronella, cinnamon, and clove oils, which readily volatize on exposure. The former are obtained by crushing and pressure, sometimes by chemical solvents, or by boiling, while the latter are extracted usually by distillation and possess the characteristic aroma of the plants from which they are derived. The former include "drying oils" (which dry fairly rapidly, leaving an elastic film), "non-drying" or "semi-drying" oils, and vegetable fats. Some fixed oils which are liquid in a warm temperature become solid in a cold temperature, *e.g.* coconut-oil; others are naturally fatty bodies, resembling grease or butter, *e.g.* those obtained from *Bassia*, *Butyrospermum*, *Pentadesma*, etc. The following are some of the principal fixed oils.

1.—FIXED OILS.

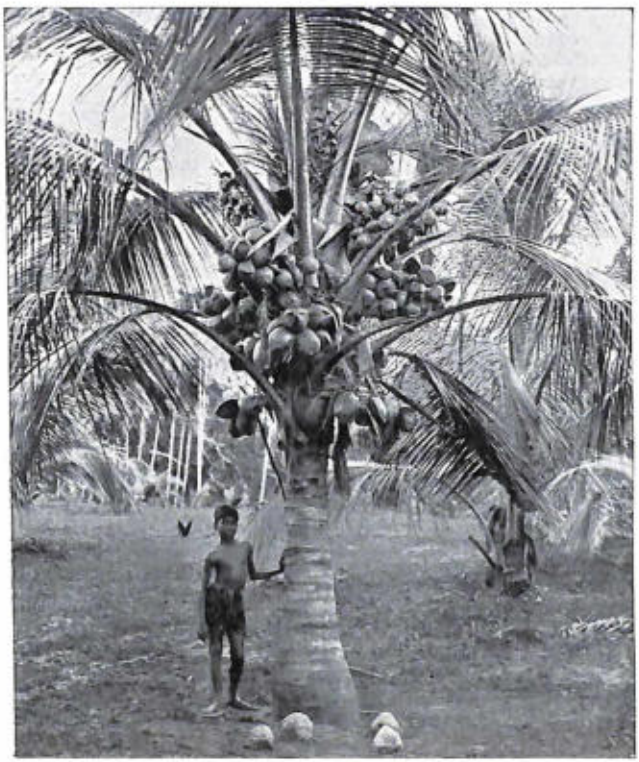
Castor-oil ; Endaru-tel, *S*; Amanaku-maram, *T*; (*Ricinus communis*. Euphorbiaceae).—A tall, quick-growing perennial with large, handsome palmate-peltate leaves, naturalised in Ceylon, often occurring as a weed in abandoned ground in the moist low-country and up to about 3,000 feet. It is cultivated in all warm countries, more particularly in India, Southern Europe, and United States, generally as an annual but sometimes as a perennial crop. It thrives in ordinary soil, but does best in open, friable, humous or alluvial soil. Excessive moisture is unfavourable to the crop, but a good rainfall after sowing is essential. About 10 lb. of seed is sufficient to sow an acre, in rows; the latter should be about 5 or 6 ft. apart, with about 3 ft. between the plants in the row, 3 or 4 seeds being placed together; the seed should germinate within 10 days. When the seedlings are a few inches high, remove the weakest, leaving one (the strongest) to each hole. The plants should be topped at a height of about 2 ft. They begin to bear in about 8 months from sowing, and the harvest may be completed about 4 months later. Castor is usually planted in India as a mixed crop.

Planted as a sole crop, the yield under favourable conditions may be 25 bushels or about 1,250 lb. of seed ("beans") per acre; under ordinary conditions 500 to 600 lbs. is a fair average yield. In the United States as much as 30 bushels or 1,600 lb. per acre is sometimes obtained. The well-known oil, of which

good seed contains 30-40 per cent. or more, is obtained from the seed by pressure and is valued at £55-£60 or more per ton. Besides its use in a refined state in medicine, castor-oil is largely employed as a body for lubricating oils, also for dressing leather and in soap manufacture, etc. The residue, after the expression of the oil, forms an important by-product, viz. *castor cake* or *poonac*, largely used as a manure. Good seed for oil production is worth about £20-£25 per ton in Europe. In Colombo the price varies from 10-12 cts. per lb. Large quantities of castor cake or "poonac" are imported annually into Ceylon, Malaya, etc., for manurial purposes. The seeds (beans) as well as the poonac contain an alkaloid poison (*ricin*), which, however, does not pass into the oil. The leaves of the Castor-oil plant furnish the principal food of the silk-worm, see page 434.

Varieties, &c.—These vary in habit of growth, size and markings of seed, &c. The large-seeded varieties produce the largest crops and the coarser oil; the small-seeded varieties yield the well-known finer oil used for medicinal purposes. *R. zanzibarensis* is noted for its large seed.

Coconut Palm. "Pol," *S.* "Tennai" or "Thenga," *T.* (*Cocos nucifera*). To the inhabitants of Ceylon, where it is estimated there are upwards of a million acres under the product, and of other tropical countries where the coconut palm flourishes, this is one of the most important trees of the vegetable kingdom. Though extensively grown in most tropical regions, the native habitat of the palm is uncertain, for it is known only in a cultivated state. It thrives best in a moist, hot climate, especially along the sea-board, but will also succeed inland at a considerable distance from the sea, provided the climate is sufficiently hot and moist. Heavy loamy or alluvial soil suits it best. Hard, rocky soil or stagnant swamps are unsuitable; otherwise the palm is not particular as to locality. In Ceylon, as well as in most other tropical countries, it is cultivated and gives good returns up to about 1,700 ft. above sea-level, or higher in sheltered valleys. The preparation of its different products for market, chiefly for export, forms an



YOUNG COCONUT PALM IN GOOD CROP.

important industry in Ceylon, Philippines, the Pacific and some West Indian Islands, and other countries.

The dried inner portion (*endocarp*) of the nut, known as copra, yields a valuable oil used in cookery, soap-making, and in the making of margarine, &c.; the same part, used in the fresh state, is made into *desiccated coconut*, which is esteemed in confectionery and cooking; the husk (*pericarp*), when retted for about a month in water, yields coir fibre, which is made into rugs, brushes, mattresses, matting, &c., or into coarse string and ropes, which are largely exported for use as binder twine, &c.; whole nuts are exported from Ceylon to the extent of about 15-20 millions a year. The local uses of the nut, leaves, stem, flowers, &c., are innumerable, supplying food, palm-wine ("toddy"), sugar, spirituous liquor, and many other domestic requisites.

Copra, obtained by breaking the nut in two, is dried in the sun or in specially constructed low houses or kilns, over smoke and heat caused by smouldering fires made with the husks and shells of the palm. Forced hot-air driers are sometimes used for the purpose, the copra shells being placed in movable trays. Ceylon copra usually ranks with the finest quality; over 50,773 tons were exported in 1923, valued at £1,208,210. It fetches in England, according to quality and demand, from about £28 to £35 per ton or locally about Rs. 85 to Rs. 100 per candy; whilst the oil itself is worth about £50-£55 or more per ton.

Coconut-oil, obtained from the copra, is quoted by the cwt. in Ceylon, from which some ½ a million cwt. is annually exported. *Poonac* (residue of copra after expression of oil) is a valuable cattle-food or fertilizer, and is exported from Ceylon to the extent of nearly ¼ million cwt. annually, valued at about 7*s*. per cwt. *Desiccated coconut* (export 818, 793 cwt. in 1923) fetches from 38*s*. to 45*s*. per cwt., or about 25 cents per lb. locally. Over 15½ million fresh coconuts were exported from Ceylon in 1923, valued at £89,236. From 1,000 to 1,500 nuts, according to size and quality, go to a candy of copra, and 4 candies make a ton. In Ceylon, copra is sold by the candy, and in Malaya, Philippines, &c., by the picul (133⅓ lbs.). From 300 to 350 nuts go to a picul, and 16 piculs make a ton. The sweet juice extracted from the base of the flower spadix by incision and tapping, when fresh and unfermented, is known as *toddy* and forms a pleasant, sweet beverage; fermented and then distilled, it yields *arrack*, a strong alcoholic spirit. See *Palm Sugar*, p. 360. For toddy-drawing, the best and healthiest trees are selected. Tapping for toddy may continue for 6 or 8 months in the year, according to climate, and the yield may be about 40 gallons or more per tree in that period. Each inflorescence may be tapped daily for 2 or 3 months. From 6½ to 7 gallons of toddy produce about 1 gallon of arrack at 25 degrees under proof. Fresh arrack is sold retail at from Rs. 9 to Rs. 11 per gallon. Arrack improves with age, and old stuff when obtainable fetches the highest prices. The extraction of the juice or toddy from the flower spathe means of course the sacrifice of the nut crop.



SEEDLING COCONUTS IN NURSERY.
Note that the nuts are laid on their sides.

The palm is propagated by the nuts, which are sown in the husk in a nursery bed, being usually laid on their sides and almost covered with soil. These germinate in about 3 months, and in 8-10 months the seedling, with nut attached, is ready for planting out. Or the nuts may be planted *in situ*. In indifferent soil it is best to plant 2 years-old seedlings. The holes should be not less than 3 ft. deep by 3 ft. wide, and should remain open for some time previous to planting. After planting, they should at first be only partially filled, with surface soil, to which may be added some well-decomposed manure. In course of time the holes become filled through the process of cultivation and weathering, and the plants are thus ensured protection when young and a firm hold of the ground when grown up.

Proper planting distances depend upon soil and locality, 28 feet apart each way (55 trees to the acre) being usually adopted for rich soils, or 25 ft. (70 trees per acre) in poor soils. A small crop may be obtained when the palms are 8 to 10 years old; but they may not be in full bearing till about the age of 15 years. They continue to yield until about 60 years old, fruiting all the year round. About 45 to 50 nuts per tree, or 3,000 nuts to the acre per annum, is considered a satisfactory yield, though with good cultivation and under favourable circumstances as many as 70 to 80 nuts or more per tree may be obtained. It is usual to make 6 pluckings a year, *i.e.* once in two months, or sometimes oftener. The heavy clusters of nuts should be supported by means of a forked stick with a pointed end, the latter being placed against the stem at the base of the leaves, as shown to the left in the illustration (p. 389). The palms attain a height of 70-80 ft., with an unbranched, wavy (never straight) stem. They are easily climbed by the natives, who throw their feet in a loop of cloth, rope, or fibre, pressed against the stem, and are thus afforded a foot-hold. In Ceylon and South-India the ripe nuts are picked by hand, but in some countries they are allowed to fall to the ground as they ripen, and are then gathered.

Varieties.—A great number of varieties occur in cultivation, these varying in size, shape, yield, &c., also in the thickness of the husk and of the interior (copra), height of tree, etc. Some of the more distinct varieties are known by different local names. The "King Coconut" ("Tambili," *S.*) is a distinct variety, said to have originated in Ceylon, bearing a yellow, ovoid fruit, which is distinguished by its sweet juice and is esteemed for culinary purposes, but it is of little commercial value for copra. The "Dwarf Coconut" bears fruit when about 4-5 years old, while the stem is only 2 or 3 feet high, the nuts being small but very numerous. Of these, an average crop of 100 nuts per tree may be expected when the palms are 8 years old, so that at 90 trees to the acre (24 × 20 ft.) a yield of 9,000 nuts per acre may be obtained. 500 "dwarf" nuts go to a picul of copra. Some plantations of this variety have been made in Malaya. The "Needle Coconut," cultivated in the Nicobar Islands, has a long triangular fruit, the nut tapering to a sharp point at the end. The "Maldive Coconut" is characterized by a small, almost round, fruit; while the "Nawasi" or the edible-husked coconut is furnished with a husk which, when tender, is fleshy and of a sweetish-acid taste.

Oil Palm. (*Elaeis guineenis*).—A handsome palm, 50-60 ft. high, with an erect, stout stem and large pinnate leaves, native of West Trop. Africa, where it forms the principal natural product of the country. It occurs over extensive areas, either naturally or in a semi-cultivated state, more especially in Southern Nigeria. The palm furnishes the natives with many of their needs; the fruit, as well as the oil obtained from

it, enters largely into their daily food ; from the tender upper portion of the stem they extract palm-toddy, which forms an intoxicating drink (see *Palm Sugar*, page 362) ; while with the leaf-stalks and leaves they build and thatch their houses. The palm is monoecious, *i.e.* bears both male and female flowers on the same tree, but in separate bunches. The flowers are fertilized chiefly by insects. Under cultivation, however, pollination may be assisted by hand, *i.e.* by distributing among the female inflorescences portions of fresh male inflorescences.

The palm thrives in a hot, moist climate, preferring low-lying alluvial soil, in sheltered valleys. In Ceylon, where it was introduced in 1850, it grows luxuriantly in the moist region up to about 2,000 feet elevation, bearing fruit annually. Recently it has been grown experimentally at Anuradhapura, in the dry zone (rainfall 54 inches, unevenly distributed), where the palms are now flourishing, though probably not so productive as they might be in a moister climate. Some 30,000 acres are now under the palm on the East Coast of Sumatra, and trials are being made with it also in Malaya.

Some seeds may germinate in 6 or 7 months from sowing, but many take 10-12 months or more. Germination may be hastened by soaking the seeds in hot water for a few days, or by placing them for 7-10 days between layers of stable manure so as to set up fermentation. When planting out, the palms may be spaced 28 × 28 ft., *i.e.* 55 palms to the acre. Wide spacing has the effect of developing stout and short stems, thereby facilitating harvesting of the crop. The palms begin to bear at 4 or 5 years of age, and should be in full bearing when about 12-15 years old. After the age of about 30 years the yield gradually declines.

The pulp or outer covering of the fruit yields "palm-," "pulp-," or "pericarp"- oil. This occurs in two grades, viz : *soft* and *hard* oil. The former is obtained in Africa by boiling the fruit, which is afterwards soaked in water for 2 or 3 days, then pounded in a mortar, &c., when the oil floats on the surface, and is afterwards cleared by boiling and straining. "Hard" oil is obtained by burying the fruit for a few days in a pit to ferment, being afterwards pounded with water, boiling being dispensed with. The latter method is less laborious, but the oil commands a lower price than the "soft" oil. Palm- or "pulp-" oil is largely exported and used chiefly in the manufacture of soap, candles, &c. After being deprived of the pulp (pericarp), the hard nuts, each containing one or two hard kernels, are largely exported to Europe for crushing and extracting "kernel-" or "white-" oil, which is distinct from the pulp-oil and is used largely for making margarine and cooking-fats. After the expression of the oil from the kernels by hydraulic presses, the residue or cake is worth about £8 per ton as cattle food.

*Yield.**—The average annual yield of fruit per tree, under uncultivated conditions, is variously estimated at from 40-80 lb. or more, but cultivated palms, under favourable conditions, have been found to give double these figures. Rutgers estimates as follows for good Sumatra plantations, viz; 5th-10th year, 53 lb. per tree; 11th-30th year, 165 lb. ; 31st-50th year, 66 lb. Palm kernels are valued in England at about £20 per ton; "palm oil" at £40; and "kernel" oil at about £45 per ton. Each palm produces, on an average, from 6-9 bunches of fruit a year, each bunch yielding from 12 to 20 lb. of fruit. The palm requires similar conditions of soil and climate to the Coconut palm. Therefore in localities where the latter is found to thrive, the Oil-palm does not seem to have important advantages over it.

Varieties.—Numerous varieties or sub-varieties are recognised, these varying in yield, as well as in quality, size, and colour of fruit, the latter being green, red, black, or dark-purple. Many are given local names, as Abe-pa, Opa-pankoro, Ope-arunfo, Osok-eyop, Potshi, Qua-qua, &c.

**Investigation on Oil Palms* by Dr. A. A. L. Rutgers, Sumatra, (1922). *Bull. Imp. Inst.*, Vol. VIII, No. 4 (1909) ; *Bull. Dept. of Agric., Ceylon*, 1922.

Gingelly-oil; Sesame-, Til-, Sim-sim or Benni-oil; Benni or Beni-seed; "Tala-tel," *S.* (*Sesamum indicum.* Pedaliaceae).—An annual plant, 2½-3½ ft. high, indigenous to Ceylon, South India, Trop. Africa, etc., extensively grown in India, Burma and elsewhere for the sake of the small seeds, which yield by expression about 40 per cent. of fine oil. The latter is edible and largely used in India, &c., for cooking, lighting, various domestic purposes and for medicine. The seeds, of which there are white, black, yellow, and red varieties, are largely exported to Europe, &c., for the sake of the oil, which is largely used for soap-making, in salad oils, as well as in the preparation of margarine. The white seeds are considered to yield the finest oil.



GINGELLY. *Sesamum indicum.*

The residue (gingelly-or sesame-cake), after expression of the oil, is much used as cattle food. The plant may be grown as a summer crop in warm or sub-tropical climates, as in Italy and the Southern United States. The seed is sown broadcast after the land is ploughed, and the crop is ripe in about 4 months' time. The plants are then cut and tied in bundles to dry; the pods upon drying burst and disperse the seeds. The usual yield in India is about 300 lb. of seed per acre, producing about 10 gallons of oil. The seed is valued in England at about £20-£25 per ton. It is estimated there are some 4½ million acres under the crop in India. Gingelly is cultivated in Ceylon to some extent for local use, more especially in the Northern Province, but large quantities of the oil and seed are imported from India. See p. 379.

Sunflower Oil. (*Helianthus annuus.* Compositae).—The Sunflower plant is a tall, quick-growing annual, growing to a height of 6-8 ft. (sometimes much more), native of Peru, and is extensively cultivated in parts of India, China, Russia, S. America, &c., for the seed, which is rich in oil. The plant thrives in ordinarily good soil, in a warm and moderately moist climate. It flourishes in Ceylon at medium or high elevations. The seed may be sown in rows 3 ft. apart, with about 1 ft. between the plants in the row. About 6 lbs. of seed is thus required to sow an acre, and a crop is obtained in about 4 months from the time of sowing, yielding 40-50 bushels of seed per acre.

The soil between the rows should be tilled or forked up occasionally in the early stages of the crop. The method of harvesting is similar to that of Maize, the heads being gathered, dried, and then threshed; or the seeds are rubbed out by hand over a rough grating. Sunflower seed for oil extraction is worth about £17 per ton. A bushel of seed, on an average, yields a gallon of oil. The latter, which is obtained by pressure, is edible and of a pleasant flavour. The seed also is edible, and forms a nutritious food for cattle and poultry. The residue after the extraction of oil makes a good cattle-food.

Shea Butter. Butter-tree, or "Emi." (*Butyrospermum Parkii*. Sapotaceae).—A medium-sized or large tree with a stout trunk, bearing rather leathery, oval leaves, each about 6-9 in. long by 3-4 in. broad, crowded at the ends of the branches, native of W. Trop. Africa

The large fleshy "nuts" (seeds), of which each fruit usually contains only one, yields a large percentage of stearine fat, which is used locally for cooking, &c., and, when exported, in the preparation of cheap chocolates, also in the manufacture of soap and candles. The fat has been valued in London at about £30 per ton. The seeds are exported to some extent from Nigeria. The tree, which is a slow grower, was introduced at Peradeniya in 1893.

Vegetable- or **Chinese- Tallow**.—A product of *Stillingia sebifera* (Euphorbiaceae), a small tree, 25-30 ft. high, native of China and Japan. The fatty oil obtained from the layer surrounding the seed is used in China in place of animal tallow for the manufacture of candles and soap, also in cloth dressings, etc. A brownish yellow oil, obtained from the seed kernels, is used in the preparation of varnishes, also locally for lighting and other purposes.

A mixture of the oil and fat is stated to form a good substitute for lard used for industrial purposes. Vegetable-tallow is exported from China in hard white cakes, weighing about ½ cwt. each. The tree has been introduced into Ceylon before 1824, and grows freely at elevations over 4,000 feet. It has become naturalised in the vicinity of Hakgala Gardens, where it seeds abundantly. Birds are fond of the fruit, which probably accounts for the local distribution of the tree. See p. 471.

OTHER FIXED OILS.

Aleurites Fordii, A. montana, A. trisperma and other spp. (*Euphorbiaceae*) afford the Tung-or Chinese wood-oil of China, which is classed as a "drying oil" and valued in the manufacture of paints, varnishes, linoleum, &c.; it is also used for lacquer-work, lubricating, lighting, &c., and sometimes in medicine. It is largely exported from China. The oil-cake residue is poisonous and only fit for manuring.

Aleurites moluccana (=*A. triloba*). Candle-nut Tree; "Indian Walnut"; "Country Walnut" (Jamaica); "Eboe," "Kukui" (Hawaii); Bankul-nut (French Colonies).—A medium-sized tree of Malaya and Pacific Islands, naturalised in India, Ceylon, Madagascar, etc. Thrives in Ceylon up to about 3,500 ft. in the moist region, and is distinct amongst other trees when bearing its glaucous-grey young foliage and dingy white flowers, the latter in April-May. In the young state the leaves are large, palmate, and shiny; on the mature trees they are ovate and entire. The hard-shelled "nuts" (seeds) yield an oil similar to Tung-oil, and are reported to be worth in England £12-£14 per ton. They are commonly used by the peasants for lighting, several being strung together on a splinter of bamboo or palm-leaf midrib and lighted. Roasted and cooked, they are edible. An average tree, it is estimated, produces about 75-100 lbs. of nuts a year; 3,750 lbs. of these with shells have been found to yield 618 lbs. of oil. The seeds take about 3 4 months to germinate.

Amoora Rohituka. "Hingul," *S.* (*Meliaceae*). Moderate-sized tree of Ceylon, India, &c. Oil from seed used for lighting, etc.

Arachis hypogaea. Ground-nut Oil. (*Leguminosae*). See page 302. The oil obtained from the seed, valued at about 46*s* per cwt., is largely used for soap-making and, when refined, in salad-oils, &c. Groundnuts, undecorticated, are worth in England about £22-£25 per ton.

Argania Sideroxylon. Argan-oil. (*Sapotaceae*). Medium-sized tree of Morocco. Seeds yield an oil used in cooking and said to be almost equal to olive oil.

Attalea Cohune. Cohune-nut. (*Palmae*). Kernels yield an oil similar to coconut-oil and suitable for use in margarine manufacture. Charcoal made from the fruits was largely used for gas masks in the late war.

Azadirachta indica. Margosa (Portuguese); Nim- or Neem-tree of India; "Kohomba," *S*; "Vempu," *T*. (*Meliaceae*).—A tall tree of India, Ceylon, &c. The strong-smelling, aromatic oil, obtained from the fruit, is much valued in native medicine, being a universal external application for rheumatism, &c., and is taken internally by women in pregnancy. It is also antiseptic and commonly used for animals, both internally and externally. A most valuable tree to the peasants, all parts of it being used for medicine or domestic purposes. See pages 206, 377.

Balanites Manghamii. "Manduro." (*Simarubaceae*). A tree of Portuguese East Africa, the nuts of which yield a clear oil, burning with a bright flame, much used locally.

B.—aegyptiaca. A tree of N. Nigeria, Uganda, &c.; yields a clear oil, sometimes called "Betu Oil."

Bassia butyracea. Indian Butter-tree (*Sapotaceae*). A medium-sized deciduous tree of Central India, occurring at 1,000-5,000 ft. elevation. The seeds yield by expression a thick oil or fat used locally for burning and externally for rheumatism, &c.; also used as an adulterant in "ghi." Flowers not generally eaten, but a syrup prepared from them yields a spirit or is made into sugar.

B.—latifolia. Mahua or Mahwa; Mowra.—A large, spreading tree with broad leaves, common in Central India up to 4,000 ft., often cultivated and of considerable value locally. From the seeds is obtained a thick, yellow oil or fat, known as "mowra fat," commonly used in India for cooking, &c. The seed was largely exported before the war, chiefly to Germany, the "oil" being used in making margarine, soap, chocolates, &c. Mowra-cake is not suitable for cattle food, but makes a good fertiliser. See p. 311.

B.—longifolia. "Mi" or "Mee," *S*; Ilippi or Illupai, *T*.—A large tree of Ceylon, Malaya and S. India, where it is referred to as the "South Indian Mahwa" (see above). It is often cultivated for the sake of the fleshy seeds, which yield an oil esteemed locally for cooking, also in medicine, etc. The cake, after the expression of the oil, is known as "arippu," and is exported from Ceylon to S. India. The tree is deciduous for a short period in the dry season. The flowers are dried and eaten. See p. 311.

Ben Oil, see *Moringa*, pages 305, 396.

Brassica juncea. "Aba," *S*; "Kaduga," *T*; Indian Mustard or "Rai." (*Cruciferae*). An erect annual, of which there are several varieties, 2-4 ft. high, naturalised in Ceylon, &c., commonly cultivated in Northern India and elsewhere as an oil-crop, the small seeds yielding an oil used in cooking, medicine, &c. Seed is sown broadcast at the rate of about 3 lbs. per acre, which yields about 30-40 lbs. of seed. The leaves are used as a vegetable. See pages 347, 378.

Butyrospermum Parkii. See "Shea-butter," p. 394.

Calophyllum Inophyllum. Punnai-nuts; "Domba," *S*; "Dommakottai," *T*. (*Guttiferae*). Medium-sized or large, handsome tree of Ceylon, India, &c. The dried fruits or "nuts" yield abundant dark-green, thick and strongly scented oil, employed locally in medicine and for burning. The "nuts" are collected in Ceylon as a "Forest produce," under license, for export. 2,333 cwt. nuts, valued at Rs. 20,510, were exported from Ceylon to India in 1923.

Calophyllum tomentosum. "Keena," *S*; "Pongu," *T*. A tall handsome tree with straight trunk and quadrangular twigs, native of the moist low-country of Ceylon, Western India and Malaya. Seeds yield an orange-coloured oil ("Keena-tel," *S*.), used for medicine, skin diseases, lighting and other domestic purposes. This is the "Kina" or "Keena" of the lower hill-country which is not so striking as the large "Keena" (*Calophyllum Walkeri*) of higher elevations. See pages 117, 206.

Carapa-, Crapa or Crab-oil. *Carapa guianensis*. (See p. 98). The large fruits contain numerous seeds which yield an oil used in Guiana, &c., for lighting, medicine and other purposes.

Carthamus tinctorius. Safflower Oil. (See *Dyes*, page 439). Largely cultivated in India, Egypt, Caucasus, &c., for the seeds, which yield safflower-oil by pressure. The oil is used in India for culinary purposes, also in the manufacture of paint and soap, and in the preservation of leather and ropes.

Cotton-seed Oil (*Gossypium*). See under *Fibres*, p. 419. Cotton-seed is one of the most important sources of commercial oils The finest grades of the seeds are rich in oil (about 20 per cent.), which is obtained by pressure and largely used in butter substitutes, also in salad oils and in cooking, etc., whilst the lower grades are employed in the manufacture of soap, paints, &c. A ton of seeds, valued at about £12, yields some 35 gallons of oil, worth about £38 per ton. The production of the latter is a very large industry in the Southern United States. Cotton-seed meal or cake, obtained from the seed after the expression of the oil, is esteemed for stock, especially dairy cows. See p. 419.

Croton Oil; "Jayapala," *S*. (*Croton Tiglium*). See page 372. Oil obtained from seed used in medicine, being a violent cathartic and vesicant. Seeds valued in Colombo at about Rs. 15 to Rs. 20 per cwt. Planted at 12 × 12 ft., a yield of 10 to 12 cwt. seed per acre may be obtained. See p. 372, &c.

Diospyros Embryopteris. A medium-sized, handsome tree of Ceylon, India, Malaya, &c., found at low and medium elevations. "Tunika-oil," used medicinally, is obtained in India from the seeds. See p. 443.

Dipterocarpus glandulosus. "Dorana-tel," *S.* (*Dipterocarpeae*). A tall, erect tree of Ceylon. A resin which exudes naturally from the stem, and is collected at the base, yields an oil which is used in medicine, &c.

Dumoria Heckeli. Bako-nuts. (*Sapotaceae*). The large, ovoid, smooth seeds, with a large oval scar along one side, are obtained from a large tree of West Trop. Africa and are rich in oil.

Garcinia echinocarpa. "Madol-tel," *S.* (*Guttiferae*). Small tree of Ceylon. Seeds yield an oil used in medicine.

Ground-nut Oil. See *Arachis*, page 302.—A valuable oil, obtained from the seed and worth about £45 per ton in London, is edible and used in salad-oils; also largely employed in soap-making, &c. The residue of the seed, after the extraction of the oil, is a valuable cattle-food or fertilizer.

Guizotia abyssinica. Ramtil-, Inga-, Black-til- or Niger seed-oil. (*Compositae*). An annual, largely cultivated in India for the sake of the oil obtained from the seed; used locally for lighting, cooking, and medicine, and exported for use in soap-making, etc. Seed commonly used as food for cage birds.

Gynocardia odorata. (*Bixaceae*). Large tree of Sikkim, &c. Bears large globular fruits, the seeds of which yield a drying oil of good quality, known as "Gynocardia oil." These were formerly supposed to be the source of "Chaulmugra oil,"—see *Taraktogenus*, next page.

Hemp-seed Oil. Obtained by pressure from the seed of *Cannabis sativa* or "Indian Hemp;" it is of a greenish yellow colour and used chiefly in paints and varnishes; produced largely in China, Formosa, Algeria, &c. Hemp seed is quoted at present at about 20*s.* per cwt. See pages 384, 421.

Hydnocarpus anthelmintica and **H. wightiana.** (*Bixaceae*). Medium-sized trees of India, Burma, &c. An oil similar to Chaulmugra oil is obtained from the seed, sometimes used as a substitute for the true Chaulmugra oil. See *Taraktogenus.*

Jatropha Curcas. Physic-nut; Pulsa-oil; "Rata-endaru," *S*; "Kaddamanakku," *T.* (*Euphorbiaceae*). A well-known shrub, commonly planted as a fence round peasants' gardens, being readily propagated from large cuttings. Seeds yield a strongly purgative oil, used in medicine and for lighting, &c.

Kokoona zeylanica. Kokun-oil; "Potha-eta Tel," *S.* (*Celastraceae*). Large tree of Ceylon and S. India. Seeds yield oil used for lighting, medicine, &c. See under *Leeches*, p. 490.

Linseed Oil. (*Linum usitatissimum*). See under *Fibres*, page 420. This valuable and well-known oil, obtained from the seed, is extensively used in paints, varnishes, printers' ink, &c., and valued in England at about £50 per ton. The plant is largely grown in India for the seed, yielding at the rate of about 300 lbs. per acre. This is largely exported and fetches from about £20 per ton. Linseed-cake, obtained after expression of the oil, is a valuable cattle-food and worth from £12 per ton.

Lophira alata. Scrubby Oak. (*Dipterocarpeae*).—A small but handsome tree, with yellow panicles of flowers, native of Sierra Leone; yields "Kiam-" or "Meme-" butter, used in Africa for cooking purposes.

Moringa pterygosperma. (See pages 305, 379). The seeds yield a fine oil known as Oil- of- Ben, used by watchmakers and in cosmetics.

Niger-seed oil, see *Guizotia*, above.

Olea europea. Olive Oil. (*Oleaceae*). See page 279. The oil, obtained by pressure from the mature but unripe fruit, is considered the best of all salad oils, and is largely used in cooking, medicine, and for domestic purposes.

Pentadesma butyracea. Tallow- or African Butter-tree; Okoto- or Koma-nut Oil. (*Guttiferae*). A large tree with long, straight, regularly radiating branches, native of W. Trop. Africa. The large, oblong fruit (5-6 in. long by 3½ in. diam.) and large fleshy seeds (3-4 in each fruit) contain a quantity of yellow, waxy juice, which is used by the natives for the extraction of an oil employed by them in cooking, &c. The

oily seeds have been valued in England at about £8 per ton. An average tree bears 700-900 fruits or about 150 lbs. of seed a year. Introduced at Peradeniya in 1897, and bears a heavy crop of fruit each year, during April-May.

Poppy Seed Oil. Derived from the seed of *Papaver somniferum* (see p. 374), cultivated largely in Egypt, S. Russia, N. India, Persia, &c.; used chiefly as a salad oil, also in artists' paints, and is largely imported into France. Average yield of seed per acre, 4 cwt.

Quillaja Saponaria. Soap-bark Oil. (*Rosaceae*). Small tree of Chili, with saponine bark, readily raising a lather in water; used locally as "vegetable soap."

Safflower Oil. See *Carthamus tinctorius*.

Sapindus emarginatus. "Penela," *S*; "Neykkodan," *T*; Soap-nut. (*Sapindaceae*). A large tree of Ceylon (dry region), India, Burma, &c. Fruits, dry or fresh, are saponine in water and used by the peasants as a substitute for soap.

S.—Saponaria. Soap-berry. Small tree of Jamaica. Fruit strongly saponaceous.

Schleichera trijuga. "Ceylon Oak," "Kusumb" of India. (*Sapindaceae*). A large tree of Ceylon, India, Burma, &c. Seeds, which are edible, are rich in oil, said to be the original "Macassar oil." See under *Lac*, page 416.



TALLOW-OR BUTTER-TREE.
Pentadesma butyracea.
(See p. 396).

Soya-bean Oil. See *Glycine hispida*, page 287. Seeds rich in oil, which is edible and largely empoyed in the manufacture of soap, paints, &c. The present price of the oil in London is about £35-£40 per ton.

Stillingia sebifera. Chinese Tallow-Tree. See page 394.

Taraktogenus Kurzii. "Kalaw" or "Kalaw-ni." (*Bixaceae*).—A large or medium-sized tree of Burma, Siam, &c., the large fleshy seeds of which yield a thick, yellowish oil or fat of the consistency of butter, valued in the treatment of leprosy and other skin diseases. This is the true "Chaulmugra oil," formerly supposed to be obtained from *Gynocardia odorata*, which see. The tree was introduced at Peradeniya in 1922. Cultivated in Hawaii. See also *Hydnocarpus*.

Trichilia emetica. Malfura or Mafureira-nut Oil. (*Meliaceae*). East African tree. Seeds rich in fatty oil, which is suitable for use in cookery, and in the manufacture of soaps and candles; valued in London at about £10 per ton.

2.—ESSENTIAL OR VOLATILE OILS.

USUALLY OBTAINED BY DISTILLATION.

Ajowan Oil. (*Carum copticum*. Umbelliferae). See page 376.

Anise Oil, Star. (*Illicium anisatum*). See p. 342.

Aquilaria Agallocha. (*Thymelaeaceae*). Eagle-wood; Aloes-wood; "Akayau" of Malaya.—A large tree of Burma. Wood rich in fragrant resin, from which is obtained an essential oil valued in perfumery and medicine; also used for burning in temples as an incense. See page 412.

Basil Oil. (*Ocimum Basilicum*. Labiatae). Sacred-, or Sweet Basil; Basilique; "Tulsi" of India; "Suvanda-tala," *S*. A strongly scented herb, 2-3 ft. high, yielding from the leaves an essential oil used in scented soaps, perfumes, &c. grown commercially in Reunion Morocco, &c.; also commonly cultivated in India, where it is often held sacred, and in Ceylon, &c., for its aromatic leaves. See page 344.

Bay Oil. (*Pimenta acris*. Myrtaceae). Oil distilled from the dried leaves, in certain West Indian islands, is quoted at about 9*s*. to 10*s*. per lb. See page 330.

Bergamot Oil. (*Citrus Bergamia.* Rutaceae). Oil obtained from rind of fruit, valued at about 12*s.* to 15*s.* per lb. See p. 456.

Cajeput Oil. Australian "Tea Tree;" "Gelam" of Malaya; "Loth-sumbul," *S.* (*Melaleuca leucadendron*, var. *minor.* Myrtaceae). A tall tree of Malaya, N. Australia, &c. A volatile oil, obtained from bark and leaves, is valued in medicine as a stimulant and tonic, &c., and worth from 15*s.*-20*s.* per lb. Bark much esteemed by Sinhalese "native-doctors," also in Malaya for making torches.

Calamus Oil. "Wadakaha," *S.* (*Acorus Calamus.* Aroideae). A herbaceous perennial, with large radical leaves, widely distributed in temperate and tropical countries; naturalised in Ceylon, commonly found in swampy ground at low elevations, the rhizomes being used in native medicine. These are collected under a royalty fee of Re. 1 per cwt. An aromatic oil distilled from the rhizomes is used for flavouring liqueurs, &c., also in medicine, being valued at about 6*s.*-9*s.* per lb. See p. 480.

Camphor Oil. (*Cinnamomum Camphora.* Lauraceae). Distilled from the wood, sometimes from the leaves, and obtained almost entirely from Formosa and Japan. It is valued in England at about 65*s* per cwt. See page 413.

Cananga Oil, or **Ylang-ylang.** (*Cananga odorata.* Magnoliaceae). A tall, quick-growing tree of Malaya. Oil obtained from the flowers by distillation or enfleurage is valued in perfumery; that extracted from dried flowers, in Java and Madagascar, is considered the best and worth about 90*s.* per lb. See p. 458.

Caraway Oil. (*Carum carvi.* Umbelliferae). See page 345.

Cascarilla Oil. See *Croton Eleutaria*, below.

Cassia Oil. (*Cinnamomum Cassia*). See page 333. The clear, greenish-yellow essential oil obtained from the leaves and young twigs by distillation, in China, is described as "intensely sweet with cinnamon-like odour and strongly refractive." It is valued in England at about 7*s.* to 8*s.* per lb., and used for scenting soaps, &c. Like cinnamon, the bark also yields a valuable oil, both being produced chiefly in the provinces of Kwang-si and Kwang-tung, where the tree is cultivated.

Chenopodium or **Worm-seed Oil.** (*Chenopodium ambrosoides, = C.—anthelminticum.* Chenopodiaceae). A perennial herb, 2-3 ft. high, introduced and now common in the mountain zone of Ceylon. A strongly scented and aromatic oil, obtained from the seed as well as from the leaves, is valued as a vermifuge, especially in hookworm treatment, being priced at about 36*s*-40*s* per lb. "Quinoa Seed" (*Chenopodium Quinoa*) is edible and used as a favourite dish in Chili, &c. See p. 308.

Cinnamon Oil. See page 336.

Clove Oil. (*Eugenia caryophyllata.* Myrtaceae). The strongly aromatic oil obtained from cloves is antiseptic and valued in medicine, etc., being worth about 8*s* per lb. See page 337.

Coriander Oil. Valued at 50*s*-70*s* per lb. See page 345.

Croton Eleutaria. "Eleutaria" or "Cascarilla Bark" (*Euphorbiaceae*). A shrub or small tree of the Bahamas, the aromatic bark of which is exported for the extraction of a volatile oil which is used in medicine, being bitter and stomachic. See p. 376.

Cumin Oil. Valued at about 48*s* per lb. See page 345.

Eagle-wood Oil. See *Aquilaria.*

Eucalytpus Oil. (*Eucalyptus globulus.* Myrtaceae). Blue-gum. A tall tree of Australia; leaves yield a strong pungent essential oil, valued in medicine as an antiseptic, febrifuge, &c. See page 180. Present price about 2*s* 6*d* to 3*s* 6*d*. per lb. The oil *E. citridora*, "Lemon-scented Gum," is worth from 5*s* to 8*s* per lb.

Geranium Oil. Obtained from the scented leaves of *Pelargonium odoratissima, P.—capitatum, P.—roseum,* &c., shrubby plants with strongly scented and palmately cut leaves, cultivated in Reunion, Morocco, &c. The best oil is furnished by plants grown on dry soil, and is worth from 30*s* to 40*s* per lb. See pp. 400, 457.

Ginger grass Oil. See *Cymbopogon Martini.*

Lemon-grass Oil. See *Cymbopogon citratus.*

Lemon Oil. (*Citrus Limonum*). See page 276. Oil obtained from the fruit rind by expression.

Lignaloe or **Linaloe Oil,** Mexican. Obtained from the wood of *Bursera delpechiana* and other species (see p. 412). "Guayana Linaloe Oil" is derived from the wood of *Ocotea caudata* (Lauraceae), a hard-wooded tree of S. America, the wood of which is exported from Cayenne, after being cut in logs and deprived of the bark.

Lime Oil. (*Citrus Limonum* var. *acida*). See p. 238. The oil, obtained from unripe fruits by expression, is worth about 6*s*. per lb. in London. The chief source is the West Indies, especially Dominica and Montserrat. See pp. 237, 238.

Neroli Oil. Distilled from the fresh blossoms of the Orange (*Citrus Aurantium*), and valued at from 6*s*. to 10*s*. per lb.; used in perfumery, &c.

Palmarosa Oil. See *Cymbopogon Martini*, p. 400.

Patchouli Oil. "Patcha" or "Patchapat" of India; "Cablan" of Malaya (*Pogostemon Cablin*. Labiatae). A herbaceous shrub, 3-4 ft. high, native of Philippines, cultivated in Malaya, parts of India, etc., for the sake of the oil obtained from the leaves and shoots, which is used in perfumes, scented soaps, &c. Propagation is by cuttings, and the plants are spaced about 3ft. by 3ft.; these are ready for cutting in about 6 months from planting, the young shoots being then cut and dried in the sun preparatory to the extraction of the oil by distillation. Three cuttings a year may be obtained, the first yielding about 10 piculs per acre. 1 picul of dried material yields about 2 lb. of oil. The plant seldom flowers. Replanting is necessary after 2 years. *P. Heyneanus* ("Kollankola" of Ceylon) also yields an essential oil similar to the above, and is sometimes cultivated in India and Java. The price of Patchouli oil varies from about 18*s*. to 30*s*. per lb., the best grade being usually obtained from the Straits. Patchouli leaves are worth 55*s*-60*s* per cwt. in London. See page 457.

Petitgrain Oil. (*Citrus Bigaradia*, or Bitter Orange). The oil is distilled from the leaves, twigs, and immature fruit, the best quality coming from Paraguay, and is valued at from about 8*s* to 10*s* per lb. See page 276.

Sandal-wood Oil. "*Handum*," *S.* (*Santalum album*. Santalaceae). A small tree, 25-30 ft. high, native of Mysore &c. The fragrant reddish heartwood yields about 5-7 per cent of valuable essential oil, used in medicine, ritualistic ceremonies, &c., and is worth about 20*s*.-26*s*. per lb. The tree is of a semi- parasitic habit and very slow growth, requiring from 20-40 years to develop the maximum amount of heartwood. The latter is worth from £80 to £112 per ton. Best suited to rather dry, poor, rocky soils, which produce the best oil. Introduced into Ceylon in 1869, now semi-naturalised around Badulla, about 2,000 ft., where the rainfall is limited chiefly to 3 or 4 months of the year, viz. in the north-east monsoon. See page 219.

Vetiver Oil. See *Vetiveria*, page 401.

Oil Grasses. This refers to a family of tropical grasses rich in aromatic, volatile oil, formerly known mostly under the generic name of *Andropogon*. These have been revised by Stapf*, late of the Royal Botanic Gardens, Kew, by whom most of the family have been included in the genus *Cymbopogon* and grouped under the tribe *Andropogoneae*. The botany of these grasses has long been confused, many of the species of some authors being regarded by others as only varieties or forms, whilst in the vegetative characters there is, in many cases, no very sharp line of distinction between them. The following species, based on the above revision, are the best known :—

Cymbopogon Nardus. Citronella Grass; "Pengiri-mana," *S.*—A large grass, 4-5 ft. high, cultivated in Ceylon and Java for the essential oil obtained from the leaves by distillation. The grass grows in ordinary soil and thrives best in a hot and moist climate. It flourishes up to about 2,000 ft. elevation in Ceylon, but its commercial cultivation is confined to the sea-coast in the south-west part of the island, where it is estimated some 30,000 acres are under the product. The grass is readily propagated by root division (fertile seed being rarely produced), and planted about 2 ft. by 3 ft. apart, in rows. Permanent shade is unnecessary and cultivation is simple, weeding and occasional manuring being the chief requirements. The grass is ready for cutting about 8

* Kew Bulletin, No. 8, 1906.

months from the time of planting, and is thereafter cut once every 4 months, subject to weather, each cutting averaging about 12 tons of grass per acre. 40-50 lbs. of oil per acre is considered an average annual yield. Re-planting should be done once in 4 or 5 years.

Citronella-oil has a strong aromatic odour, and is exported for use in perfumery, scented soaps, etc. Mixed with other ingredients, as coconut-oil, kerosine, etc., it is an excellent preventive against mosquito and leech bites. The value of the oil varies, according to quality and demand, from about 3*s*. to 6*s*. per lb., Java grades usually fetching the highest prices. Like many other oils, citronella-oil is frequently adulterated, generally with kerosine oil, and this fact depresses the price. The export of citronella oil from Ceylon in 1923 was nearly 1½ million pounds, valued at £142,019.

Varieties.—In Ceylon, two distinct varieties occur, viz. "Maha-pangiri" or "Winter's Grass," and "Heen"- or "Lenabatu-pangiri." The former is distinguished from the latter by a more robust habit, with long and broad leaves, and though rich in oil it is said to require more frequent replanting than "Lenabatu"; the latter, therefore, being considered hardier, is often preferred for planting. A robust variety with long, broad, drooping leaves, introduced from Java, is known at Peradeniya as "Java Maha-pangiri."

Cymbopogon citratus. Lemon- or Melissa-grass; "Sereh" of Malaya; "Saira," *S*; "Vasana-pillu," *T*. Resembles Citronella-grass in general appearance, but is distinct by the odour of the leaves and less robust habit of growth. It gives a smaller yield of oil, known as lemon-grass oil, which however commands a higher price than Citronella oil. The grass thrives under similar conditions to Citronella, propagation and cultivation being also the same as for the latter. It is only known under cultivation. Stapf concludes that the best lemon-grass oil of India is obtained from *C. flexuosus* (see below). Lemon-grass is grown to a small extent in Ceylon, but the chief supply of the oil is obtained from S. India. "Cochin" lemon-grass oil is valued in London at from 4*s*. to 8*s*. per lb., according to quality. It is used for flavouring, and in medicine, scented soaps, perfumery, etc.

C.—Martini. Palmarosa-, Rusa-, Geranium-, Ginger-grass-; Nimar-Oil, &c. —A rather slender grass of Central and Northern India, bearing panicles of a distinct reddish-brown tint. Yields an oil from the leaves similar to that of *C.—citratus*, known by the above names, and valued at about 6*s*. per lb.

C.—Schoenanthus. Camel Grass; "Khavi" of India. Native of Northern Africa, Northern India, &c., thriving in dry, arid localities, and distinct by the large swollen culms formed by the leaf-bases. Yields an aromatic oil mostly used for medicinal purposes.

C.—flexuosus. Malabar- or Cochin-Grass; "Kodi-pillu," *T*.—A tall grass, bearing large, loose, greyish panicles; yields an oil known as Malabar- or Cochin-grass oil. It is sometimes known as "Malabar Lemon-grass" and "Ginger-grass." STAPF considers this to be the source of the best Lemon-grass oil. See *C. citratus*.

C.—Jawarancusa, STAPF. Similar to *C. Schoenanthus*, but "distinct from it by the long, broad, flat leaves." It is said to prefer moist localities, as near rivers or streams, while the latter species is naturally found in dry, arid localities.

C.—coloratus. Similar to *C.—flexuosus*, but is less robust and has narrower leaves than the latter.

C.—polyneuros (=*Andropogon Schoenanthus*, var. *versicolor*, Trimen).—A moderately robust, spreading grass, indigenous to the Nilgiris and Ceylon up-country patanas. It is also common on the Island of Delft, Ceylon, and is known as the "Delft grass" or "Kapuru-pillu," *T*. (="Camphor-grass"). The odour of the leaves on being crushed resembles that of fennel and anise.

C.—confertiflorus. "Maana Grass"; "Toda" of the Nilgiris.—An erect, coarse grass with long, coarse blades, 5 ft. or more in height, common on the patanas of Ceylon and S. India. The leaves, on being crushed, emit a strong, overpowering odour. Cattle will not eat it, except in a young state after the patanas have been burned.

Andropogon odoratus. Leaves in dense bunches, yield an inferior kind of oil. The name "Ginger-grass" is also applied to this species.

Vetiveria zizanoides, STAPF. (formerly *Andropogon muricatus* or *A.—squarrosus*). "Khas-Khas" or "Khus-khus" of India; Vetiver-grass; "Saivandera," *S.*—A distinct, upright grass with narrow, odourless leaves and strongly scented roots. The latter have a pleasant odour like that of sandalwood, and yield by distillation an oil known as "Vetiver-oil." Tied up in small bundles or bags, they are often used for placing in wardrobes, &c., for the sake of their odour and for the purpose of keeping away insects. They are also woven into fancy mats, fans, &c. Under cultivation, it is estimated that one ton of roots per acre, in 2 crops, may be obtained in a year, yielding about 6 to 7 lb. of oil per acre per crop, or 14 lb. per ton of roots. Reunion Vetiver-oil is usually quoted at about 30*s.* to 40*s.* or more per lb. in London. The oil is used in compound perfumes, &c.

CHAPTER XXVII.

RUBBER, GUTTA, GUMS, & EXUDATIONS

1.—*HEVEA & OTHER CULTIVATED RUBBERS.*

2.—*MISCELLANEOUS RUBBER-YIELDING PLANTS.*

3.—*GUTTA & BALATA.*

4.—*GUMS, WAXES, RESINS, ETC.*

5.—*INCENSE WOODS.*

6.—*CAMPHOR.*

7.—*LAC OR SHELLAC.*

1.—RUBBER.

Rubber is obtained from certain trees, climbers, or shrubs, being extracted in the form of white milk (*latex*) by means of incisions (*tapping*) made in the bark (*cortex*). Until recent years rubber was a forest product obtained chiefly from the forests of Brazil and tropical Africa. About 1895, it began to be taken up as a plantation crop in the Eastern tropics, and now most of the world's supply comes from cultivated plantations of *Hevea brasiliensis* or "Para Rubber," only a comparatively small proportion coming from uncultivated trees in Brazil, where economic conditions do not admit of its profitable cultivation.

The "Para" or "Wild Rubber" of Brazil, of which some 20,000 tons are exported annually, comes on the market in large round or ovoid lumps or rolls, each weighing from 80-100 lbs. or more. Each lump has a hole through the centre, caused by the pole on which the mass is formed, the latter being revolved by hand over smoke whilst the latex is being ladled over it by another person. (See under *coagulation*, p. 405). When dry, the pole is withdrawn, leaving a hole in the centre. "African Wild Rubber," which is still exported to some extent, is collected from large climbers or lianes, chiefly species of *Landolphia*, and is usually in the form of round black balls, sometimes called "Negro heads".

Hevea is a quick-growing, tall, erect tree, of the N.O. *Euphorbiaceae*, native of Brazil, introduced into tropical Asia in 1876, through the Royal Botanic Gardens of Kew, and now extensively cultivated. Plants were first established at, and later propagated and distributed by, the Botanic Gardens of Ceylon and Singapore. About the year 1898, the cultivation received a great impetus owing to a large demand for rubber, caused chiefly by the sudden development of the motor industry, and it has since made rapid strides in Ceylon, Malaya, Sumatra, Java, Burma and other tropical countries. In 1900 the export of rubber from Ceylon was 8,223 lbs., of the value of £859; in 1922 it was over

46,690 tons,* and in 1923 the restricted export was 37,417 tons, valued at £4,906,290. The area under rubber at present in Ceylon is estimated at 404,375 acres, and that in British Malaya at about 1,226,236 acres, the total for the British Empire being given as 1,841,228 acres.



MODERN RUBBER-TAPPING IN CEYLON.

The *Hevea* tree thrives in any moderately good, deep soil, provided the rainfall is not under 70 inches a year and is fairly evenly distributed, with a minimum temperature of about 65° to 75° Fah. In Ceylon, it flourishes from sea-level to about 2,500 feet elevation. Propagation is by seed, "and sowing at stake" is best if efficient protection from animals is provided; otherwise planting with "stumps" or basket-plants is advisable. Good deep holes, about $2\frac{1}{2} \times 2\frac{1}{2}$ ft., should be prepared. Spacing in the first place may be about 20×20 ft., or at the rate of about 100 trees to the acre, allowing for thinning out later, on the merit of individual trees, to an average of about 75-80 trees to the acre. Too close planting results in the exclusion of light and air when the trees attain maturity, and consequently in unhealthy trees and unsatisfactory renewal of bark over the tapping area.

Tapping.—With good growth the tree becomes tappable at from 5 to 6 years of age, or when the stem has attained a girth of about 24 inches at 2 ft. from the ground. Specially constructed "knives," or instruments on the principle of a chisel, are employed for tapping. It is essential to prevent the tapping knife from penetrating the cambium (see page 11), otherwise a knotted condition of the stem will result, which will not only render future tapping difficult, but also injure the cambium and affect the life of the tree. Formerly large V-shaped cuts were made, and from these were evolved the "herring-bone," "$\frac{1}{2}$ herring-bone," "spiral," and "$\frac{1}{2}$ spiral" systems.

At the present time a single slanting cut from left to right (see illustration), beginning at about 2 or $2\frac{1}{2}$ ft. from the ground, is in general vogue. The area of

*Exports restricted by Government licence in Ceylon and British Malaya since Nov. 1922, owing to slump in price.

the stem being divided perpendicularly into two equal halves, the cut is made at an angle of about 22½ degrees, *i.e.* ¼ of a right angle. A thin shaving (not less than 32 to the inch) is taken off the lower side of the cut every alternate day for 10 or 11 months in the year, allowing a month or more for resting during the dry period (usually February and March in Ceylon), when the tree discards the old leaves and, after a brief interval, puts on fresh foliage. Six inches of bark is thus consumed in a year, so that in about 8 years the whole of the old bark up to the tapping height is exhausted, and the process is repeated on the new bark. On



1 2 3 4

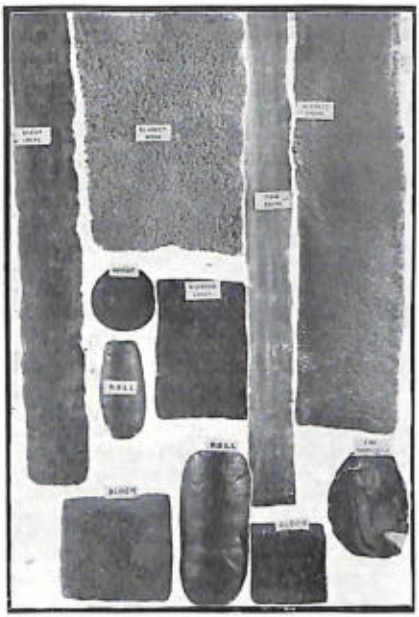
RUBBER TAPPING EVOLUTION.

1, V-cuts on lower portion, herring-bone on upper portion, with scaffolding.
2, Spiral tapping; 3, Herring-bone on lower portion only.
4, Present-day system of 1-cut on half, beginning about 2 feet from ground.

some estates a change over to the opposite side of the tree is made once in six months. A cooly will tap, under favourable conditions, about 200 to 250 or more trees a day, beginning with daylight and finishing about 10 a.m., when the latex is collected from the cups or coconut shells into enamelled buckets, &c., and brought to the factory. Below each cut is held in position, by means of a simple metal holder, a "collecting cup," usually consisting of the half of a coconut shell, but sometimes of enamelled tin. When emptied of the latex, these are inverted and replaced on the same holder until again required. The latex on being brought to the factory is strained through a fine brass mesh, after which it is ready for

Coagulation.—Latex coagulates on standing, and that of some species more rapidly than others (see *Castilloa*, p. 406).. In the case of Plantation Hevea, coagulation is accelerated by the addition of acetic acid. The latex is first standardised, by the addition of water, to a density of 1½ lbs. of rubber per gallon, this being ascertained by means of an instrument known as a "hydrometer" or "metrolac". To every 50 gallons of latex thus standardised, 4¾ oz. of acetic acid is usually added for complete coagulation. During coagulation, the rubber particles coalesce to form a white spongy mass. Heating the latex also hastens coagulation. The soft wet rubber is then separated from the remaining liquid (which is discarded), washed and pressed out under running water with machine rollers, and made up into the usual commercial forms, as lace, ordinary crepe (Nos. 1 and 2), blanket-crepe,

smoked sheet, or block. Formerly it was commonly made into biscuits,* but this form entails too much labour when large quantities are dealt with. The rubber is then dried in hot air dryers, or, if in sheet form, in a smoke-house supplied with smoke from a fire placed outside. Smoke is considered to have a preserving effect on the rubber. In the case of wild or "Hard Para" rubber, smoking and coagulation are done in one process, the latex being ladled over a round stick, whilst the latter is revolved by hand by another man over the smoke of palm kernels, the roll increasing in size, in layers, as fresh latex is poured on. (See p. 402). Ordinarily about two weeks are required for the rubber to become quite dry and ready for packing for export, but with hot-air dryers and light, airy drying sheds the process may be completed in 2 or 3 days or less.



COMMERCIAL FORMS OF RUBBER.

Top row, from left: Scrap crepe, worm-crepe, lace, blanket-crepe.
Centre: Biscuit, diamond sheet, roll.
Bottom row: Block, roll, block, hard-para.

Yield, &c.—The average annual yield of dried rubber may be approximately ½lb. per tree at 6 years of age, increasing to 2 or 3 lbs. per tree at 9 years of age, and to an average of 4-5 lbs. **per tree when 12-14 years old. A return of 150 lbs. dried rubber per acre per annum from trees 6 years old, and about 500 lbs. at 10 years old is considered a good average yield, though in many cases much larger crops can be obtained if desired. The trees increase in circumference of stem at an average rate of 3½-4 inches per annum until 12 years old, and at slower rates thereafter. They bear seed when about 6 years old, each tree producing from 1,000-2,000 at that age, increasing to about 4-6,000 when 18 years old. The seeds are large and oily. The oil has been reported as suitable for varnishes, being valued at £25 per ton, against £35 for linseed oil, but so far the seeds have not been employed commercially to any extent. About 110 average seeds weigh a pound; they are of short vitality and germinate in about 10-12 days when fresh. For transmission by post, 500 seeds with packing weigh about 9 lbs.

A demand has of late arisen for Hevea latex for use in the manufacture of paper, &c., and considerable quantities are now being exported to Europe. The latex in this condition has to be treated with a preservative or anti-coagulant, the agent generally used being ammonia in the proportion of 3-4 gallons of the latter to 100 gallons of undiluted latex. 11,486 gallons of latex were exported from Ceylon in 1922, valued at Rs. 42,855.

The usual cost of bringing Hevea rubber into bearing, exclusive of cost of land, varies from about £25-£35 per acre, according to the nature of the land and locality. Young rubber trees are sometimes manured in order to bring them into bearing early and to form good healthy trees. Weeding and draining have to be carefully attended to; one cooly per 10 acres is considered sufficient for maintenance when the trees have covered the ground. The all-in cost of producing rubber has now been reduced on many estates to about 6d. per lb., as against 1*s.* or 1*s.* 3*d.* in 1914. Rubber has suffered a severe drop in price since 1920. In April 1910, Plantation rubber reached 12*s.* 10*d.* per lb., with "Hard Para" at 12*s.* 6*d.*

*First invented by John Parkin, M.A. (Cantab.), 1898-99.

**No. 2 tree at Henaratgoda Botanic Gardens, Ceylon, planted in 1876, yielded 392 lbs. of dry rubber in 4 years and 9 months, in 1908-13.

Ceara Rubber. (*Manihot Glaziovii.* Euphorbiaceae).—A small or medium-sized spreading, quick-growing tree, 30-40 ft. high, native of South America, introduced into Ceylon in 1877. In 1883, as many as 977 acres were reported to be under this product in Ceylon, but the cultivation afterwards fell into neglect for a number of years. During the years 1905-1912, with good prices ruling for rubber, "Ceara" became a paying proposition, the rubber being considered second in quality only to that of Hevea. The tree is suited to a dryer climate and higher elevation than the latter, and is usually ready for tapping at the age of from 4-5 years, yielding from 4-6 oz. of rubber per tree. In tapping, the surface papery bark has first to be stripped off in perpendicular sections, and incisions are then made in the green bark. Unlike *Hevea*, fresh incisions are made at each tapping, generally on the herring-bone system. *Manihot* latex is remarkable for its readiness to coagulate without the addition of acid.

The tree may be planted at closer distances than *Hevea*, and also tapped usually at an earlier age than the latter. It is propagated by seed or cuttings. The former are of a hard, horny character, retaining their vitality for a long period; they should be rasped at one or both ends before sowing (see page 36), or buried for some time in a fermenting manure heap. About 720 seeds go to a pound. Those about a year old are sometimes preferred for propagation, fresh seed being considered by some to be slow and uncertain in germination. The seeds are edible when roasted, having a pleasant nutty flavour.

Jequie Manicoba Rubber. (*Manihot dichotoma*).—A quick-growing tree, similar to, but rather smaller than, the Ceara-rubber tree, being distinct from the latter by the regular forking of the branches. It is a native of S. America and was introduced into Ceylon in 1907. The seeds are larger than, but not so hard as, those of Ceara-rubber; at Peradeniya they germinated in 2-3 weeks without filing or other artificial aid. The tree is adapted to a dry, hot climate; thrives on a loamy soil, but is susceptible to strong winds. It is tappable at 3-4 years from planting, attaining its maximum yield at the age of 8 or 10 years. In Brazil the trees were formerly planted about 6 feet apart each way, say 1,000 to the acre, and an annual yield of about 1 lb. per tree, from two tappings a month, was recorded.

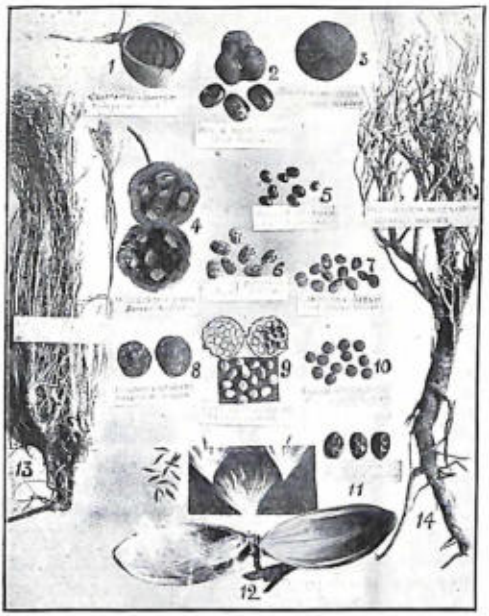
Remano Manicoba Rubber (*Manihot piauhyensis*).—Another South American tree, resembling the two preceding species, described as reaching a height of only 8-15 ft., the branches forking twice or three times. It was introduced into Ceylon in 1908. The tree is found in the state of Piauhy, and grows best in a light sandy soil. The seeds are large, not very hard and horny, and germinate readily.

Manihot heptaphylla.—Another species of "Manicoba Rubber," growing to about 20-25 ft. in height, with dark-brown bark and purplish green twigs. The seeds are larger and paler than those of *Manihot Glaziovii*.

Panama- or **Ule Rubber.** (*Castilloa elastica.* Urticaceae).—A tall, quick-growing tree, with large, oval, coarse leaves, native of Central America, introduced into Ceylon in 1876. It is propagated by the white, papery seeds, which are of the size of peas and of short vitality; thrives best at medium elevations, with a rainfall of not less than 70 inches. The tree may be planted at the same distances apart as Hevea, and is tappable at the age of 6-7 years. Though at one time recommended for cultivation, more especially in parts of the West Indies, it has not been found a profitable crop, owing chiefly to difficulties of tapping and in collecting the latex. The method of tapping generally adopted was to make several slanting cuts at a time on one side of the tree, leaving the latex for 3 or 4 days to run and coagulate on the tree, the rubber being then collected and formed into "scrap balls." This was repeated 3 or 4 times a year, fresh cuts being made each time. The trees thus averaged about 2 lbs. of rubber each in a year. *Castilloa* has now gone out of cultivation in the East.

Lagos Rubber; "Ofruntum Tree." (*Funtumia elastica*, formerly *Kickxia africana*. Apocynaceae).—A large, upright tree, native of West Tropical Africa, Uganda, etc., introduced into Ceylon in 1899. Cultivation is much the same as for

Hevea, but unlike the latter the tree does not take well to tapping, requiring, it is said, an interval of 3 or 4 weeks between each cutting; the latex, as in the case of *Castilloa*, does not readily coagulate. An annual yield of 1 lb. or more per tree has been obtained from uncultivated trees in Uganda, and the quality of the rubber is reported to be but little inferior to that of Hevea. The tree, however, takes longer than the latter to attain a tappable size. In Ceylon, a caterpillar pest (see p. 488.) attacks and completely defoliates the branches regularly each year. The seeds are small, brown and grain-like, with a long silky appendage at the apex; they retain vitality well, and germinate readily in about 14 days. The tree has been planted to some extent in parts of Africa, but has probably now given place to *Hevea*. It is not cultivated in the East.



DIFFERENT SPECIES OF RUBBER PLANTS AND SEEDS.

1, Cryptostegia grandiflora (fruit); 2, Hevea brasiliensis (fruit and seed); 3, Raphionacme utilis (tuber); 4, Willughbeia firma (fruit); 5, Manihot Glaziovii (seeds); 7, Landolphia Kirkii (seeds); 8, Hancornia speciosa (fruit); 9, Castilloa elastica (fruit and seeds); 10, Sapium biglandulosum (seeds); 11, Manihot sp. (seeds edible); 12, Funtumia elastica (fruit and seed).

Rambong-, Assam-, or India-Rubber. (*Ficus elastica*. Urticaceae).—A very large spreading tree, with large aerial roots developed downwards from the branches, or with enormous buttressed roots which spread over the surface of the ground. The buttressed roots as well as the stems may be tapped for rubber, but the tree may take at least 12 to 15 years to attain a tappable size; when at maturity, however, it yields large quantities of fairly good rubber. The tree does not produce fertile seed in Ceylon, and has to be propagated by cuttings, which do not strike root readily, or by layering. Not now cultivated for rubber. See p. 100.

Guayule-, or Mexican Rubber. (*Parthenium argentatum*. Compositae).—A low-growing shrub, 2-4 ft. high, indigenous to the dry arid regions of Mexico. During the rubber boom, this came into prominence as a source of a low-grade rubber, for the extraction of which large quantities of the dried shrub were exported. The plant cannot be profitably cultivated, as it is reported to take upwards of 20 years to come to maturity. In the process of rubber extraction, the whole shrub is pulled up and crushed between rollers. The plant contains no latex, but granules of rubber are scattered through the tissues.

Ecanda- or Bitinga-Rubber. (*Raphionacme utilis*. Asclepiadeae).—A low, stemless plant, bearing a large tuberous root, not unlike a turnip in form, native of treeless grass tracts or plateaus in Zambesi, British Central Africa, etc. It is found chiefly at elevations of 4,000 to 5,000 feet above sea level, and is considered one of the most important of root-rubbers, the tuberous rhizomes containing a large percentage of rubber, which is extracted by rasping and boiling these. Propagated by tubers. The seed is difficult to germinate.

Jelutong.—A glutinous rubber-like substance obtained from the latex of species of *Dyera* (chiefly *D. costulata*) and *Alstonia*,—tall, erect trees of Borneo, Sumatra, and Malaya. The trees are tapped generally once a week, in a similar manner to *Hevea*,

and the latex is coagulated by adding a little kerosine oil or other ingredients. The latex contains about 10% of rubber and a considerable proportion of resin and other solids. Mature trees are said to yield an average of 50-60 lb. a year. Valued at present at from £40 to £60 per ton, being in demand for insulating purposes.

2.—MISCELLANEOUS RUBBER-YIELDING PLANTS (UNCULTIVATED).

[MOST OF THESE YIELD ONLY A SMALL PROPORTION OF RUBBER, OF AN INFERIOR QUALITY, AND WERE EXPLOITED ONLY WHEN RUBBER FETCHED HIGH PRICES].

Actinella Richardsonii. (*Compositae*). Colorado Rubber. Dwarf shrub of Mexico.
Bleekrodea tonkinensis. (*Urticaceae*). Tonkin Rubber. Sub-tropical tree of Cochin China.
Carpodinus lanceolatus. (*Apocynaceae*). Root-rubber. African climber, with large tuberous roots.
Clitandra henriquesiana. (*Apocynaceae*). Root-rubber. Climbing shrub of Central Africa.
Cryptostegia madagascariensis. (*Apocynaceae.*) "Lombiri" or Madagascar Rubber. Large climber.
Ecdysanthera glandulifera. (*Apocynaceae*). A large climber of Cambodia.
Eucomia ulmoides. Chinese Rubber. A bushy tree of China, suited to a temperate or sub-tropical climate.
Euphorbia rhipsaloides. (*Euphorbiaceaea.*). "Almeidina" or "Potato-gum," A small succulent tree of Portuguese East Africa, yielding a kind of rubber known as "Almeidina" or "Potato-gum," which fetched 6*d*-9*d* per lb. in London, in 1913.
Ficus Vogelii. (*Urticaceae*). West African-, Congo-, Abba-, or Memleku-Rubber. A medium-sized tree, introduced at Peradeniya in 1881.
Forsteronia floribunda. (*Apocynaceae*). "Milk-vine" of Jamaica.
F.—gracilis. A large climber of British Guiana.
Hancornia speciosa. (*Apocynaceae*). Mangabeira- or Pernambuco-Rubber. Small shrubby tree; fruit edible, seed of short vitality.
Landolphia Heudeloti. (*Apocynaceae*). "Gohines," or African Vine-Rubber.
L.—Kirkii. Zanzibar Rubber; L.—owariensis. Congo- or Sierra-Leone Rubber.
L.—petersiana. East African Rubber.—Large African liane.
L.—ugandensis. Nandi Rubber. A large vine found in Uganda at elevations of 4,000-5,000 ft. Tapping is effected by shaving off slices of bark, the latex being coagulated by smearing salt water on the surface. The rubber is said to be of good quality.
Leuconotis elastica. (*Apocynaceae*). A large vine of Borneo.
Mascarenhasia elastica. (*Apocynaceae*). "Hazondrano," or Madagascar Rubber. A tree 40-50 ft. high, with several upright furrowed stems and slender branches; leaves opposite, coriaceous. Said to be adapted to swampy ground. Native of Madagascar and East Africa, introduced at Peradeniya in 1902.
Parameria glandulifera. (*Apocynaceae*). Talaing milk-creeper. A Malayan liane.
Plumeria acutifolia and P. rubra. (*Apocynaceae*). Respectively white-and red-flowered "Temple-trees," both indigenous to tropical America. They yield a quantity of white latex, which contains a little resinous rubber. See page 91.
Sapium Jenmani. (*Euphorbiaceae*). Large trees, yielding the "Carthagena rubber" of Colombia, and "Tonckpong Rubber" of British Guiana; also known as "Esmeralda", or "Scrap Rubber."
S.—Thomsoni. "Virgen Rubber"; also a native of Colombia.
Tabernaemontana crassa. (*Apocynaceae*). A small tree with large handsome leaves, native of Senegal, introduced at Peradeniya in 1881.
Urceola elastica. (*Apocynaceae*). A large climber of Burma.
Willughbeia firma. (*Apocynaceae*). Borneo Rubber. A large liane of Borneo, etc.

3.—GUTTA AND BALATA.

Gutta, or Gutta-percha.—A substance similar to rubber, obtained from a group of tall but slow-growing trees, of the family *Sapotaceae*, which are indigenous chiefly to the Malay Archipelago. Formerly the trees were felled in order to obtain the gutta, in the form of gum, from incisions made in the bark, but now they are usually "tapped" in

the form of numerous slanting cuts. An average collector will bring in about 2 lbs. of crude gutta a day.* Unlike Hevea, the trees cease to yield if tapped at frequent intervals.

Gutta may also be extracted from the leaves when ground and treated with hot water. The article is always in good demand, and is exported from Malaya and Java, where extensive plantations have recently been made, especially in the latter country. Like rubber, gutta softens in heat. It is cleaned in hot water, and pressed into moulds to form blocks of a definite size for export. Gutta is largely used for insulating cable wires, making goloshes, soles for boots, shoes, &c.

The following are the principal gutta-yielding trees of Malaya :—

Palaquium (*Dichopsis*) *Gutta*, known as "Taban Gutta" or "Taban Merah"; *P. Maingayi* (Gutta-Tabban Simpoo); *P. pustulata* or *P. oblongifolium* (Gutta-Taban Puteh); *P. obovata* and *P. Treubii*. *P. grandis* (" Kiri-hembiliya," *S.*) is indigenous to the moist low-country forests of Ceylon, but does not yield gutta. *Payena Leerii*, of the same order, introduced into Ceylon in 1880, and established at Peradeniya and Henaratgoda Gardens, yields in Malaya the " Gutta Sundek," while "Gutta Singgarip" is obtained from the climber *Willughbeia firma*, of the family *Apocynaceae*. The two first named usually command the highest prices. The best qualities fetch at present about 3*s*. to 4*s*. per lb. *The export of Gutta from Singapore in 1920 amounted in value to over 8 million Malay dollars.

Balata, a product analogous to gutta-percha, is obtained chiefly from *Mimusops globosa*, known as " Bully " or " Bullet-tree," also belonging to the N.O. *Sapotaceae*, and found chiefly in Venezuela and the Guianas. The tree is felled in the early morning and large cuts are made in the bark; in the afternoon the gummy latex is brought in and afterwards coagulated by boiling, the substance being then pressed into slabs or blocks, and afterwards sun-dried. An average tree yields in a year 3 gallons of latex, producing about 18 lb. balata, worth from 1*s*. to 1*s*. 6*d*. or more per lb. About 1½ million pounds are annually exported from British Guiana alone. Balata has considerable powers of wear and resistance, and is used for belting, water-proofing, etc.

4.—VEGETABLE WAX, GUMS, RESINS, ETC.

Candelilla Wax.—The product of *Euphorbia antisiphyllitica* (Euphorbiaceæ), a shrubby plant, native of the drier parts of Mexico.

Wax occurs as a thin coating over all parts of the stems and branches, and is separated by a process of boiling, which yields about 3-4 per cent. of almost pure wax. This is used in the manufacture of polishes, floor-waxes, varnishes, carbon papers, gramophone records, electrical insulation, etc., and worth about 2*s*. per pound in London. The Candelilla plant (signifying "little candle" from the smooth, cylindrical, leafless stems and branches) is easily propagated by cuttings. The name is also applied to *Pedilanthus Pavonis*, another Euphorbiaceous shrub of North Mexico, 6-8 ft. high.

Carnauba Wax.—A product of the Brazilian Wax-palm (*Copernicia cerifera*), a handsome palm, 30-40 ft. high, found in abundance in certain parts of the forests of Brazil, first introduced at Peradeniya in 1889. On the underside of the leaves there is a thin layer of wax, which is collected by gathering the leaves and exposing them in a dry place to wither, with cloth spread underneath; as the leaves dry, the wax cracks and peels off in flakes, being afterwards collected, melted, and poured into moulds; or the wax may be removed from the leaves by scraping with a blunt-edged knife, or by cutting the leaves into pieces and boiling them in water, when the liquid wax rises to the

**Malayan Forest Records*, by F. W. Foxworthy.

surface, and is skimmed off. The leaves are collected three times a year in the dry season, and about 10 to 12 leaves are obtained yearly from each palm. On an average, 2 lb. of wax may be obtained from 100 leaves.

The collection of the wax is an important industry in Brazil, where the annual export of the article amounts to some 2,000 tons, valued at over £200,000. The wax is used for the manufacture of fine-quality candles, polishes, gramophone records, &c., being valued now in London at about 90*s.* to 100*s.* per cwt. The value of the wax is dependent upon tint, texture, and richnes in oil. It is melted down, and afterwards graded into three qualities; the best quality is of uniform pale-cream tint and rich in oil, the inferior grades being darker and less rich in oil. It is used locally for lighting. The small black seeds are edible.

Wax-palm of Colombia. (*Ceroxylon andicola*).—This differs from the Carnauba wax-palm, in that the wax is deposited on the trunk and not on the leaves, while the palm itself is suited to a higher elevation and cooler climate than the Brazilian species.

A specimen flourished in a sheltered spot in Hakgala Gardens, Ceylon (elevation 5,500 ft.), where it was introduced about 1890, for about 25 years, reaching a height of over 30 ft., when the monsoon winds proved to be too much for it. The palm normally grows to a height of about 30-40 ft., and the trunk is usually distended half-way up. The wax, which is deposited between the leaf-scars on the trunk, often so thick than it can be removed in flakes, is used in the manufacture of candles, &c., and forms an article of trade in Colombia. The annual yield of wax per tree is said to be sometimes as much as 20 lbs. or more.

Ivory-nut Palm or **"Corozo-nut"**; Tagua Palm (*Phytelephas macrocarpa*). A slow-growing palm, with handsome pinnate, erect leaves, 15-20 ft. long, native of Colombia. Introduced in 1850, it has flowered and fruited in Peradeniya Gardens at irregular intervals during the last 30 years. For many years stemless, the palm forms in course of time a short prostrate stem. Being dioecious (male and female flowers borne on different plants), it is necessary to have a plant of each sex in order to obtain fertile seed. See "Double Coconut," p. 168.

The large white seeds, contained in large, round clusters of spiky fruits produced at the base of the palm, become very hard as they ripen and furnish what is known as "vegetable ivory." They are used for making superior buttons, articles of ornaments, etc., and command at present about 40*s.* per cwt. The chief source of supply is Ecuador, whence some 20,000 tons are said to be exported annually.

Other palm seeds are used to some extent as "vegetable-ivory," such as the West African "Wine Palm" (*Raphia vinifera*); the "Coquilla-nuts" (*Attalea funifera*) of Brazil; *Metroxylon vitiense* of Fiji, and others. The seeds of the Talipot Palm (*Corypha umbraculifera*) are commonly worked into buttons and articles of ornament in Ceylon.

Chickle Gum is obtained from the latex of *Achras Sapota* (Sapotaceae), or a variety of this tree, being known as the Sapota-tree or Zapote Chico (see "Sapodilla," page 230). The tree is a native of tropical S. America, attains 25 to 30 ft. or more in height, and is employed largely in Mexico, and to some extent in Honduras, for the extraction of the gum. V-shaped slanting incisions are made in the bark, these being arranged so that the latex flows in a stream to the base, where it is collected in leaves or other simple receptacles. The gummy latex, after being strained, is coagulated by boiling, after which the gum is kneaded and pressed.

Chickle-gum forms the basis of chewing-gum, so largely used in America, being scented and flavoured with mint, vanilla and other ingredients. Good yielding trees are said to produce from 15 to 25 lbs. of gum annually, in some cases much more. The production of the gum is an important industry in parts of the countries named, over 2,000 tons being exported annually from Mexico, chiefly to the United States. Considerable quantities are also exported from British Honduras.

Gamboge of commerce, produced chiefly by *Garcinia Hanburyi*, a tree of the Mangosteen family, is obtained mainly from Siam. The trees, which are of slow growth, and must be not less than about 12 years old, are tapped during the rainy season, a spiral groove being cut round the trunk. The yellowish viscous fluid trickles along the cut, and is collected into small hollow bamboos placed below. It is then strained into smaller bamboos, and left for a month to solidify. The bamboo is afterwards separated from the Gamboge by heating over a fire, when it cracks and is easily removed. "Roll" or "pipe" gamboge, which is the usual commercial form, is thus obtained.

Indian Gamboge, which is generally in the form of "tears" or "grains," is obtained from *Garcinia Morella*, a small tree found in Eastern Bengal, Western India and Malaya. The tree is also common in the low-country of Ceylon, where, however, gamboge is but little collected. The method of collecting gamboge in Ceylon is usually by cutting gashes in the bark. Trimen reported in 1883 that a consignment of Ceylon gamboge, in the natural "tears," fetched £14.5.0 per cwt. in London. Gamboge is used in artists' paints, also in dyes and medicine. The usual quotation in London for Siam gamboge ranges between £8 and £10 per cwt., according to quality.

Benzoin ; "Benjamin" or "Gum Benjamin" (*Styrax Benzoin*. Styraceae). A moderate-sized tree, native of Malaya, chiefly Sumatra and Java, yielding a fragrant gum-resin which is soluble in water and known by the above names. It is a forest product, and obtained by incisions made in the bark, which is usually done in a very crude manner by means of a hatchet. A few days after making the incisions a yellowish latex begins to exude, and this is allowed to continue for a period of 3 months. It is then sufficiently hardened and picked off, with fragments of bark adhering, being then cleaned and graded.

The yield from subsequent tappings improves in quantity and quality. July-September is the usual period of collection, though it can be carried on practically all the year round. The yield is variously estimated, though the average is probably about 3 lb. per tree per annum. Several grades or forms of the article are recognised, as "Sumatra," "Siam," "Palembang," &c. "Siam" is qoted at from 30*s*.-40*s*. per cwt. according to quality, whilst 39 dollars per picul (133⅓ lbs.) is said to be about the average price in Malaya. Benzoin occurs in commerce in two forms, "Block" and "Tears." Its chief use is for burning as incense in churches, but it is also used in medicine and perfumery. The tree thrives at Peradeniya, where it was introduced in 1881, producing seeds usually in Sept.-October.

OTHER SOURCES OF GUMS, RESINS, VEGETABLE-WAX, ETC.

Acacia senegalensis. "Gum-arabic;" "hashab" of Soudan. A small tree of Soudan, Senegal, &c., and the principal source of commercial gum-arabic, which exudes naturally from stem and branches ; the exudation is assisted by making incisions in the bark.

A.—arabica. "Babul." Also a small tree, yields the Indian Gum-arabic, mature trees producing up to about 2 lb. of gum each a year.

A.—decurrens and other species (evergreen trees of Australia) yield "Wattle-gum," valued at about 35*s*. or more per cwt., according to quality.

Agathis alba. A large coniferous tree of Malaya, yielding the gum known as as "Dammar" or "Dammar-minyak," which is obtained naturally or by means of incisions made in the bark. Singapore Damar is valued in England at from £3-£6 per cwt., according to quality and demand.

A.—australis. New Zealand "Kauri." Large, handsome tree ; yields "Kauri-copal," a valuable gum-resin, some 15,000 tons of which are collected annually in the tree's native home for the extraction of oil and turpentine, which it yields in large proportions.

Anogeissus latifolia. "Dhaura." (*Combretaceae*). Medium-sized tree, supposed to be the source of the "Ghati-gum," of India.

Aquilaria Agallocha. "Aloes-wood"; "Eagle-wood." (*Thymelaeaceae*). Large tree of Assam, Burma, &c.; yields aromatic resin. See *Incense Woods*, p. 413.

A.—malaccensis. "Eagle-wood." Yields the "Kayu-garu" resin of Malaya.

Bursera. (*Burseraceae*). A genus of small, shrubby, slow-growing, aromatic trees, with bipinnate leaves, natives of Mexico and Trop. S. America. Several species yield by exudation from the stem a fragrant balsam-resin, used in incense, perfumery, medicine, etc. The principal balsam-yielding species are *B. cuneata*, *B. delpechiana*, *B. pinnata* and *B. gummifera*. The last named, also known as "Turpentine-tree," yields a balsam-resin known as "American Elemi," "Cachibou," or "Gomart."

B.—tomentosa, of Venezuela, yields "Tacamasha Resin," used in medicine, incense, etc. See *Lignaloe oil*, p. 399.

Canarium strictum. (*Burseraceae.*) "Black Dammar"; "Gual" of India. Large, handsome tree of India, &c.; foliage almost crimson when young. Valuable resin, used in incense, &c., obtained by incising and firing base of tree. **C. bengalense,** a similar tree, introduced at Peradeniya in 1881; yields copious quantities of fragrant resin.

C.—zeylanicum. "Mala-Kekuna," *S.* Large tree of low-country, Ceylon. Fragrant gum resin exudes copiously from base of trunk.

Copaifera Lansdorfii and **C. officinalis.** (*Leguminosae*). "Balsam of Copaiba." Large trees of Brazil; yields a balsam or gum-resin from stem.

Doona zeylanica. "Dun," *S.* Tall, handsome tree of moist low-country of Ceylon. Fragrant gum-resin exudes from base of trunk of this and other species.

Dryobalanops aromatica. (*Dipterocarpeae*). Borneo- or Sumatra-Camphor. A large tree; yields a camphor-like resin, used in Chinese medicine and for embalming; usually valued in Malaya at 6-7 dollars per picul (1 Malay dollar=2*s.* 4*d.*)

Guaiacum officinale. "Lignum Vitae." (*Zygophylleae*). Small, very slow-growing tree of Trop. America. A green resin exudes naturally from stem, or is obtained by making incisions in the latter, or by cutting the tree into sections and driving the resin out by fire-heat.

Hymenaea verrucosa. (*Leguminosae*). "Copal Resin" of Madagascar. Tree about 40 feet high. Resin obtained from bark incisions, or dug from ground (natural exudations) at base of tree; used in varnishes, &c.

H. Courbaril. "Locust Tree" of W. Indies and S. America. Medium-sized or large tree; yields "Gum-animi."

Japanese Wax. See *Rhus succedana*, below.

Liquidambar orientalis. (*Hamamelideae*). "Liquid Storax." Asia Minor. Tree, 40-50 feet high; yields fragrant balsam-resin by boiling wood, &c., in water.

Melanorrhoea usitatissima. (*Anacardiaceae*). "Varnish Tree." Burma. Large tree with broad, oval leaves; resinous juice obtained from stem

Myroxylon Pereirae. (*Leguminosae*). "Balsam-of-Peru." Large spreading tree of Trop. America; copious gum-resin obtained from base of tree.

Odina Woodier. (*Anacardiaceae*). "Hik." *S.* Small tree of Ceylon, India, Java, etc. Gum obtained from stem.

Pistacia Terebinthus. (*Anacardiaceae*). "Chian-turpentine Tree." Small tree of Asia Minor, Mediterranean, &c. An oleo-resin is obtained by incisions made in bark.

P.—Lentiscus. "Mastic." Small tree of N. Africa, Western Asia, &c. Resin, obtained by incisions made in bark, used in chewing gums, also in dentistry, &c.

Pterocarpus marsupium. (*Leguminosae*) "Gammalu," *S*; "Kino." Ceylon & S. India. A tree about 50 feet high; gum-resin exudes naturally from bark.

Raphia Ruffia. "Raffia Palm." A considerable quantity of valuable wax is obtained by beating the dried leaves on mats. See also under *Fibres*, p. 431.

Rhus succedana. (*Anacardiaceae*). Japan "Wax-tree." Small tree of China, Japan, etc.; furnishes "Japan vegetable-wax" of commerce, from waxy deposist on berries, obtained by boiling; valued at 85*s*-100*s* per cwt.

R.—vernicifera. Japan "Lacquer-tree." Small tree of China, Japan, etc. Resinous juice obtained from wounds made in stem, becomes hard and black on exposure.

Shorea oblongifolia. (*Dipterocarpeae*). "Dumala," *S.* Large tree of Ceylon only, common in moist low-country; yields a clear resin, suitable for varnishes, &c.

Trachylobium verrucosum. (*Leguminosae*). Large, spreading tree with smooth bark, native of E. Africa. Yields copal-resin, usually found in semi-fossilised state near old trees or where these once existed. The small, ovoid, 1-seeded, warty pods are resinous and inflammable.

Vateria acuminata (*Dipterocarpeae*). "Hal," *S.* Yields a clear yellowish resin, considered equal to the best dammar, which exudes abundantly from stem. See p. 444.

V.—indica. "Indian Copal;" "White Dammar." Moderate-sized tree of S. India; yields a resin similar to that of preceding species.

Vatica roxburghiana. (*Dipterocarpeae*). "Mendora," *S* Ceylon & S. India. Tree about 50 ft. high; a clear, yellowish resin exudes abundantly from stem.

5.—INCENSE WOODS.

Aquilaria Agallocha. Aloes-wood; Eagle-wood. A large tree of Assam and Burma; wood resinous and aromatic. See p. 412.

A.—malaccensis. "Eagle-wood" of Malacca; "Kayu-garu" of Malaya. The principal incense wood of Malaya.

Bursera gummifera and other species. See p. 412.

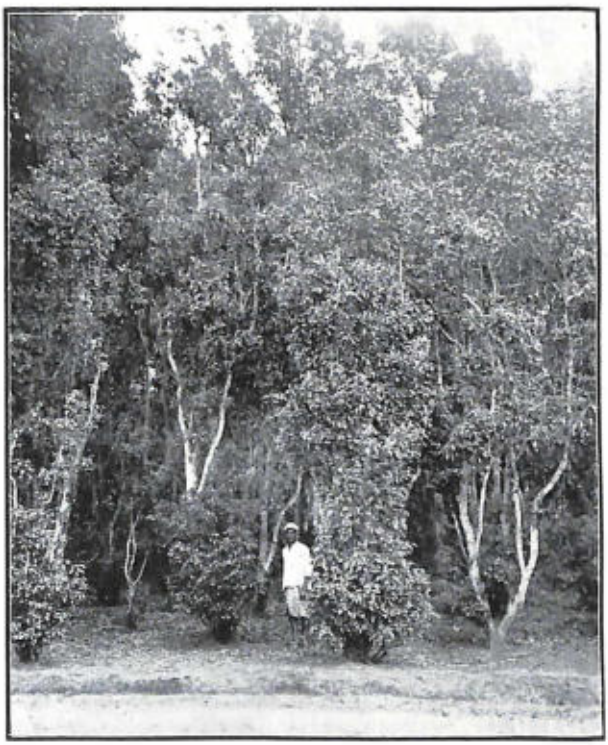
Camphor, see below.

Santalum album, see *Sandal-wood*, page 399.

Styrax Benzoin. "Gum Benjamin." See *Benzoin*, p. 411.

6.—CAMPHOR.

The Camphor Tree, or "Kapuru-gaha," *S.* (*Cinnamomum Camphora.* Lauraceae), is a moderate-sized, much branched species of the Cinnamon family, normally attaining a height of 30 to 40 feet or more; native of Formosa and Southern China, yielding by distillation of the wood, leaves, &c., the camphor of commerce. The world's supply of camphor at present (approximately 6,000 tons) comes almost entirely from Formosa, but the tree is commonly cultivated in Japan, S. China and other countries for shelter or ornament. It is said to reach an age of 20 years before it bears seed, the usual season for the latter being Sept.,–Oct.



CAMPHOR TREES AT EXPERIMENT STATION, PERADENIYA, CEYLON.

The Camphor tree has been introduced into all warm countries, and in recent years efforts have been made to cultivate it in on systematic lines for the production of camphor, as in Ceylon, South India, California, Hawaii,

the West Indies, etc. It has been established in Peradeniya Gardens since 1852. In 1893, a plot was cleared and planted at Hakgala Gardens, Ceylon, the plants being raised from seed imported from Japan. Many estates followed with small areas, and for some time the crop seemed a promising proposition. About 1,000 acres were estimated to be under young Camphor cultivation in Ceylon in 1908, and the export of prepared camphor for that year was nearly 15 cwt., valued at Rs. 3,075.

The tree, though naturally sub-tropical, is adapted to a wide range of climate and soil. It thrives in Ceylon from sea-level to 6,000 ft., but the most healthy and uniform growth occurs at the higher elevations, provided the soil is fairly good and well-drained. It is commonly planted for ornament in up-country gardens, also occasionally in windbelts, for which it is well adapted. It coppices well and is suited for hedges. Propagation is best by seed, of which about 1,600 go to a pound ; these normally take from 3-4 months to germinate, and often give a low percentage of germination. Soaking the seed in hot water for about 2 days before sowing has been found generally to increase this percentage. The tree may be propagated also by root-cuttings, but branch-cuttings are difficult to strike. Seedlings should, if raised in baskets or pots, be large enough in about 10 or 12 months from sowing for planting out.

In cultivation for camphor, the trees are best kept at a height of about 5-6 feet, by successive clippings, the latter being used for distillation ; therefore the plants may be spaced about 6 feet apart each way, *i.e.* about 1,210 plants per acre. Or they may be planted in parallel hedges about 8 ft. apart, with 4 ft. between the plants in the row. In the third or fourth year, they should be fit for clipping. Fresh clippings, 6-10 in. long, should yield about 1½-2½ per cent. distilled camphor, in addition to about 30 per cent. of camphor oil. Estimated on results obtained at Hakgala Gardens and on Ambawela Estate, Ceylon, the trees may be clipped 3 or 4 times a year, each tree averaging about 15-20 lbs. of clippings, at which rate an acre, it is estimated, should give from 120 to 130 lbs. of distilled camphor. In Formosa, the annual yield is estimated at 120 lbs. per acre, and in Florida at nearly 200 lbs. Fair average camphor commanded £20 per cwt. in 1907; in 1913 it fetched only about £7-£8 per cwt., while during the Great-war it was priced at over £100 per cwt. At the present time (1924) the price is about £15. to £20. per cwt. It has recently been found that while certain varieties of the Camphor tree yield both camphor and oil, others yield oil only. The latter kind occurs in Mauritius and some of the West Indian islands. The question of variety is, therefore, of much importance when growing the tree commercially. See p. 398.

Distillation.—Camphor is obtained by steam distillation of the clippings, wood, or roots, and the principle of the process is briefly described thus: " The vapour is condensed in a box, which is divided into compartments and placed upside down, in water in a larger and shallower box. The sides of the inverted box extend over the bottom case, and water is allowed constantly to run on to this box, keeping it cool and renewing the layer of water in the larger and shallower box, which acts as a seal. A third box is inverted over the first, and is made in a similar way to condense any vapour that may escape; in both cases holes are made in opposite corners of the partitions in the boxes, in order to cause the vapours to travel by a circuitous route. Solid camphor is deposited on the sides of the "condensing" boxes and is afterwards scraped off, while crude camphor-oil is skimmed from the surface of the water. Camphor is used in the manufacture of celluloid, xylonite, disinfectants, smokeless gunpowder, incense, &c.

Synthetic Camphor consists chiefly of a compound prepared from oil of turpentine, the introduction of which has probably accounted chiefly for the considerable drop in the price of natural camphor in recent years.

Borneo-or Sumatra-Camphor. See *Dryobalanops*, page 412.

Nagal Camphor. (*Blumea balsamifera.* Compositae).—A perennial, shrubby plant, native of Borneo. The leaves when bruised smell strongly of camphor, and are used medicinally by the local inhabitants.

7.—LAC OR SHELLAC.

Lac* is a resinous substance, of an orange-red colour, secreted by species of scale-insects, chiefly *Tachardia lacca*, which live on the tender branches of certain trees, sucking the juice of the latter and forming on these a continuous incrustation. These insects occur naturally in various parts of the tropics, showing partiality for certain trees and producing heavy encrustions or secretions on wild or uncultivated trees, which at one time were the only source of lac supply. In recent years the systematic cultivation of selected trees for inoculating with the lac insect has been undertaken in India, whence nearly all the world's supply of lac is obtained.

The first introduction of lac into commerce was for colouring purposes, the dye being extracted and the resin discarded. Since the discovery of aniline dyes, however, lac-dye has ceased to be of commercial value, whilst the lac itself has become of great importance for various purposes. In recent years, more especially during and since the Great War, the demand for shellac, *i.e.*, the purified and manufactured lac, has greatly increased and prices have correspondingly advanced. The industry however is a somewhat precarious one, but efforts have of late been made to establish it on systematic and scientific lines.



LAC DEPOSITS ON BRANCHES OF *Zizyphus Jujuba.*

Climate.—A hot but moderate climate is necessary for successful lac culture, extremes of dry or wet weather being injurous to it. In the chief lac districts in India, three distinct seasons occur, viz. the cold, hot, and rainy seasons, whilst the annual rainfall is about 30-40 inches. At Pusa, where lac has been grown successfully for the last several years, the seasons are as follows: Cold season from October to the middle of March; a hot season of 3 months from March to June; and a rainy season from July to the end of September. The average annual rainfall is about 45 in., and the temperature rarely rises above 100° Fah.

Lac in other Countries.—Lac cultivation is carried on to some extent in Cochin China, and efforts have been made to establish it in Formosa, Egypt, West Africa and elsewhere. Lac is found naturally in small quantities on certain trees in Ceylon, in semi-dry districts. It is collected to some extent by the peasant lac-workers, and used by them in the ornamentation of ceremonial staves, furniture, toys, etc., but the industry is small and local. The chief species of insects producing lac here are *Tachardia albizziae* and *T. conchiferata*, which occur mostly on trees of *Albizzia stipulata* ("Kabal-mara," *S*), *Croton aromaticus*, and *Filicium*

*See *Cultivation of Lac in the Plains of India* (Bull. 142, Agric. Research Inst., Pusa), by R. B. C. S. Misra, B.A.

dicipiens. These, however, do not produce so plentiful an incrustation of lac as the Indian form (*T. lacca*). Efforts have been made to introduce and establish the latter here, but so far without success.

Inoculation of Trees.—When the trees have attained a suitable size, which may take from about 8 or 9 years (*e.g.* "Ber"), to 16 years or more in the case of "Kusumb," they are inoculated with brood-lac, this being done about a week or a fortnight before the insects begin to emerge or swarm. Healthy sticks of brood-lac, 8-11 inches long and well furnished with lac insects, are selected and tied to the tender branches of the selected and pruned trees. The insects rapidly multiply and proceed to secrete the resinous encrustation (lac) around them. The trees must not be inoculated too young or too heavily, as otherwise their vitality will be affected and they may succumb to the effect of the insects. It is important that the two ends of the brood-lac sticks when tied in position should each touch the branches. Inoculation should not be done in rainy weather, as the young insects are then liable to be washed off the trees.

Harvesting.—In about 4-8 months from inoculation, according to season, the insects will have ceased to emerge and the lac-covered branches (stick-lac) are ready for gathering. The lac-encrusted shoots or branches are then cut, a liberal allowance being left on the tree for serving as brood-lac; after being dried in the sun for about a week, the lac is scraped off with a knife or crushed by a grinding mill, then dried in the shade. It is afterwards ground, soaked in water for 24 hours, and thoroughly washed in changes of water, so as to remove as much as possible of the colouring matter (*lac-dye*). The washed, granular material, which is of a pale-orange colour, is the *seed-lac* of commerce. By subjecting this to a process of heating in a special factory, it is formed into thin sheets (*shellac*). The latter is often adulterated or blended, according to grades required or uses to which it is put, with a small percentage of pine-resin and arsenic, the latter being for the purpose of improving the colour. Shellac is made in various grades, as "T. N.", "Fine orange," "Garnet-lac," "Tongue-lac," &c.

Yield and Cost.—No accurate figures as to yield and cost of production appear to be available; much depends on locality and host-plant. The work connected with cultivation, &c., is light, requires but little labour, and need interfere but little with the grower's ordinary occupation. Once the host trees are established, the crop requires but little attention, whilst wild trees, or those grown for shade or boundary lines, may be turned to useful account by cultivating lac on them. Two crops a year are usually obtained, one ("Baisakhi" or summer crop) taking about 8 months, occurring between May and August, and another ("Katiki" or winter crop) taking about 4 months, viz. from October to January. The annual yield of stick-lac per tree varies considerably and may be only 2 or 3 lb., or as much as 20 or 40 lbs. in the case of well cultivated trees. In the Central Provinces, an average of about 4 maunds (say 320 lbs.) per acre is said to be often obtained from *Butea* ("Palas") trees; taking 110 trees to the acre, this would average over 3 lb. each. Prices vary considerably, and at present range from about Rs. 25 to Rs. 30 per maund (80 lb.), for stick-lac, to about Rs. 150 or Rs. 275 for superior grades of shellac.

Uses.—The uses of shellac are numerous. It is employed in the manufacture of high grade varnishes, sealing-wax, gramophone records, polishes, backing mirrors, electric insulation, fixing shafts, filling material for explosives, lithographic inks, stiffening hats, and covering for chocolates,—in this case without the addition of arsenic. Inferior grades are largely used for making bangles, toys, and delicate

lacquer work. The lac-dye contains a percentage of nitrogen and is sometimes used in India for manuring paddy fields; otherwise it is discarded.

Trees suitable for lac culture.—The selection of host trees, *i.e.* trees suitable for providing food for the lac insect, is of first importance, as on these the quality and yield of the lac largely depends. The trees should be fairly quick-growing, adapted to pollarding, and able to withstand heavy infestations of the lac insect. The best "lac tree" in India is the "Kusum" (*Schleichera trijuga*), next to which are the "Palas" (*Butea frondosa*), "Ber" (*Zizyphus jujuba*), and "Sirrus" (*Albizzia Lebbek*). The following are some of the principal lac-bearing trees in India.

Acacia arabica. "Babul" of India. (*Leguminosae*). A small tree, adapted to poor soils and dry climate. Bears lac in Sind, &c.

Albizzia Lebbek. "Sirrus" or "Sirin." (*Leguminosae*). See above.

Anona palustris. "Ata," "Alligator-apple." (*Anonaceae*). See pp. 252, 433.

Butea frondosa. "Palas" or "Pulas," "Dhak." (*Leguminosae*). Produces a high-grade lac, rich in colouring matter. May be planted 22 ft. apart each way. See pages 85, 206, 440.

Cajanus indicus. "Arhar" or "Tur" of India; "Pigeon Pea"; "Rata-tora," *S.* (See pages 285, 310, &c.). Cultivated for lac in Assam, being inoculated when about 2 years old; produces a year later from 6 to 8 lb. or more of lac per plant. The plants being spaced 8 ft. by 4 ft., *i.e.* 1,360 to the acre, a handsome yield may be obtained. The lac, however, is rich in colouring matter, does not bleach well, and is therefore not classed as a superior variety, being often used for adulterating other lac.

Croton aromaticum ("Wel-keppitiya," *S*); and C.—lacciferus ("Keppitiya," *S.*) (*Euphorbiaceae*). See p. 415.

Ficus glomerata. "Crattock" or "Guler" of India. (*Urticaceae*).

F.—religiosa. "Peepul" or "Pipal" tree of India; "Bo-tree" of Ceylon. Common all over India, Burma, &c. Bears inferior lac, used chiefly by local bangle makers. Being sacred to Buddhists, it is not recommended for cultivation in a Buddhist country. See p. 465.

Filicium decipiens. "Pehimbiya," *S.* (*Burseraceae*). See page 100.

Harpullia cupanioides. "Na-imbul," *S.* (*Sapindaceae*). Medium-sized tree.

Mangifera indica. Mango. (*Anacardiaceae*). See p. 243.

Pithecolobium Saman. "Inga-saman," "Guango," "Rain-tree." (*Leguminosae*). See pages 102, 207, 451.

Schleichera trijuga. "Kusum" or "Kusumb" of India; "Kon," *S.* (*Sapindaceae*). A slow-growing tree, taking 16-18 years to grow to a sufficient size to withstand inoculation. Bears heavy crop of superior lac every second or third year. Kusumb stick-lac usually sells at Rs. 5 to Rs. 10 per maund more than other best sorts.

Shorea robusta. "Sal" of India; and S. Talura.—"Jalla" or "Jalari" of Mysore. (*Dipterocarpeae*).

Zizyphus Jujuba. "Ber" of India; "Masan," *S.* (*Rhamnaceae*). A hardy spreading tree, adapted to poor soils and dry climate; may be planted 30 ft. apart each way. See page 272.

CHAPTER XXVIII.

FIBRES

1.—*COMMERCIAL FIBRES.* 3.—*PITH PLANTS, OLAS, ETC.*
2.—*OTHER FIBRE PLANTS.* 4.—*RATTANS OR CANES.*
5.—*SERICULTURE.*

A large number of plants in the tropics yield fibres capable of use for industrial purposes. Many of these, however, are of no commercial importance, as they either lack certain essential qualities, or are not obtainable in sufficient quantity to make their exploitation a profitable proposition; whilst many are not adapted to successful cultivation. The value of a fibre, moreover, is often dependent on whether a satisfactory and economical means of extracting and preparing it is available.

Vegetable fibres in general consist of the fibro-vascular tissue or thread-like filaments forming the tougher parts of plants, their function being primarily for rigidity. They may be classified botanically into *bast* or *inner-bark fibres* (*e.g.* Jute, Hemp, Ramie, Hibiscus, &c.), *leaf fibres* (*e.g.* Manila-hemp, Sansevieria, Agave, Phormium, &c.), and hair-like or *floss fibres* surrounding the seeds of certain fruits (*e.g.* Cotton and Kapok). Coir-fibre consists of the husk (mesocarp) of the coconut.

Commercially, fibres may be classed into *Textile fibres* (including Cotton, Flax, Ramie, Hemp, and Jute), *Cordage fibres* (including Manila-, Sisal-, Mauritius-, and New Zealand-hemps), *Bristle, Brush* or *Mat fibres* (*e.g.* Piassava, Coir, Palmyrah), *Stuffing fibres* (*e.g.* Kapok and other silk-cottons), and *Paper-making fibres*, which include various fibrous materials capable of pulping and felting, &c. The following include well-known fibre plants.

Bowstring Hemp; "Niyanda," *S*; "Maral," *T.* (*Sansevieria zeylanica.* Haemodoraceae).—A herbaceous plant with succulent, rigid, concave or furrowed leaves, blotched and mottled with grey and attaining a height of 4-5 feet, native of Ceylon, India, etc. It is naturally found in rocky or sandy places, chiefly in rather dry districts at low or intermediate elevations, but thrives also in a moist climate up to 2,000 feet or higher, and is readily propagated by seed, rhizomes or leaf-cuttings. Under cultivation, it may be planted in rows about 2 × 1 ft., say 21,780 plants to the acre. It takes at least 3 years to become thoroughly established and fit for harvesting, and when in full bearing is estimated to yield about 1 ton or more fibre per acre. The fibre is used for weaving into

fine mats, also for making twine, bow-strings, &c. It is of fine quality, —white, tough, and elastic, and has been valued in London at £30 per ton. See other species of Sansevieria, pages 431-432.

Broom Corn. (*Sorghum vulgare var.* Gramineae).—A variety of Dhurra or Kaffir-corn, extensively cultivated in some warm temperate countries, as in the United States, Italy, &c., for its large panicles of grain-heads which, being cut before the grains are fully ripe, are largely employed for making carpet brooms, whisk brushes, &c. The "fibre" ranges in price from about £20 to £30 per ton or more according to quality. It should be not less than 15 in. in length, and must not be coarse or brittle. An average crop is said to yield from 7-10 cwt. of clean fibre per acre. Sowing is done at the rate of about 6 lb. of seed per acre, the seeds being sown in rows 3 ft. apart; a crop is obtained in about 4-5 months, the "fibre" being dried in the shade and afterwards graded.

Cotton; "Pulun," *S.*—The cotton of commerce consists of the delicate hair-like fibres or floss which surrounds the seeds of various species of *Gossypium* (N.O. Malvaceae). These are naturally shrubby perennials, but are usually cultivated as annual crops, partly in order to guard against insect attacks. Cotton is the most important of all textile fibres, and has been grown and used in India from time immemorial. The principal cotton-producing country at present is the United States, those countries coming next in importance being Egypt and India. The cotton plant requires a rich, friable, deep soil (black humous soil being considered the best), a warm climate with a rainy season of 2 or 3 months followed by dry weather, the latter being indispensable to the successful maturing and harvesting of the crop. Strong winds are injurious to the plants as well as the crop. It is suited to the semi-dry region of Ceylon, especially in the North, North-Central and parts of the Southern Provinces.

In some of the principal cotton-growing districts of India the annual rainfall is only about 27 inches, and irrigation is resorted to. Shade trees must be avoided, but windbreaks are beneficial where strong winds occur. The seeds, which must be fresh, should be sown in the rainy season, being thus timed to allow the crop to be picked in the dry season. The land being ploughed and harrowed, the seed is sown in rows about 3 or 4 ft. apart (or more in rich soil), with a distance of about 2 ft. between the plants in the row. It is usual to sow 3 to 4 seeds to the hole, a few inches apart, taking about 6 lb. to the acre. Or they may be sown more liberally, say at the rate of 8-10 lb.* per acre. The seeds germinate in about a week. When a few inches high, the weaker seedlings are pulled out and the strongest one left to each hole. If the ground be flat and rather wet, the soil should be thrown up in drills, but in dry regions with loose soil, level cultivation is best. Vacancies should be supplied early, preferably by seeds, as plants do not bear transplanting well.

The crop is ready for picking in 5-6 months (according to variety) from the time of sowing, and harvesting may continue for 4-6 weeks or longer. In Ceylon, it is best to sow in October or November (rainy season), the crop thus maturing in March-June, which is generally a dry period. When ripe, the pods burst open and the cotton bolls are picked by hand. The cotton is afterwards thoroughly dried in the sun (thus getting rid of "stainers" and other insects), then separated from the seed by a ginning machine, after which it is made up into compressed bales of about 500 lbs. each for export.

Grading and Yield. Grading must be carefully attended to, being begun in the field and completed in the store; it is essential to sort the cotton according to quality into 2 or 3 grades so as to obtain uniform qualities. An average of 40 pods per plant is considered a fair crop, though some plants may bear as many as 100 pods. 50 pods should yield 1 oz. clean cotton. The yield per acre varies, according to climate, soil, and variety, from 600 to 1,500 lb. or more of seed-cotton, about 850 lbs. being a good average. Ginned cotton (*i.e.* freed from the seeds) is about half the weight of seed-cotton. The seeds also are a source of revenue, being used largely, after being deprived of the lint, for cattle-food or for the extraction of

*1 lb. = about 4,000 seeds.

oil. (See p. 395). Cotton may sometimes be grown as a catch-crop with other products, as with young Rubber or Coconuts, etc. The production of cotton in Ceylon is at present limited to a small area, chiefly in the Hambantota district in the Southern Province, and the crop is nearly all used by local mills. Only some 8 cwt. was exported in 1923, valued at Rs. 270.

Varieties.—Numerous species or varieties of *Gossypium* are known, either in a wild or indigenous state, or in cultivation, being distributed over Trop. Asia, Africa, and America. Many of the races of cotton in cultivation have each special qualities suited to certain localities, climate, &c., and their commercial value depends mainly on the length and lustre of the fibre or lint. Their botanical origin is confused, but the principal sorts are considered to have been derived chiefly from the following species, viz: *G. barbadense*, the source of "Sea Island" type, the best of all cottons, which has a silky fibre 1⅝-2¼ inches long, and is found only in cultivation; *G. peruvianum*, affording the "Peruvian" and "Egyptian," among the best varieties of the latter being the "Mitafiffi," with a fibre length of 1·3 to 1·5 inches. *G. hirsutum* is considered to be the original source of the "American Upland" Cotton, with a fibre about 1 in. in length; this is the most largely cultivated type and is in greatest general demand. *G. herbaceum*, also a short-staple type, yields the "Indian" or "Tinnevelly" cotton. "Durango" and Cambodia," forms of *G. hirsutum*, are especially suited to the tropics, and have recently given yields of 1,037 lbs. and 626 lbs. respectively per acre in Ceylon, valued locally at Rs. 20 per cwt. *G. arboreum*, is a tree form which attains a height of 15-20 ft., considered a native of Africa, but is not cultivated for fibre. "Caravonica," a hybrid tree-form raised in Queensland, is claimed to give heavy yields and to be adapted to perennial cultivation. "Allen's" and "Sunflower" varieties have proved superior to Egyptian Cotton in Uganda, giving an average yield of well over 300 lb. per acre. (*Uganda Administration Report*, 1911-12). A form of Cotton with a reddish or "khaki" coloured floss, cultivated in Siam, parts of China, &c., has probably originated from *G. religiosum* or *G. Nanking* ("Siam Cotton"). It is known as "Khaki" cotton, and has certain advantages locally over white cotton.

Flax or Linseed. (*Linum usitatissimum*. Linaceae).—An erect annual, cultivated from antiquity in Europe for its fibre, and now largely in India, Brazil, &c., for the seed, which furnishes linseed oil. Its cultivation has recently been undertaken in British East Africa (now Kenya). About two months from sowing, the plants begin to flower and assume a yellowish colour; 3 weeks later the seed capsules become brownish yellow. The fibre is then at its best, and the plants should be pulled by hand, not cut. If, however, the crop is grown for its seed, it must not be pulled till the seed capsules are quite brown.

Harvesting.—The stems as they are pulled are left in handfuls in lines on the field for 5 or 6 days. They are then tied in small bundles, which are placed flat between poles set in the ground 2 feet apart, the ground between these being first covered with dry grass. In 3 weeks' time, the straw should be thoroughly dry and the seed dark-brown in colour. The crop is then placed in stacks, the top-ends inside and the bundles sloping upwards.

Threshing or removal of the seed is done either by drawing the flax by hand through iron pins closely set in a block of wood, or by beating out the seed with wooden hammers, or by a machine consisting of a series of hammers falling on to a table. The straw is then made up in bundles, one-half with the roots coming next the tops of the other half. Each bundle is tied at either end and in the middle with thin twine.

Retting.—The bundles are placed upright, close together, in a tank supplied with running water; wooden planks, with large stones above, are placed on top, and water is turned on. In 6 or 8 days the water is drained off, the bundles are removed, laid out in lines, and left for about a couple of days to dry and bleach. The straw is then put back into bundles, which are immersed as before in the tank for a second period, which ordinarily occupies 4-6 days, varying with the temperature of the water and the quality of the straw. In cold weather as much as 30 days in all may be required for the process of retting, which is not complete till the fibre readily separates from the wood.

Breaking.—The next operation consists of breaking or crushing the wood in the "straw," without damaging the fibre, by passing the straw between two fluted rollers, either driven by hand or steam. The next process is

Scutching, which consists in passing the straw through a machine with hard wooden blades, which remove the wood from the fibre. The flax (fibre) is then finished, made up into bundles averaging 14 lbs. each, tied in three places, with the roots all to one end. It is then made up into bales of about 200 lbs. each, and covered with cloth for shipment.

Cultivation.—A clayey soil gives the best flax, a light sandy soil producing too short a straw. The stems should be supple, of a light yellow colour, and have a length averaging 36 inches. In British East Africa, the seed is sown, about the end of April, usually in drills about 4 in. apart, about 80 lb. of seed being thus required to sow an acre. In Belgium, the usual rate is 120 lb. of seed to the acre, owing to the greater loss in the latter country caused to seed and young plants by birds and unfavourable climate. At Kabete, in British East Africa, a 5-acre field produced over 13 tons of straw, averaging 2 tons, 12 cwt., and 20 lbs. per acre. A sample of straw, taken haphazard from this crop, gave : 17 lb. of seed (=496 lb. per acre, or 8½ per cent. weight of straw), 21 lbs. clean fibre (=613 lb. per acre, or 10½ per cent.), and 8 lb. waste fibre, removed during the process of scutching (=291 lb. per acre, or 5 per cent.). The average yield of seed per acre in India is about 300 lb.

Hemp, Indian. (*Cannabis sativa.* Urticaceae; Nettle family). See pp. 384, 396. An annual dioecious shrub, growing to a height of 8-10 ft. or more, with erect stems and small, green flowers, native of Central Asia and long cultivated in Persia, N. Africa, parts of India, China, etc., either for the fibre obtained from the stems or for the oil from the seed, also sometimes for the powerfully narcotic properties of the plant. It is cultivated for fibre chiefly in Russia, Italy, Hungary, Servia, Mexico, United States, Kashmir, China, Japan, &c.; thrives best in a warm climate and a humid atmosphere, preferring a rich loamy soil on a stiffish sub-soil. With manuring, the crop may be grown on the same land for several years in succession. Applications of potash manures and sulphate of ammonia are especially beneficial as fertilisers; all refuse from the retting and scutching processes should be returned to the soil.

After thorough preparation of the soil, the seed is usually sown broadcast, sometimes in drills by a machine. For the production of fibre, which is used for cordage and coarse textiles, the seed is sown at the rate of about one bushel per acre, whilst for a finer quality of hemp as much as 3 bushels or more is allowed per acre in order to produce long uniform stems. If required for fibre only, both male and female plants are harvested at the same time; but if for both fibre and seed, the male plants are first collected by hand-pulling, and the female plants are left for about 3 weeks longer for the seed to ripen. Upon the process of retting (see p. 420), much of the quality of the fibre depends. Hemp seed for the extraction of oil is valued at about 20*s.* per cwt.

Yield. An average crop should give 2-3 tons of dry stems per acre (yielding about 25% of fibre clean), or 25-35 bushels of seed. The best hemp, when ready for market, is nearly white, has a silky lustre, and is 6 ft. or more in length. Italy produces the best quality of Hemp, the present price of which fluctuates between £38 and £45 per ton. The fibre is used chiefly for ropes, cables, twine, nets, sail-cloth, canvas, warp of carpeting material, &c.

Jute or **Gunny-fibre.**—This valuable fibre is obtained from the stems of cultivated varieties of *Corchorus capsularis* and *C. olitorius* (Tiliaceae),—annual plants with long, erect, thin stems and yellow flowers, indigenous to Ceylon, India and Malaya. In cultivation the plants, being grown close together, attain a height of 8-12 ft. Of the numerous varieties, those of *C. capsularis* are generally preferred, as they yield better fibre and come to maturity earlier than those of *C. olitorius*. The crop thrives best in rich, loamy or alluvial soil on flat land; the latter may

occasionally be flooded without much damage to the crop, but the plants will suffer if long or much submerged. Jute is an exhausting crop and requires manuring. Cow-dung, applied at the rate of 3-4 tons per acre, gives excellent results. Rotation with mustard, rice, and pulses is generally adopted; or these are sometimes grown and dug in as a green-manure.

The seed is sown broadcast at the rate of about 8-10 lb. per acre, the seedlings being thinned out when about 1ft. high, allowing a spacing of about 6 inches. The crop matures in 3-4 months and is cut when the plants are in blossom. Retting takes about 10 days. The average yield of fibre is about 1,200 lb. per acre, but almost double this quantity is sometimes obtained.

The cultivation and manufacture of jute forms a large industry in India, chiefly in Bengal, where some 3 million acres are yearly under the product. The fibre is extensively used for making cordage, carpets, fishing nets, gunny bags, etc. It fluctuates in price, and is at present valued in London at from £32 to £38 or more per ton, according to quality.



JUTE. *Corchorus olitorius*, var.



KAPOK. *Eriodendron anfractuosum*.
1, trees in fruit and deciduous; 2, fruits and leaves; 3, ripe fruit bursting open and shewing cottony contents.

Kapok or Silk-cotton; "Pulung" or "Kotta-pulung," *S.* (*Eriodendron anfractuosum*, =*Ceiba pentandra*. Malvaceae).—A small or moderate-sized, quick-growing, upright, thornless tree, branching horizontally, in whorls, at right-angles to the stem. The tree is deciduous in the dry season, usually February-April, the greenish-white flowers being produced in clusters shortly after the leaves have dropped. The fruit

pods, which ripen about 2 months after flowering, contain a quantity of silky, creamy-white floss (kapok), consisting of lustrous, unicellular hairs about ½ to 1·2 in. long, closely packed around the black, round seeds, and when ripe burst open and disperse their contents. The pods should therefore be collected before they are quite ripe, then dried in the sun, and shelled

Until lately, kapok fibre has been used chiefly for stuffing pillows, cushions, etc., and during the war for making life-saving waistcoats and similar articles. Recently, it has been employed, mixed with other fine fibres, for weaving into fine fabrics, and there is at present a considerable demand for it. The largest supply comes from Java and the Philippines, where the tree is cultivated to some considerable extent. The export of kapok from Java alone is about 12,000 tons a year. Some 325 tons were exported from Ceylon in 1923, valued at about £88. 10*s.* per ton. Cleaned kapok commands at present, in London, from 1*s.* 2*d.* to 1s. 6*d.* per lb., according to grade, Java kapok usually fetching the highest price. The tree is readily propagated from seed, or from post-cuttings planted *in situ*, and thrives from sea-level up to about 2,500 ft. It may be planted about 15 × 18 ft. Along roadsides or boundaries, or as windbreaks, the trees may be planted closer, say 10 ft. apart, and used as supports for pepper vines.

Yield.—The trees begin to yield about the 4th or 5th year, when they may be expected to give about 1-2 lb. of kapok each, allowing 1 lb. for every 100 pods. Trees vary considerably in yield ; some fruit heavily one year and may be almost barren the next. A good tree at maturity (say 15 years old) may produce from about 900 to 1,000 pods, or 9-10 lb. of clean floss. A single pod contains from about 100 to 150 seeds ; 200 of the latter when fresh go to 1 oz., and about 180,000 to a bushel. By weight, the dried pods contain about 50 per cent. seeds, 35 per cent. floss, and 15 per cent. core.

Other species of *Eriodendron* and other genera yield a silky floss similar to Kapok. That of *Bombax malabaricum* (see page 83) is said to be exported from India under the name of "Kapok." It does not, however, appear to be collected anywhere in Ceylon, owing doubtless to the difficulty of access to this very prickly, large, erect, bare-stemmed tree.



RED COTTON-TREE. *Bombax malabaricum.* (See page 83).

Manila Hemp; Abaca Fibre. (*Musa textilis.* Scitamineae).—A large herbaceous plant or small tree of the Banana family, indigenous to the Philippines, where it is extensively cultivated for its excellent and well-known fibre. The plant requires a hot and moist climate, with a fairly heavy and evenly distributed rainfall, and is best suited to elevations below 1,000 ft. Its cultural requirements are similar to those of the Plantain or Banana, which it closely resembles. Hemp plantations in the Philippines are confined chiefly to flat land with volcanic soil, as in the eastern side of the Islands.

Propagation is entirely by suckers (fertile seeds being rarely produced), which are planted out when about 3 feet high, at distances of 8-10 feet apart

each way. These produce several stems (suckers), forming a clump. The first crop of fibre is obtained about two years from planting, and a full crop in the fourth year, the plantation continuing to yield for 15 or 20 years afterwards.

To obtain the fibre, the soft watery stems, formed by the leaf bases, are cut down just before they begin to flower (*i.e* when the fibre is at its best), about a foot from the ground, being then stripped by hand or machinery into ribbons; the fibre is afterwards bleached and dried in the sun. The inner portion of the stem yields the finest quality of fibre. The annual yield varies from 3 cwts. to 1 ton per acre, an average of ½ ton per acre being usually regarded as a satisfactory crop. A single plant may give from 1-5 lb. of dry fibre, *i.e.* about 2 per cent. of the stem by weight. The fibre as prepared for market is composed of strands 6-10 ft. long. It is very strong, light and tenacious, and its principal use is for making ropes and cordage, which are known for their superior quality. The quality of the fibre depends on climate, soil, and variety grown. It fluctuates in price, according to grade, &c., from £32 to £40 or more per ton.

Sunn or **San Hemp**; "Hanna," *S.* (*Crotalaria juncea*. Leguminosae). An erect annual, 6-10 ft. high, with bright yellow flowers, indigenous to to Trop. Asia generally, commonly occurring in the dry region of Ceylon. It is cultivated practically all over India, and to a small extent also in the north or north-western districts of Ceylon, for the sake of the strong and useful fibre obtained from the stems by retting. The plant may also serve when young as fodder for cattle, or for green-manuring (see p. 26). For fibre purposes, it is best grown on a light soil, in rather dry districts. The seed is sown thickly, either broadcast or in drills, at the rate of 20-30 lbs. (sometimes 50 lb.) per acre, the seedlings being afterwards thinned out to 3 or 4 inches apart. In India, where it is generally grown as a catch-crop, the crop is sown at the beginning of the rains and occupies the ground usually for 3½ to 4 months, being cut when the plants blossom.

Harvesting, &c.—In harvesting, the plants are usually pulled up by the root, though sometimes cut close to the ground and left on the field for a few days to wither; they are then stripped of the leaves and tied in bundles of about a hundred stalks. The bundles are dried for 2 or 3 weeks, then placed in pools (preferably of still, shallow water) and weighted down with stones or logs. Retting is complete in 6 to 8 days. The fibre is afterwards stripped off, washed and bleached.

Yield, &c.—A good average crop should yield 3 to 4 tons of dry stems per acre, which furnish about 8 per cent. of their weight of clean fibre; hence the yield of fibre per acre should be about 5 or 5½ cwts. The value of the fibre in London, where it is known as "Bombay Hemp," usually ranges from about £28 to £35 per ton, depending on length, colour, &c. The best grade comes from Bombay, and is about 4 ft. long. The chief use of the fibre is for making canvas, cordage, fishing nets, etc.

Mauritius Hemp; "Green Aloe." (*Furcraea gigantea*. Amaryllideae).—A large, succulent perennial, indigenous to Trop. America, bearing large fleshy leaves, 5-7 feet in length, and producing at maturity a "pole" (inflorescence) 20-25 ft. high, which bears numerous bulbils. Introduced into Ceylon before 1824, the plant has, as in India, &c., become almost naturalised, especially up-country and near the railway, along which it was once planted to form boundaries. First introduced into Mauritius about 1790 as a garden plant, it gradually spread over waste lands and became completely naturalised. About 1875 an industry of extracting the fibre was started, and recently systematic cultivation has been practised, the plants being spaced 5 ft. apart in poor soil, up to about 7 ft. in heavy soil. The fibre is sometimes extracted in Ceylon by hand and used for making fine mats, twine, &c. The yield of dry fibre varies from 2-3 per cent. of the weight of fresh leaves, as against 3-4 per

cent. in Sisal Hemp. The plant is readily distinguished from the latter by the paler green and thinner leaves, which are furnished with short spines along the margins from about the centre towards the base. Propagation is by bulbils or suckers. See p. 427.

New Zealand Hemp. (*Phormium tenax.* Liliaceae).—A handsome perennial, bushy, stemless plant with long sword-shaped leaves, which are either green or margined and streaked with white, and are 5-7 ft. long. It is indigenous to New Zealand, where it covers large areas of swamp land, especially in the south of the North Island. Here the crop grows wild, the only cultural attention given being the removal of surface water by drains and canals; these and general protective measures cost about £1 per acre a year. See pp. 188, 210.

A crop of 15 or 20 tons of green leaf per acre is obtained once in every 3 or 4 years, yielding 1½ to 2 tons of clean fibre. The latter has a high breaking strain and is valued for binder twine, ropes and cordage, being worth about £35 per ton. The plant grows freely at the higher elevations in the tropics, and is readily propagated by suckers or seed, preferably the former. Being naturally a swamp-plant, it prefers a moist locality. It is cultivated in St. Helena, where it has been introduced and promises to become a profitable industry. The variegated variety is commonly cultivated in gardens as an ornamental plant.

Panama Hat Plant. "Jippi-Jappa" or "Toquilla Palm." (*Carludovica palmata.* Cyclanthaceae). A stemless, palm-like bush with large, palmate leaves, similar to those of a fan-palm, with stalks 5-6 ft. long. The flowers, followed by the seed, are produced in cones borne on short stalks rising from the base. A native of Trop. America, it is extensively cultivated in parts of Ecuador, Colombia, etc., for the sake of the leaves, from which the well-known Panama hats are made. The plant is fully developed when about 3 years old, and lives for many years in the same ground. The young leaves are taken once a month, just as they begin to unfold, the stalk being cut some distance below the leaf-blade to facilitate handling.



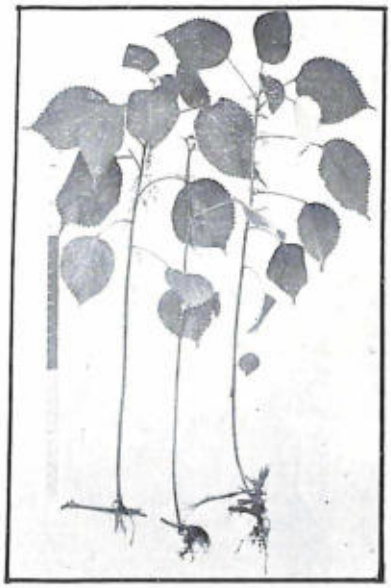
PANAMA-HAT-PLANT.
Carludovica palmata.

Each leaf is torn into plaits about ½ in. wide, and then into shreds by means of an instrument consisting of a piece of wood in which needles are fixed, the larger ribs (veins) being rejected. These shreds, known as "straw," are then submerged in boiling water for about 10-15 minutes, being afterwards dried in the sun for 3 hours, then bleached in a sulphur chamber for a day. The "straw" (toquilla) sells in the plant's native home at the equivalent of about 2*s.* 9*d.* per lb., the price having advanced considerably in recent years. About 6 leaves are required to make one hat; a coarse hat can be made in one day, but a finely made one will take 18 days to make. Introduced at Peradeniya in 1866, the plant grows here luxuriantly, preferring a moderately moist, heavy soil, and light shade; the latter, however, is not essential. A hot, humid climate is indispensable.

"Toquilla straw" is also obtained from the young leaves of certain species of Pandanus and Palms, *e.g.* the "Alta palm" (*Mauritia flexuosa*) of South America, and made into hats, baskets, &c. *Carludovica jamaicensis*, which is similar to the preceding species, is employed in Jamaica for making Jippi-jappa hats, which resemble the Panama hats.

Ramie ; Rhea-fibre or "China-grass." (*Boehmeria nivea*. Urticaceae or Nettle family).—A perennial shrub, 5-6 ft. high, with large, heart-shaped, crenate, hairy leaves, which are greyish-white beneath, indigenous to parts of tropical and sub-tropical Asia, and cultivated in China and Formosa. From the inner bark of the stems is obtained the rhea-fibre of commerce, which is pure white, of a silky lustre, and is used in the manufacture of fine linen, incandescent gas mantles, etc. The plant is easily grown, thrives best in a loamy, alluvial, or humous soil, up to about 3,000 ft., and requires either a moist climate or irrigated land. It grows best in partial shade, though the latter is not essential once the plants are well established. The crop is of an exhausting nature, and manuring is indispensable in order to keep up the quality of the fibre. Propagation is by seed, cuttings, or suckers, preferably the latter. The seed is very small. Excessive moisture or drought affects the quality of the fibre.

The soil being dug or ploughed to a depth of 8 or 10 inches, the plants may be planted about 2 ft. by 3 ft. apart, in rows. The production of straight, clean, unbranching stems is essential for good quality fibre. It is stated that a good field will not require replanting for about 5 years, but weeding and cultivation must be maintained and the sides of the rows occasionally chopped. A small crop of stems may be obtained in about 10 months from planting, and cuttings may afterwards be made 3 or 4 times a year. The fibre is not separated from the stems by retting, as in the case of other similar fibres, but is removed either by hand, as in China, or by a decorticating machine, which also removes the thin outer layer of bark. It is then subjected to a chemical process of *degumming* in order to remove the gummy substances in which the fibre is embedded.



CHINA-GRASS, RHEA, OR RAMIE FIBRE. *Boehmeria nivea.*

Yield.—The annual yield is estimated at about 15-20 tons of canes per acre, giving about ¾ to 1 ton of dry ribbons, which furnish about 50 per cent. of their weight of degummed fibre or *filasse* ; thus the yield of the latter per acre may be about 10 cwt., or 2½ per cent. The filasse is sometimes valued in London at from £35 to £50 per ton. The laborious process of preparing the fibre is an obstacle to the development of the Ramie industry, which has not yet attained large proportions. The cultivation of the plant has been advocated in the Colonies from time to time,

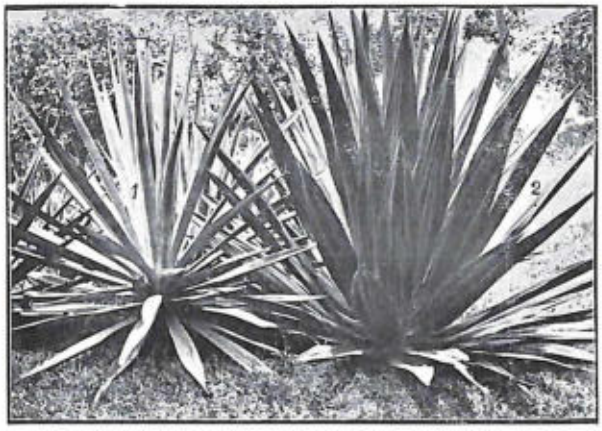
and in 1897-98, upon the discovery of a satisfactory decorticating machine, a special impetus was given it; but this proved to be ineffective and of short duration only.

Varieties.—Boehmeria nivea, var. *tenacissima* has smaller leaves, which are green underneath, and is suited to higher elevations than the preceding species. *B. pulchra* has large, handsome, dark-green, velvety-looking, long-toothed leaves, and is worth growing for ornament.

"Wild Rhea," see *Debregeasia*, page 430.

Sisal Hemp or **Henequin.** (*Agave rigida*, var. *sisalana*. Amaryllideae). —A perennial stemless plant, indigenous to Mexico, introduced into Ceylon in 1890. Furnishes a valuable fibre (Sisal-hemp) from the leaves, and is extensively cultivated in the Bahamas, Florida, East Africa, etc., and to some extent in other parts of the tropics. It bears long, thick, succulent leaves, 4-6 ft. long, smooth-edged, with a sharp, terminal, dark-brown spine. The plant flowers when about 7 or 8 years old, according to climate, producing a central pole, which should be cut (unless required for the bulbils) at 4 ft. from the ground, as otherwise the quality of the fibre will be affected. The "pole" does not produce seed, but if allowed to mature will bear from about 1,500 to 2,000 or more bulbils.

The plant thrives on almost any soil and is suited to a dry or moderately wet climate; a dry climate improves the quality of the fibre. It is drought-resistant, thrives practically on any soil, and requires but little or no cultivation beyond keeping weeds in check and removing suckers. Propagation is by bulbils (produced by the flowering pole) or suckers. On fairly good soils these may be planted out at about 8 × 6ft., or 6 × 6ft. in poor ground, *i.e.* 908 or 1,210 plants to the acre respectively. One-year old bulbils from nursery beds are best for planting; sucker-plants are considered to pole earlier, are less uniform in size, and more costly.



1, SISAL HEMP. *Agave rigida* VAR. *sisalana*.
2, MAURITIUS HEMP. *Furcraea gigantea*.
(See page 424).

Yield.—The first cutting of leaves may usually be made about 3 or 4 years after planting, the mature leaves only being cut; these should yield from 3-4 per cent. of their weight in clean fibre, 1,000 leaves giving about 40-50 lb. of commercial fibre. Subsequent cuttings may be made at intervals of about 4 or 5 months, each plant averaging about 28 leaves a year (yielding 10 or 15 lb. of clean fibre), or about 130 to 160 leaves in all. The cutting period, as well as yield, varies considerably in different countries, according to climate and soil. Under favourable conditions this takes about 4 or 5 years, though in Mexico it may extend to 8 years or more.

In East Africa and the Bahamas, the average annual yield is estimated at over 1 ton of clean fibre per acre. In Fiji, a yield of about 11 cwt. per acre of 681 plants is reported, whilst yields elsewhere are reported as giving only from 6 to 9 cwt. per acre.

Since the plants in a Sisal plantation do not all pole at once, the intercalary method of planting is sometimes recommended, *i.e.* young plants are interplanted between the old rows, when the latter are in bearing. Usually, however, the first planting is allowed to finish, after which the land is allowed to lie fallow for a year or more before replanting. Sisal hemp is used largely for binder-twine, ropes, cordage, &c., and commands from £30 to £40 or more per ton, according to quality.

Yucatan Hemp or **White Henequen.** (*Agave rigida*, var. *elongata*, = *A. fourcroyoides*).—A distinct variety, the leaves of which are of a whitish, glaucous hue, with numerous sharp spines along the margins. This is the principal fibre plant of Yucatan, whence the fibre is largely exported, and is said to yield a larger perecentage of fibre than the Sisal-hemp plant, though considered inferior to that of the latter. Cultural requirements are, in general, the same as for the Sisal Hemp plant ; the very spiny leaves are a drawback from a cultural standpoint.

2.—OTHER SOURCES OF FIBRE.

Abroma augusta. (*Sterculiaceae*). Devil's Cotton ; "Ulatkambal."—Tall, quick-growing shrub of India and Java,with large angular leaves. Fibre from stems, obtained by retting, used for ropes and cordage.

Abutilon Avicennae. (*Malvaceae*). "Chinese Jute." "Indian Mallow."—An annual extensively cultivated in China for its fibre, yielding about a ton per acre.

Adansonia digitata. (*Malvaceae*). Baobab Tree. Fibre from inner bark used for ropes and cordage in Madagascar and Africa. See pages 205, 206, 513.

Agave Cantula. "Maguey Fibre." Cultivated in the Philippines for its fibre, being planted about 6ft. × 6 ft. The leaves are ready for cutting in from 4-5 years from planting, each plant producing 25 or 30 mature leaves a year; these yield about 3 per cent. of their weight in fibre, which is equivalent to about 1 ton per acre. Cutting is carried on for 2-3 years, the plants dying at the age of about 7 or 8 years.

A.—rigida var. **elongata** (=**A.—fourcroyoides.**) See Yucatan Hemp above.

Agave Zapupe and **A. Lespinassei.** See *Zapupe Fibre.*

Allaeanthus zeylanicus. "Alandu," *S.* (*Urticaceae*). A small spreading tree of Ceylon; yields coarse fibre used for ropes, &c.

Ananas Magdalenae. "Wild Pineapple;" "Pita Fibre" or "Colombia Pita" (*Bromeliaceae*).—A stemless plant, with leaves 8-10 ft. long, 3-4 inches broad at the butt end, spine-toothed along margins, forming large areas ("pitales") of forest undergrowth, chiefly at medium elevations, in Colombia, &c.; thrives under natural shade and prefers light sandy soil. The leaves yield strong, durable, and hard fibre of considerable length. Propagation is best by suckers, and an acre of 5,000 plants, each giving 100 leaves a year in 2 cuttings, is estimated to be capable of yielding 1½ tons of fibre. The latter is valued in London at about £28 to £30 or more per ton.*

Ananas sativus. Pineapple Fibre. (*Bromeliaceae*). Certain varieties or species of Pineapple yield good fibre, for which they are cultivated in Formosa, Philippines, and Southern China, the fibre being used in textile fabrics. 1 cwt. of the leaves yields about 2½ lb. of prepared fibre. The variety known in the Philippines as "Nanas" produces a fine quality of fibre used for fine weaving, as in the celebrated "pina" cloth of the Philippines. See page 231.

Anona reticulata. Inner bark furnishes fine lace-like fibre, used for wrappers, ornaments, hats, &c. See page 252.

Antiaris toxicaria (**A. innoxia**). Sack-tree ; Upas-tree ; "Riti," *S.* (*Urticaceae*). Large tree of Ceylon, Java, Moluccas, &c. The dense inner bark, obtained by retting and beating, furnishes a fibre material used by certain tribes for ready-made

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*M. T. DAWE, F.L.S., in *Tropical Life* for Dec., 1920 ; and Jan., 1921.

clothing. "Bark Cloth" is also funished by other trees, *e.g.* a species of *Brachystegia* in Uganda, and *Broussonetia* in the Pacific Islands. See *Broussonetia*.

Arenga saccharifera. Sugar-palm; Gomuti-fibre.—Large handsome palm of Malaya. Bristle fibre obtained from leaf-sheaths used in brushes, &c. See page 361.

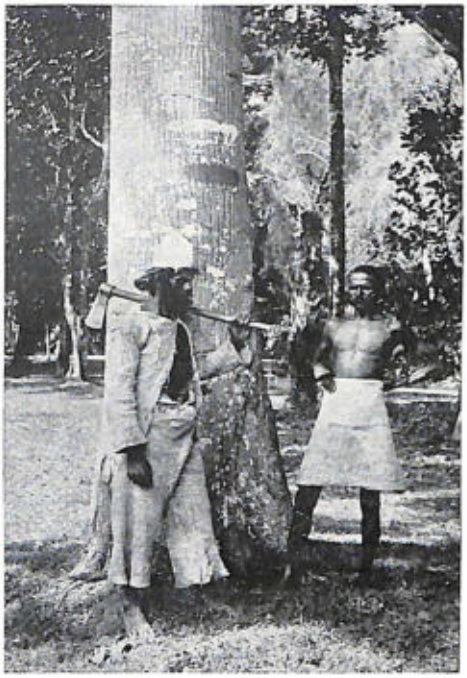
Arghan Fibre. The trade name "Arghan" has been applied by a company, formed in 1919, to the fibre of a species, not yet exactly determined, of Bromeliad (*Bromeliaceae*), a family of herbaceous, stemless plants, extensively distributed over Trop. S. America. Several of the larger species yield excellent fibre, see *Ananas Magdalenae*. Considerable interest has been taken recently in these plants as sources of commercial fibre, but although introduced into Malaya, Ceylon, India, &c., they have not yet become established on any extensive scale.

Asclepias curassavica. (*Asclepiadeae*). Erect shrubby perennial of the W. Indies. Fine fibre obtained from stems used for textile fabrics, etc.

Attalea funifera. See *Piassava*.

Bark-cloth. See under *Antiaris*.

Bauhinia racemosa." Mavila," *S.* (*Leguminosae*).—Small tree of Ceylon, India, and Malaya. Fibre from inner bark used for making ropes and cordage.



BARK-CLOTH TREE. *Antiaris innoxia*. Showing bark-cloth made from inner bark; *left*, a complete suit; *right*, a sarong, both made from inner bark.

Borassus flabellifer. See Palmyra Fibre, also Pith Plants, Olas, &c.

Bromelia Pinguin and other species. (See p. 73.).—Large, spiny, pineapple-like plants, yielding a fibre known as "Pinguin", "Wild pineapple," "Bromelia-pita," or "Colombia-pita." Leaves 7-9 ft., spines curved forward. Introduced at Peradeniya before 1864, now common in hedges about Negombo, &c. See also "*Arghan*."

Broussonetia papyrifera.—"Tapa-" or "Kapa-fibre"; "Paper-mulberry." (*Urticaceae*). Medium-sized tree of the Pacific Islands, with large ovate leaves. Inner bark furnishes a fine fibrous material, suitable for making paper, &c. The famous "tapa" or "kapa" cloth of the Pacific Islands, made from this fibre, formed the only wearing attire of the indigenous inhabitants until comparatively recent years. See also *Antiaris*.

Calotropis gigantea. "Akund-fibre," "Madar-fibre," "Wara," *S.* "Manakovi," *T.* (*Asclepiadeae*).—An erect shrub, common in Ceylon, India, Malaya, &c. Yields from the stems a fine hemp-like fibre, used for fishing lines, &c., and exported to some extent from India and Java. Silky floss from fruit used for stuffing pillows, &c.

Cocos nucifera. Coir or Coconut-fibre. See under Coconut Palm. Husk of fruit, after retting, yields useful fibre, largely employed for making rugs, matting, mattresses, brushes, coarse yarn, cordage, &c. The fibre is sorted into bristle-fibre, mattress-fibre, coir-yarn, rope, mats and matting. The exports from Ceylon in 1923 amounted to nearly 500,000 cwt., valued at about Rs. 4,650,700 = (£310,046).

Cryptostegia grandiflora. (*Asclepiadeae*). Climbing shrub, native of Trop. Africa; stems yield good fibre. See page 207.

Cyperus corymbosus. A sedge of Ceylon, India, &c. Stems or leaf-stalks used in India for making ropes, grass-mats, &c. The "stems" of *C. dehiscens*, a 3-angled sedge common in marshy places in India and Ceylon, are also commonly used for making grass-mats, sometimes known as "Pan-peduru" in Ceylon.

Cyperus Papyrus. Egyptian Papyrus.—Handsome, perennial, aquatic sedge, 8-10 ft. high, native of Soudan, &c.; thrives up to about 4,000 ft. The pithy stems (leaf-stalks) furnished the ancient papyrus paper of the Egyptians, and is still used to some extent for paper-making. See page 174.

Debregeasia velutina. "Wild Rhea," "Gas-dul," *S.* (*Urticaceae*). Small tree of Ceylon, India, and Java. Inner bark affords strong fibre, used for ropes, &c.

Eryngium pandanifolium. (*Umbelliferae*). S. America. Leaves yield the "Caraguata-fibre."

Grass-mats. See *Cyperus*, p. 429.

Grewia microcos. "Keliya," *S.* (*Tiliaceae*). Large shrub, common in low-country of Ceylon, also in India, Malaya, &c. Stems yield strong fibre.

Gyrinops Walla. "Walla-patta," *S.* (*Tyhmelaeaceae*). Small tree of Ceylon; inner bark yields strong fibre used for ropes, &c.

Helicteres Isora. "Liniya," *S.* (*Sterculiaceae*). Shrub or small tree, with hazel-like leaves, common in Trop. Asia. Inner bark affords tough fibre.

Hibiscus cannabinus. "Deccan-", "Ambari-", or "Bombay-hemp," "Bimlipatam Jute." (*Malvaceae*). Shrub, 10-15 ft. high, with prickly stems, native of India, cultivated in India, Nigeria, &c., for the fibre obtained from the inner bark. In cultivation, the plants are grown close together, so as to produce straight clean stems. The fibre is largely exported from India.

H.—elatus. "Cuba-bast," "Mountain-mahoe."—Small bushy tree of the West Indies; valuable fibre obtained from the inner bark.

H.—Sabdariffa, var. **altissima.** "Rozelle Fibre." Known in W. Trop. Africa as "Rama."—A quick-growing, annual shrub, yielding a strong, jute-like fibre from the inner bark of the stems. The plant occurs in "red" and "green" forms, and there are different varieties of both. (See *Trop. Fruits*, page 264). The variety "Altissima" has erect stems, reaching a height of 10-12 ft. or more. The crop prefers flat or undulating land, and thrives best in deep loamy soil. Seed may be sown in drills about 5-6 inches apart, at the rate of about 12 lb. per acre. Close spacing, say 6 in. × 6 in., ensures straight erect stems with few branches, which yield the best fibre. The crop should be ready for cutting about 5-6 months from sowing, and a yield per acre of about 15 cwt. of prepared fibre should be obtained. Retting takes about 8-10 days, and the fibre is afterwards cleaned by hand, then dried and bleached in the sun, after which it is made up into bales for export. The fibre is quoted in London at about £20 per ton for "uncombed," and £30 for "combed" qualities. $.



ROZELLE FIBRE. *Hibiscus Sabdariffa*, var. *altissima*.

H.—tiliaceus. "Beli-patta," *S.*—Large shrub or small tree, common at low to medium elevations in most parts of the tropics, chiefly near seacoast and rivers. Yields strong fibre, used for cordage and mats.

Honckenya ficifolia. "Bolo-bolo," "Napunti," "Potepo." (*Tiliaceae*). Annual shrub of Trop. Africa. Stems yield excellent fibre, known by above names.

Istle Fibre. See *Tampico Hemp.*

Kitul Fibre Similar to Piassava, which see. A black bristle fibre, 2-2½ ft. long, obtained from the leaf bases of *Caryota urens*, the Toddy-, Kitul-, or Jaggery-palm. Kitul fibre was exported from Ceylon in 1923 to the extent of 35 tons, valued at about £1,835, equal to about 43*s.* per cwt.

Lagetta lintearia. Lace-bark Tree; "Lagetto." (*Thymelaeaceae*). Small tree of Jamaica. The inner bark consists of concentric layers of fine interlacing fibres, resembling lace; used for ornaments, &c.

Lasiosiphon eriocephalus. "Naha," *S.* (*Thymelaeaceae*). Bushy shrub of Ceylon and S. India, 6-8 ft. high; inner bark yields good fibre.

Luffa aegyptiaca. "Loofah" or "Sponge gourd" (*Cucurbitaceae*).—An annual gourd. By retting the fruit in water, a fibrous interlacing network is obtained, which is commonly used for a bath sponge. It is sometimes called "vegetable sponge." Produced largely in Japan for export.

Musa sapientum. Plantain-or Banana-Fibre. See *Manila Hemp*, also p. 244

Maguey. A Mexican general term for Agave and Furcraea. See *Agave Cantula.*

Palmyra Fibre. Strong, wiry, black bristle fibre, similar to kitul-fibre, obtained from the butt ends of the leaves of *Borassus flabellifer*, the Palmyra Palm. Formerly largely exported from Ceylon. Only 18 cwts. were exported in 1923, valued at £40, or about Rs 33. per cwt. The fibre is usually made up into small bundles about 9-12 inches in length. See pp. 169, 206, 362.

Pandanus utilis. Screwpine; "Vacoa"; "Bacoa." (*Pandanaceae*). A shrubby plant, native of Mauritius and Madagascar, commonly grown along boundaries of sugar fields, &c., for the sake of the leaves, which are woven into mat-bags and largely used for lining sugar sacks for export, these being afterwards used as fish-bags, &c. Locally, they are also employed for thatching. Young leaves of this and other species are much used in Philippines for making fine "Manila-hats."

Piassava; Bast-, Bass-, or Dass-fibre, the commercial term for the long stiff, wiry, flexible bristle-fibre, brownish or black in colour, obtained from the leaf-bases of certain palms and used in the manufacture of brooms, whisks and brushes. Bahia Piassava is obtained from *Attalea funifera*, Para Piassava from *Leopoldinia Piassava*, both Brazilian palms. Madagascar Piassava is derived from *Dictyosperma fibrosum*, and West African Piassava from *Raphia vinifera* (the "Wine-palm") and *R. Hookeri*. The market price of piassava ranges, according to quality, from £30 to £38 per ton for "Bahia," and from £28 to £32 for "African." The principal sources are Brazil and Liberia.

Pita-fibre. "Pita," a general Spanish term for fibre. See *Ananas*, p. 428.

Pueraria thunbergiana. "Ko-hemp," "Kudzu." (*Leguminosae*). Useful fibre obtained from stems; cultivated in China and Japan. See *Green Manures*, p. 26.

Raffia tape or bass. A well-known material used for tying purposes and making mats, baskets, &c., is derived from the cuticle of the leaves of *Raphia Ruffia*, a handsome palm of Madagascar with very large, arching, feathery leaves, 22 to 26 ft. long, and enormous spadices 10 to 15 ft. long. "Raffia" is largely exported from Madagascar, and valued at about £30 to £35 per ton. See p. 166.

Rozelle Fibre. See *Hibiscus Sabdariffa.*

Sansevieria cylindrica. Trop. Africa. (*Haemodoraceae*). "Ife Hemp." Stemless plant with succulent, cylindrical, erect leaves, 4-5 ft. long; propagated by rhizomes or seeds. Leaves furnish fine, white fibre. See p. 432. *S.*

S.—Ehrenbergii. Somaliland. Grows in arid districts; leaves yield good fibre.

S.—guineensis. "Konje Hemp;" "Sword-plant." Trop. Africa. Leaves flat, 3-5 ft. long by 3-4 in. broad, banded and blotched with grey. Thrives in moist shady places. Yields fine, white fibre, used for ropes, mats, &c. *S.*

S.—Roxburghii. "Murva-" or "Moorva Fibre." From the upright fleshy leaves is obtained a white fibre, used in India for making fine mats, hats, &c.

S.—zeylanica, see Bow-string Hemp, p. 418.

Sesbania aculeata. "Dhanicha" or "Dhunchi" (*Leguminosae*). Erect annual. Strong and durable fibre obtained from stems, used for ropes and cordage. See p. 26.

Sida rhombifolia. "Kotikan-bevila" *S*; "Chittamadi," *T.* (*Malvaceae*). An erect shrub, common in most tropical countries; stems afford a good fibre.

S.—tiliaefolia. Cultivated in China for the excellent fibre obtained from the stems.

Sterculia Balanghas. "Nawa," *S.* (*Sterculiaceae*). Small tree of Ceylon, India, and Malaya. Inner bark yields strong fibre, used for cordage, making hats, &c.

LIBRARY &c.



BOW-STRING HEMP.
1, *Sansevieria guineensis*; 2 & 4, *S.—zeylanica*; 3, *S.—cylindrica.*

Tampico Hemp. "Istle Fibre." *Agave heteracantha.* An Aloe-like plant, found in Mexico and South United States, yielding a fibre resembling Yucatan Hemp. See page 425.

Touchardia latifolia. "Olona." (*Urticaceae*). A Shrub of Hawaii; yields a fibre used for fishing nets, &c.

Trachycarpus excelsus. "Chinese coir" or Hemp-palm. Small sub-tropical palm of S. China. Fibre obtained from leaf-sheaths used for brushes, &c.

Triumfetta rhomboidea. "Epala," *S.* (*Tiliaceae*). Common shrubby perennial or annual, 5-6 ft. high, with burr-like fruits; useful fibre obtained from inner bark.

Urena lobata. "Patu-epala," *S.* (*Malvaceae*). Large, erect shrub, common in Tropics; stems yield jute-like fibre, used for cordage, &c. Cultivated in Madagascar and Cuba; also in Brazil, where it is known as "Aramina" fibre.

Vegetable Hair. A kind of curled fibre, much used for stuffing in upholstery, &c., is obtained from the stem of *Chamaerops humilis*, a dwarf fan-palm of Northern Africa and the Mediterranean region. Large quantities are exported annually from Algeria to Europe, being usually quoted in England at the following prices: "green," £5-£6 per ton; "black," £8-£9 per ton.

Villebrunia integrifolia. "Wild-" or "Ban-Rhea." (*Urticaceae*). Small shrub-by tree, found at medium to high elevations in forests of Ceylon, Bengal, Burma, Malaya, &c. Excellent fibre obtained from stems.

Wissadula zeylanica. "Kiri-kaju," *S.* (*Malvaceae*). Erect shrubby plant, 5-6 ft. high, common in low-country of Ceylon and tropics generally. Good fibre obtained from stems.

Zapupe Fibre is obtained in Mexico from several species of *Agave*, of which the most important is *A. Zapupe*, resembling Sisal-hemp. It is claimed to be superior to "Sisal" and to yield a crop earlier than the latter. An average yield of about 2½ lb. of fibre is obtained annually from each plant, in 3 cuttings. Valued in England at about £30 to £35 per ton.

3.—PITH-PLANTS, OLAS, ETC.

Aeschynomene aspera. "Pith-plant;" "Shola;" "Maha-diya-siyambala," *S.* (*Leguminosae*).—Aquatic or marsh shrub of Ceylon, India, Malaya, etc., common near sea-coast. Stems spongy, upright or floating, 2-3 in. in diameter. Cut into slices, they are largely used for making pith-hats or topees.

Anona palustris. "Pith-tree," "Pond-apple," "Alligator-apple." (*Anonaceae*). A small tree inhabiting swampy land in Trop. America and the West Indies. Wood light and pithy, used for floats, corks, etc.

Borassus flabellifer. "Palmyra palm." The young fan-shaped leaves are made into olas (leaf-paper), which are used for writing on with an iron stylus. See Palmyra palm, pages 169, 430.

Cecropia peltata. "Trumpet Tree." (*Urticaceae*). Small or medium-sized tree of Trop. S. America and West Indies, with large palmate leaves. The light, hollow branches are used for making musical instruments, etc.

Corypha umbraculifera. "Tala-gaha," *S*; Talipot Palm. See pages 167, 170. The large fan-shaped leaves made into olas, being written on with a metal stylus; also used for umbrellas, thatching, etc. See Glossary.

Fatsia (Aralia) papyrifera. Rice-paper Plant. (*Araliaceae*). A shrub with large, coarse, palmate leaves, silvery white on under side, the stems being light, pithy and spongy. A native of Formosa, it was introduced into Ceylon in 1856, and is now occasionally found naturalised by roadsides up-country, spreading by underground rhizomes. Suited to sub-tropical conditions. A troublesome weed in some countries.

Herminiera elaphroxylon. Nile Pith-tree. (*Leguminosae*). Small aquatic or marsh tree of Trop. Africa. Wood white and spongy, used for floats, &c; also cut into slices and used for making sun-hats.

Ochroma Lagopus. See page 217.

Scaevola Koenigii. "Takkada", *S.* (*Goodenoviaceae*). Large bush, common on sea-cost of Eastern tropics. Wood white and pithy, resembling that of the Rice-paper plant (*Fatsia*).

Sonneratia acida. Mangrove; "Kirilla," *S.*, and other species (*Lythraceae*). Large spreading shrubs, growing by the side of, or in, lagoons. Wood of roots and branches soft and pithy, used for corks, entomologists' boxes, &c.

4.—RATTANS OR CANES.

The rattans or canes of commerce are the long, slender stems of certain climbing palms, divested of the spiny sheaths of their pinnate leaves. They consist chiefly of species of *Calamus*, a large genus indigenous mostly to Trop. Asia, producing several stems from the base and climbing or spreading by means of sharp recurved spines, often reaching the tops of the tallest trees and in some cases attaining a length of 300-400 feet or more. Rattans (from "rotang," the Malay name) are a product of hot, humid forests, chiefly of Malaya, India, Ceylon, Borneo, Siam, Philippines, and Java, and the chief port of export is Singapore.

The largest rattans are furnished by the stems of *Calamus rudentum*, *C. ornatus*, *C. palustris*, *C. zeylanicus*, &c., and are used entire, as cables, for tying timber rafts, making bridges, cart-hoods, &c. The smaller canes, as *C. javanicus*, are used for making chairs, window-blinds, saddlery, basket-work, mats, &c. Those of medium thickness, as *C. Rotang*, which is of the size of the thumb, are usually split into strips of uniform width and length, the inner spongy portion being removed, so as to leave the external portion, which is hard, flexible, and tough, the outer surface being smooth, silicious and polished. These strips are used extensively for chair bottoms, bags, hats, &c. The finest and most valued rattans are, when entire, of the thickness of the little finger. These fetch about 8 dollars per picul.

Rattans were imported into Ceylon from Singapore, in 1923, to the extent of 108 cwt. valued at Rs. 2,160, *i.e.* about Rs. 20 (£1. 6*s* 8*d.*) per cwt. The value of rattans collected in Ceylon during the same period, chiefly in the forests of the dry districts of the Eastern Province, as a forest produce, under license, is Rs. 1,398.

Malacca Canes (walking-sticks) are obtained from the stems of non-climbing species, of which the best is *Calamus scipionum*, on account of its very long internodes, which are sometimes as much as 5 ft. *C. bacularis*, also a non-climbing species, is similarly employed and is valued for tool handles, fishing rods, &c.

5.—SERICULTURE.

As is well known, the silk of commerce is obtained from the cocoons formed by the "worms" (caterpillars) of certain moths, which in some countries, as in China, Japan, India, parts of Southern Europe, &c., are raised in great numbers from "seed" (eggs). The worms are reared in light, airy sheds, on tiers of trays, and fed on the leaves of certain plants which they eat voraciously. There are numerous species or varieties of silk-producing worms, among the best known being: (1) the Mulberry silk-worm (*Bombyx mori*), which feeds chiefly on the Mulberry leaves and is specially suited to temperate countries; (2) the "Eri" (*Attacus ricini*), a multivoltine worm (*i.e.* it undergoes from 6-8 generations in a year) which feeds on the Castor-oil plant and is adapted to the tropics; and (3) the Indian "Tasar" or "Tussar" (*Antherea paphia*), a bivoltine worm (2 crops or generations a year) which feeds on various plants, as species of Cassia, Zizyphus, Lagerstroemia, Eugenia, Terminalia, etc.

The Chinese "Tasar" (*Anthereae pernyi*) is bivoltine and feeds on species of Oak. The worm of the "Atlas-moth (*Attacus atlas*), which is common in Ceylon, also produces a good second-rate silk and is omnivorous. The Mulberry kind yields the finest silk, and is reared extensively in certain temperate countries as well as in India. Of this there are numerous varieties, all of which are univolitine, *i.e.* they go through but one generation in the year. The Eri and Indian Tasar worms are especially valued in India, while the Chinese Tasar is largely reared in China.

The silk moth lays its eggs on a leaf or twig, to which they adhere by means of a gummy substance. The number of eggs laid by each moth varies from 250 to 600 or more, according to species or variety. These are hatched out on large trays of hessian, which are arranged in tiers in light airy sheds. The caterpillars resulting are voracious feeders and require to be fed twice daily with leaves of trees on which they naturally feed. In 2-4 weeks, according to climate, and variety of worm, they begin to spin. Before commencing to spin, the caterpillars fast for 2 or 3 days, void their excrements, become soft and flaccid, and seek a suitable spot for the construction of their cocoons.

The spinning of the latter occupies from 3-5 days. The length of the silk-thread in a cocoon varies according to kind from 900 to 1,500 yards or more, and cocoons weigh at the rate of about 200 to 300 or more to the pound, according to size, variety of worm, &c. The process of spinning is effected by passing the thread through two small holes (spinnerets) in the head of the worm, which by a combined movement of the mouth and front legs unites the filament into one, binding it closely together by a gummy liquid. The cocoon finished, the worm undergoes metamorphoses, *i.e.* changes into the chrysalis or pupa state. In about 3 weeks, in the tropics, the moth, under natural conditions, emerges by forcing its way through the cocoon. The males appear first, then the females, the former being the more active in their movements; they proceed at once to pair, and both usually live but 4 or 5 days, the females meantime laying their eggs, thus completing the life cycle.

In silk culture, however, the moth is not usually permitted to emerge from the cocoon, as in doing so the latter is seriously damaged, both by the act of piercing and by the dirt and stain left behind. Therefore, in order to obviate this the pupae are destroyed by heating the cocoons, in an oven or by steaming. Indispensable

conditions for successful sericulture are cheap labour and a plentiful supply of suitable food for the worms. In Italy, Japan, China and other silk-producing countries, it is essentially a cottage industry. Efforts have been made from time to time to establish sericulture as an industry in Ceylon, it being considered an occupation peculiarly adapted to the peasants, but it had little attraction for the latter, due partly to the necessity for destroying the chrysalis in the cocoons, which constitutes an offence against the Buddhist religion.

Yield.—Both the Mulberry (*Morus indicus*) and Castor-oil plant (*Ricinus communis*) flourish in the tropics at various elevations, the former being readily propagated by cuttings, and the latter from seed and often found in a wild state. Planted at about 4 × 5 ft., an acre should furnish sufficient food for about 600,000 worms. The Eri-worm will produce 6 generations of 100,000 each in a year. Each of these, allowing for deaths, will furnish about 450,000 cocoons, which should weigh about 300 lbs. These should realise 3*s.* to 4*s.* or more per lb., or about £45-£50 per acre. The value of the cocoons depends largely on colour, "whites" being generally preferred. Italian silk is the highest priced in the European market, the cocoons being sometimes worth as much as 18*s.* or more per lb.

CHAPTER XXIX.

DYES AND TANS

1.—*PRINCIPAL DYE PLANTS.* 3.—*PRINCIPAL TANS.*
2.—*OTHER DYE PLANTS.* 4.—*OTHER TANNING TREES, ETC.*

Many vegetable dyes are now superseded by artificial dyes, as aniline, alizarine, and other products of coal tar, &c., but certain kinds are still of some commercial importance. Vegetable dye-stuffs owe their origin to the presence of small quantities of certain chemical substances secreted in the plant tissue which are extracted by processes of fermentation, boiling, treatment with chemicals, &c. Various tints or shades may be obtained from a single dye by the use of different mordants, with which the fabrics to be dyed are treated. Tannin, closely related to dye-stuffs, often occurs in plants as an excretum in the bark and other parts, which are either employed direct, or used for the extraction of tannin in a concentrated form. Tan-stuffs are often used for dyeing or staining as well as for tanning purposes.

1.—DYES.

Annatto or **Arnatto**; "Roucou." (*Bixa Orellana*. Bixaceae).—A large, quick-growing shrub or small tree with cordate leaves, native of Trop. America, naturalised in parts of W. Trop. Africa; thrives from sea-level to about 3,000 feet in a moist climate, and prefers a deep, loamy soil. It bears at the ends of the branches large clusters of brown or dark-crimson, capsular, ovoid, or round fruits, covered with fleshy spines; these contain a number of small seeds, the bright crimson covering of which affords the annatto dye of commerce. The fruits are collected when nearly ripe, and as the shells dry they burst open and disperse the seeds, which are then either pressed and made into "annatto paste," or merely dried with their covering, when they are marketed



ANNATTO. *Bixa Orellana.*
A, fruit capsule showing red-coated seeds.

as "annatto seed." Formerly the paste form was preferred by manufacturers, but the demand for this has declined in favour of the dried seed.

About 80 tons of annatto seed are said to be imported into England annually, chiefly from S. America, and a similar quantity into the United States. The present price of "Annatto seed" fluctuates from about 1*s.*-1*s.* 6*d.* per lb., according to quality and demand. Small plantations of Annatto were made in Ceylon about 1890-95, chiefly in the Matale district, and the product was until recently an article of export. It has now, however, disappeared from the export list, but the dye is sometimes used locally by the peasants, as for colouring cacao beans. The tree is readily propagated from seed, and a crop may be obtained from the third year. Two or three varieties of the tree occur in Ceylon, these differing chiefly in the shape and colour of the fruit, which is either oblong and pointed, or rather circular, and dark crimson or green.

Cochineal consists of the dried bodies of woolly insects, commonly known as "bugs" (*Coccus cacti*), which live on species of *Opuntia* or *Nopalea*, chiefly *N. coccinellifera* or "Spineless Cactus" (see p. 171). There are two kinds of the insects, viz. "silver cochineal," which has a greyish-red colour, the furrows of the body being covered with a white down; and "black cochineal," which is of a dark reddish-brown colour and destitute of down. The former is the more valuable. The male insect is winged, but the female is wingless and when full-grown is of the size of a rice grain. It is the latter which forms the cochineal of commerce, to produce a pound of which some 70,000 insects are required.

The insects are gathered three times a year; they are carefully brushed from the Cactus leaves into bags, and are then killed by immersion in hot water, or by exposure to the sun or hot steam; or are heated in an oven, losing by this process about $\frac{3}{4}$ of their weight. The dried insects keep in good condition for many years. Cochineal is valued especially for dyeing silk, producing beautiful scarlet shades; it is also employed in medicine to give a pleasant tint to certain preparations. It is imported from Mexico, the West Indies, Canary Islands, the Southern United States and Guatemala, over $1\frac{1}{2}$ million pounds being brought annually to Europe. The average price, which formerly ranged from 6*s*-9*s.* per lb., is now about 2*s.*-2*s* 6*d* per lb. The demand for cochineal has greatly diminished since the introduction of aniline dyes.

Cutch or **Catechu;** "Khair" or "Katha" of India. (*Acacia Catechu.* Leguminosae). A medium-sized tree, common in parts of India and Burma. A black gum-resin, known as "Cutch" or "Catechu," obtained by boiling chips of the heart-wood, is astringent and extensively employed for dyeing and tanning, being largely exported. It is estimated one ton of heart-wood yields on an average 250 to 300 lbs. of cutch. This is also commonly used as a masticatory in India. A valuable gum, resembling "gum arabic," is also obtained from this tree, and the wood is one of the best for making charcoal. The term "cutch" is also applied to a similar extract from Gambier. See pages 442, 443.

Dragon's Blood.—A resinous dye obtained from certain plants in different countries, among the most important source being the scaly covering of the fruits of *Daemonorops propinquus*, a climbing palm of the Rattan family (see p. 433), collected chiefly in Malaya and Borneo.

The fruits are dried, then shaken in a basket, through which the resin falls; it is collected on a cloth damped in hot water, and pressed into moulds. Lump dragon's blood is valued at about £15-£28 per cwt., according to grade, &c. Similar substances known by the name of "Dragon's Blood" are obtained from *Dracaena Draco* in the Canary Islands, *Dracaena Cinnabari* in Socotra and Zanzibar, and *Croton Draco* in Mexico. The chief use of the product is for colouring varnishes.

Henna ; Tree Mignonette ; Marithondi, *T.* (*Lawsonia alba.* Lythraceae). A deciduous, much-branched shrub, 6-8 ft. high, indigenous to Western India, Persia, etc., and to the dry region of Ceylon ; commonly cultivated throughout Egypt, Persia, India, etc., for its small oval leaves, which yield the "henna" dye; also often grown as a hedge plant (see p. 74). A crop of leaves is reaped in the second year from planting, two crops being afterwards obtained annually for many successive years. The leaves are exported to France for the extraction of a dye used in the preparation of hair dyes, etc.

At each cutting, about 9 inches are taken off the top shoots, an acre thus yielding about 1,600 lbs. of dry leaves a year. The leaves are dried and reduced to a powder which, made into a paste with water, is very commonly used by Mohammedan, and to some extent Hindu, women as a cosmetic for staining the eye-brows, finger-nails, hands, feet, etc., a dull orange-yellow ; also employed from early times in some countries, as Arabia, etc., by both men and women for dyeing the hair a reddish colour. Henna is now made up in shampoo powders, &c.

Indigo. "Nil-awari," *S.*—A blue dye obtained from species of *Indigofera*, chiefly *I. arrecta, I. sumatrana, I. anil* and *I. guatamalensis.* All are shrubby plants, annual or perennial, 3-6 ft. high, belonging to the Leguminous family. Several species occur in a wild state in Ceylon up to about 2,000 feet, chiefly in the dry region. *I. arrecta,* native of Natal, and introduced into India through Java, is especially recommended both on account of its heavier yield of crop and higher *indigotin* content. India and Java are now almost the only indigo-producing countries, as owing to competition with synthetic indigo, introduced in 1880, the price of the natural article slumped, and production rapidly decreased. Since 1914, however, the indigo industry has recovered to some extent, the price advancing from £17 to £67 per cwt. in one year. It has now, however, dropped to less than half the latter figure. Natural indigo is preferred by certain manufacturers, and species of *Indigofera* have been discovered in recent years which yield a larger percentage of indigotin than was formerly obtained. Indigotin is developed in the plant from a glucoside, by the process of fermentation. *Seet,* the refuse mould left after the extraction of indigo, is rich in nitrogen and potash, and regarded as a valuable manure.

The plant is best grown in rotation with other crops, and the best conditions for its profitable cultivation are a light loamy soil with a free sub-soil, and a moist, hot atmosphere, with a fairly evenly divided rainfall, not under 70 inches. Rich organic soil and a temperature below 60° Fah. are both unfavourable to the crop. The land being ploughed and harrowed, the seed is sown in lines about 2 feet apart; 12 to 15 lb. of the small seed is required to sow an acre. The seed germinates in 3 or 4 days, and about 3 months later the flowers appear, when the plants are ready for harvesting. The crop is usually cut down to within about 6 inches fom the ground, tied up in bundles, and carried fresh to the factory. The stumps left in the ground will afterwards "rattoon," and two, or in favourable circumstances as many as four, cuttings may be obtained from the same roots within the year.

To produce the dye, the green crop is placed in large masonry tanks and weighted down with planks. Water is laid on so as to cover the whole, which is subjected to a process of fermentation and churning. Fermentation is allowed to go on for 12-16 hours, and stopped when the leaves become a pale colour. The liquid is run off by means of a tap at the bottom of the tank, into a second tank or cistern, and is kept constantly agitated by either wading coolies, who beat it with paddles, or by a mechanical contrivance, for 2 or 3 hours, after which the indigo settles in the bottom in the form of bluish mud. This, after draining off the water, is put into bags which are hung to dry, being afterwards cut into cubes about 3 in. square, stamped, and further dried for export.

Yield.—A good yield should give about 20,000 lb. of green crop per acre from the first cutting, subsequent or rattoon cuttings giving much less. About 35-40 lb. of indigo paste may be obtained from 1,000 lb. of green plant, and 500 lb. of paste per acre is considered a good average annual yield. Indigo fetches about 2*s.* 6*d.* — 3*s.* 3*d.* per lb. in England.

Logwood. (*Haematoxylon campechianum*. Leguminosae).— A small, slow-growing tree, about 20ft. high, native of Central America, introduced and naturalised in Jamaica and other West Indian Islands. The heart-wood as well as the roots are extensively used and exported for the extraction of a valuable "fast" dye (black, dark-blue, or purple), which is used in the manufacture of woollen and silk goods, and for numerous other purposes in the arts and sciences. Introduced at Peradeniya in 1845.

The tree thrives naturally in a hot and arid climate; a moist atmosphere and rich, heavy soil is unfavourable to the development of the dye. In cultivation, care should be taken to select the "red-wood" kind, the "bastard" or colourless sort being of no value. Very little attention is necessary beyond weeding, after the plants are well established. Propagation is by seed. The seedlings may be planted out about 12 ft. by 12 ft. apart, or about 300 to the acre. From the age of 10-12 years the trees are ready for felling; the sap-wood, being valueless, is chipped off and discarded, and the brownish-red heart-wood is made up in bales for export, being valued at about £6-£8 per ton. In Jamaica it is used to some extent for the extraction of the dye locally.

Orchella. (*Rocella Montaguei*).—A pale, greenish-grey lichen, with flaccid, ribbon-like fronds, found growing on rocks or old tree trunks, chiefly in dry, arid districts close to the sea coast. The lichen was formerly collected in Ceylon and, being dried and made up in bales, exported for the purpose of extracting the dyes litmus, orchil, etc. It was valued at about 15*s.* -20*s.* per cwt. The export of orchella from Ceylon has now ceased.

Saffron. (*Crocus sativus*. Irideae). Small, showy bulbous plant of the Iris family, 6-10 in. high, native of Southern Europe, cultivated in Spain, Southern France, Turkey, Kashmir and China for the sake of the stigmas of the flowers, which form the true saffron of commerce, used for special dyes as well as for colouring cheese, special puddings, &c. The dye is employed in India chiefly for princely marriages and for caste markings of the wealthy, but its supposed medicinal properties are discredited. A warm or sub-tropical climate and a rich, well-drained garden soil suit the plant best. It is propagated from bulbs (corms), which should be planted in well-prepared ground. When once established they may be left undisturbed for 10 to 15 years or more. During the blossoming period (usually October-December in Kashmir) the flowers are collected daily, just as they open. The orange-coloured stigmas are then removed by hand, and dried immediately, usually in a fine sieve, over a low fire. When fully dried, they are stored in a dry place until required. The yield is variously estimated at from 10-30 lb. per acre, according to cultivation. About 60,000 flowers are required to produce a pound of dry saffron, which consequently is very expensive, being worth at present about £6. 10*s* to £7. 10*s* per lb.

Safflower or **False Saffron**; "Kasum" or "Kurdi" of India. (*Carthamus tinctorius*. Compositae). A prickly, shrubby annual, 2-4 ft high, supposed to be indigenous to India; cultivated in Egypt, China, India, Persia, Spain, &c., for the orange-yellow florets of the aster-like flowers, which are used as a dye. These are collected fresh in the morning, dried in the shade, on muslin trays, and afterwards stored in tins. In India it is grown chiefly as a subsidiary crop, being generally sown in October and November and harvested in January-April. The crop does best in a light, well-tilled, sandy soil. Seed is sown broadcast, or in drills 18 in. × 22 in. apart, at the rate of about 6 lb. to the acre. The yield of florets should be about 80 lb. per acre. The red colouring matter (*carthamin*) is valued in India for dyeing silk, cotton, &c., and fetches from about Rs 45/- to Rs 60/- (=£ 3-£4.) per cwt. Safflower is still grown to a considerable extent in parts of India, Persia, &c., and was at one time largely exported to Europe, &c. The seed, obtained after picking the florets, yield a valuable edible oil, and the leaves are used as a vegetable.



SAPPAN WOOD.
1, pod ; 2, flowers ; 3, section of wood; 4, open pod, showing seeds.

Sappan-wood. "Bakam," "Tairi," or "Patang" of India; "Pattangi," *S.* (*Caesalpinia Sappan.* Leguminosae).—A large, straggling, prickly, semi-climbing shrub, indigenous to India and Malaya, naturalised in the moist low-country of Ceylon. The dark-red heartwood yields a red dye and is exported, chiefly from Siam and the Philippines, after removal of the sapwood, for the extraction of the dye.

Some 880 cwt. of sappan-wood was exported from Ceylon in 1923, valued at about £400, or about 9*s.* per cwt. The dye is valued for dyeing wool and calico. The plant grows in clumps, producing several stems, which take about 6 years or more to produce a marketable heart-wood, and requires no cultivation. As the older stems are cut, others grow up and take their place. Seed season, usually August-November. The plant, woven by itself or between trees, forms a good barrier hedge.

2.—OTHER DYE PLANTS.

Artocarpus integrifolia. "Jak" or "Jack"; "Kos," *S*; "Kanthal" of India.—A large tree of India, &c. The heart-wood yields a yellow dye, used for dyeing mats, priests' robes, &c. The young shoots, on being cut, yield a quantity of white sticky latex. See *Tropical Fruits*, page 254.

Baphia nitida. "Camwood"; "Barwood."—A large Leguminous tree of W. Trop. Africa. The red heart-wood, which yields a bright red dye, is exported, chiefly to the United States ; it is valued at from £6 to £10 per ton in London.

Butea frondosa. "Palas" or "Pulas." Flowers used in India to produce a yellow or orange-red dye. See pages 85, 206, 417, 440.

Curcuma domestica (=*C. longa*). Turmeric. (See page 342).—The dried rhizome yields the yellow dye "turmeric."

Chlorophora tinctoria. "Fustic." (*Rubiaceae*).—A large tree of Central America. Heartwood yields yellow dye, which was much employed during the Great War for colouring khaki cloth, being obtained chiefly from Jamaica and Trinidad.

Cosmos sulphureus. "Xochipalli." (*Compositae*). Ornamental annual of Mexico. The bright orange-yellow flowers yield an orange-red dye. See p. 198.

Garcinia Xanthochymus. Cochin- or Rata-goraka, *S.* Small, bushy, conical tree. Yellow dye obtained from bark is extensively employed in Assam for dyeing cloth, &c. See *Trop. Fruits*, page 263.

Hibiscus rosa-sinensis. Shoe-flower ; "Sapatthu-mal," *S.* Tall shrub, occurring in many varieties. Flowers afford a red dye; commonly used locally for colouring in cookery, etc. See page 111.

Lonchocarpus cyanescens. "Yoruba Indigo." (*Leguminosae*). Large climber with fine, pinnate leaves, native of W. Trop. Africa. A blue colouring matter, extracted from the young leaves, used in the Gold Coast "for dyeing the yarn made from native cotton," &c.

Mallotus philippinensis. "Hamparila," *S*; "Kapila," *T.* (*Euphorbiaceae*).—A moderate-sized tree of Ceylon, India, Malaya, &c. The glandular pubescence of the fruit yields a rich, orange-red, permanent dye, known as "Kamela-dye."

Memecylon capitellatum. "Weli-kaha" or "Dodan-kaha," *S*; "Katti-kaya," *T*. (*Melastomaceae*). Ceylon shrub, 6-8 ft. high; small, blue flowers in clusters, along stems. Leaves afford a yellow or brown dye, used for colouring mats, &c.

Nyctanthes Arbor-tristis. "Night-flowering Jasmine"; "Sepalika," *S*. (*Oleaceae*). Large shrub of Central India. Flowers yield a yellow dye, used for dyeing cotton cloth, etc., also as a "cheap substitute for saffron." (Watt).

Oldenlandia (Hedyotis) umbellata. Chaya-root; "Saya," *S*; "Chaya," *T*; sometimes known as "Indian Madder." (*Rubiaceae*). Small annual, 10-12 in. high, found by sea coast (chiefly in dry region) in India, Ceylon, &c. Roots afford a pinkish-purple dye. The collection of the roots for export was once a Government monopoly in Ceylon.

Pterocarpus santalinus. "Red-sanders"; "Red Sandal-wood." (*Leguminosae*). A medium-sized tree of India, the red heartwood of which is fragrant and resembles Sandal-wood; it affords a reddish brown dye, used for colouring woollen cloths, &c. Cultivated in Bengal and elsewhere in India.

Rhus Cotinus. "Venetian Sumach"; "Young Fustic." (*Anacardiaceae*). Small tree of S. Europe. Young twigs yield a bright yellow dye. See page 444.

Rubia tinctorum. Madder. (*Rubiaceae*). Herbaceous perennial climber, formerly largely cultivated in Southern Europe, Northern India, &c., for the dye (alazarin) obtained from the roots. Now largely replaced by synthetic dyes.

Semecarpus anacardium. Marking-nut. (*Anacardiaceae*).—Moderate-size tree of India, Malay, &c. Juice of nut mixed with quick-lime forms indellible ink, used for marking linen, etc.

Turmeric. See *Curcuma*.

3.—TANS.

Divi-Divi; Livi-divi; Libi-dibi; "American Sumach"; "Vanni," *T*. (*Caesalpinia coriaria*. Leguminosae). A small, spreading tree, 25-30 ft. high, with small bipinnate leaves and greenish-white, sweet-scented flowers, native of Central America. It was first introduced into India about 1834, and into Ceylon probably about the same time. The tree is specially adapted to poor soil and a rather arid region, but will also thrive in rich soil and a moist locality, up to about 3,500 feet; it is sometimes found in a cultivated state in Resthouse compounds and elsewhere in Ceylon, chiefly in dry districts. Divi-divi pods, which are rich in tannin, are exported largely from Venezuela and the Island of Curacao. The exports from India, in parts of which the tree has become quite acclimatized, dropped from about 400 tons in 1914, to 150 tons in 1918, valued at about £11 per ton.



DIVI-DIVI. *Caesalpinia coriaria*. Shewing the brown, twisted pods.

Propagation is by seeds, which may be sown in beds, the seedlings being afterwards transplanted into pots or bamboo joints, from which they are afterwards planted out; or seeds may be sown direct in bamboo-pots or in the field, placing 3 or 4 seeds together. Spacing may at first be about 15 ft. each way, or 193 trees per acre: these may be thinned out later, when they cover the ground, to about 100 to the acre, say 20 × 20 ft.

Or they may be planted at once at the wider spacing, so as to enable catch-crops, such as food-crops, castor-oil plants, &c., to be grown between for at least the first few years. The tree has been recommended as a shade-tree for Coffee, for which purpose, however, its slow rate of growth is against it. The trees usually begin to bear when 6-8 years old; at the age of 10-12 years they should, under suitable climatic conditions, each produce from 30-40 lb. of dry pods, and when in full bearing, say at 15-20 years of age, 50-80 lb. per tree or about 2-3 tons per acre. Light shade, at least for the first few years, is beneficial to the crop, and excessive moisture or severe drought is injurious to it. The pods, which are in season in Ceylon chiefly during December-February, are picked when fully ripe, *i.e.* when the seed can be heard to rattle inside. They contain some 30-50 per cent. of tannin. The crop is a precarious one, and the demand for the product is apparently uncertain. In England, the pods are valued at about £10 per ton. See p. 212.

Gambier or **Gambir ; Terra Japonica ; Cutch.** (*Uncaria Gambier*. Rubiaceae). A climbing shrub of Malaya, from which a black, tar-like resinous, gummy substance is extracted by boiling chips of the wood, as well as from the leaves and young shoots.

Cutch is of an astringent character and is used for dyeing and tanning; it is also employed in medicine, and in Malaya as a common masticatory with other ingredients, as the betel-leaf, &c. It is a forest produce, and is largely exported from Malaya, being valued, according to quality, at from 50*s.* for "blocks", to about 80*s.* per cwt. for cubes. The Gambier plant was introduced into Ceylon in 1887, and flourished in the moist climate of Henaratgoda Gardens, near sea-level. It is probably unsuited for cultivation above 2,000 feet elevation. The product is obtained chiefly from, Johore. See also p. 437.

Wattle Bark. The bark of several species of Australian *Acacia* or "Wattle-barks" is rich in tannin, the more important being Black-wattle (*Acacia decurrens* var. *mollissima*); Silver-wattle (*A. dealbata*), Black-wood (*A. melanoxylon*), and Golden- or Broad-leaved wattle (*A. pycnantha*). See pages 176, 178 & 215-218. These and other "wattles" have become thoroughly established at elevations of 5,000-6,000 feet in Ceylon, thriving on almost any patana land. Wattle-barks have also been introduced and acclimatised in India, South Africa, and other warm countries. Natal has now become the principal wattle-bark producing country, where the tree is systematically cultivated.

Propagation.—Seeds (3 or 4 together) should be sown in plant-baskets, bamboo, or reed-joints. When planting on a large scale, the seed is best sown at stake, *i.e. in situ*, in the rainy season, as the Wattles do not bear transplanting well. As the outer coating of the seed is very hard, the seed should be placed in almost boiling water and left to soak for 2 or 3 days. If the seed can then be cut with the thumb nail, it is soft enough for sowing; otherwise pour more boiling water over it, and leave to soak longer. About 30,000 seeds usually go to a pound, and from 1 to 1½ lb. of seed should be allowed for sowing an acre.

Cultivation.—The trees grow readily in almost any soil, under sub-tropical conditions, or at medium to high elevations in the tropics. They make excellent wind-breaks, especially *A. dealbata*, which suckers or coppices freely, and may be planted for this purpose about 8 ft by 8 ft. apart. Planted for bark, a spacing of 6ft. by 6 ft. (= 1,210 trees to the acre) is recommended in Natal. This allows for thinning out when the trees are about 4 years old. The trees grow rapidly, attaining in Ceylon a height of 15-20 ft. or more in 2 years.

Harvesting & Yield.—Under favourable conditions the trees should be ready for *barking* at about 7-8 years of age, when the yield should be about 3-4 tons of bark per acre. A small crop may be obtained from thinnings, which should take place when the plantation is 4 or 5 years old, but the bark from young trees is less rich in tannin. The best time to strip is when "the sap is up," or when growth is active. The usual method is to clear the stem of small twigs and branches, and ring the bark with an axe as high up the tree as a man can reach. A longitudinal cut is then made in the bark from the ring to the bottom, and the bark may be slightly hammered with the back of the axe. The bark can then be easily removed by inserting

the axe under it, pulling it off in strips with a downward jerk. The trees are then felled, the upper branches cut off, and the remaining bark stripped. Well-grown trees about 10 years old yield as much as 1 cwt. of dry bark each, and smaller trees from 30 -40 lbs. At Hakgala Gardens, Ceylon, trees 5 years old yielded each over 50 lbs. dried bark. In Natal, coolies work mostly on task-work, each stripping about 800 lbs. of bark per day. In Australia, the cost of barking varies from £2.10*s.* to £3 per ton. Drying the bark is done in the open air, but open sheds, fitted with horizontal poles on which the bark can be placed in case of rain, are useful. In the open, green bark will dry in about 8 days in fine weather, losing about 30 per cent. of its weight in the process. The bark is then cut up by a machine into small inch-pieces, and afterwards packed with hessian in bales of about 200 lb. each.

The bark fetches at present from £9 to £11 per ton in London. In some localities a revenue may be obtained from the sale of stripped trees for poles, timber, fuel, &c. During the first year a catch-crop may be raised between the lines. Regeneration may be effected every 8th or 9th year, after the ground is cleared of all timber and debris.

4.—OTHER TANNING TREES, ETC.

Acacia arabica, "Karuvel," *T*; "Babul" of India (*Leguminosae*).—A small tree, widely distributed in dry districts in India, Ceylon, Africa, &c. The astringent bark is extensively used in India for tanning; also as a dye in calico printing.

A. Catechu. "Cutch;" Catechu, "Black Catechu" or "Pegu Catechu." A small tree of N. India, Burma, etc., the heart-wood of which, cut into chips, yields on boiling a dark resinous substance, which is very astringent and much used for tanning, also sometimes for dyeing. See p. 437.

Anogeissus latifolia. "Dhaura." (*Combretaceae*).—A large deciduous tree of South and Central India, the leaves of which are used for tanning. A gum obtained from the stem is used in calico printing. See p. 441.

Areca Catechu. Arecanut; "Puwak," *S.* An erect, slender palm, native of Malaya. Wood used for tanning; fruit also astringent and similarly employed. See *Masticatories*, page 380.

Caesalpinia digyna. "Tari Pods." The fruit of a prickly, climbing shrub of India, rich in tannic acid (30 to 50 per cent.), of which high hopes have been formed in India as a tanning material.

Canaigre, see *Rumex*, p. 444.

Careya arborea. "Patana Oak"; "Kahata," *S.* A small or medium-sized tree, of Ceylon, India, etc. Bark astringent, used for tanning as well as in medicine. The round green fruits, borne in great profusion, are in season in May-June.

Cassia auriculata. "Ranawara," *S*; "Avarai," *T*; "Tanner's Cassia"; "Matara Tea." Ceylon, India, Burma, &c. A quick-growing large shrub. Bark largely used by tanners in India and Ceylon. Leaves used in medicine, and young shoots as tooth-brushes. See pages 109, 140, 378.

Casuarina equisetifolia and other species. Bark astringent and sometimes used in tanning.

Ceriops Candolleana. Mangrove Bark; Tengah Bark. (*Rhizophoreae*). Ceylon and Eastern Tropics. Moderate-sized spreading tree, inhabiting lagoons. Bark and extracts from it used for dyeing and tanning. See *Rhizophora*, page 444.

Diospyros Embryopteris. "Timbiri." *S.* (See page 396). Bark and unripe fruits very astringent, the latter commonly used in Ceylon for tanning fishing nets, &c., and medicinally in India. Bark alone medicinal in Ceylon.

Mallet Bark. (*Eucalyptus occidentalis*, var. *astringens*). West-Australian tree. Bark recently come into use for tanning, being rich in tannic matter.

Mangrove Bark, see *Ceriops* and *Rhizophora*.

Mimusops hexandra. "Palu," *S*; "Palai," *T*. (*Sapotaceae*). Moderate-sized, hard-wooded, slow-growing tree of India and Ceylon. Bark astringent, recommended for tanning; commonly used for retarding fermentation in toddy. See *Timbers*, page 219, under "Palu."

Myrobalans, see *Terminalia*, page 444.

Phyllanthus Emblica. "Emblic Myrobalans;" "Nel-li," *S.* Small tree or shrub of Ceylon, India, Java, etc.; common on patana land at medium elevations in Ceylon. Fruits, bark, and leaves used in India for tanning and dyeing, also in native medicine.

Quebracho or **"Quebracho Colorado."** (*Quebrachia Lorentzii* and *Q.—Morongii*. Anacardiaceae). In Paraguay the wood is chopped up and much used for tanning purposes.

Rhizophora mucronata. Mangrove Bark; "Kadol." *S*; "Kandal," *T.* (*Rhizophoreae*). Ceylon and Eastern Tropics. Moderate-sized spreading tree, inhabiting lagoons. Bark and extract from wood used for tanning and dyeing. See *Ceriops*.

Rhus Coriaria. Mediterranean Sumach. Hardy shrub, found on rocky slopes in Sicily, &c; cultivated for the leaves and shoots, which are used for tanning.

R.—Cotinus. "Venetian Sumach"; "Young Fustic." See p. 441.

R.—Metopium. "Jamaica Sumach." Jamaica.

Rumex hymenosepalus. "Canaigre." (*Polygonaceae*). Mexico. A tuberous perennial, the astringent tuberous roots of which are used for tanning purposes in Mexico.

Semecarpus Anacardium. Marking-nut Tree. (*Anacardiaceae*). A moderate-sized deciduons tree of India, Malaya, &c. An acrid, viscid juice, obtained from incisions made in stem, used as a varnish; astringent juice of fruit used for marking-ink.

Sumach, Cape. (*Colpoon compressum*. Santalaceae); Jamaica Sumach (*Rhus Metopium*); Mediterranean Sumach (*R.—coriaria*); Venetian Sumach (*R. Cotinus*).

Terminalia belerica. "Beleric Myrobalans;" "Bulu," *S*; "Tanti," *T.* (*Combretaceae*).—A very large tree of Ceylon, India, Malaya, &c. The dried fruits ("nuts") are used in India as an inferior dyeing and tanning material; also much employed in native medicine. Kernels edible. Wood of little value except for inferior planking.

T.—Chebula. "Chebulic" or "Black-Myrobalans;" "Ink-nuts;" "Gall-nuts"; "Aralu," *S*; "Kadukkay," *T.* Ceylon, India, Burma, &c. A moderate-sized deciduous tree. Flesh of fruit rich in tannin; the dried ovoid fruits ("nuts") used largely in India for dyeing and tanning, being regarded as one of the most valuable of Indian tanning materials; they are also valued in native medicine, and yield a black or yellow dye. They are collected as a "forest produce," under license, and largely exported from India, as they were formerly from Ceylon. Like other species of Terminalia, the tree yields a gum, which is collected and used for mixing with other gums. Wood fairly hard and durable.

Vateria acuminata. "Hal." *S*. A large, very handsome tree of the moist low-country of Ceylon (endemic). Bark astringent, commonly used in Ceylon for retarding fermentation in palm toddy. See page 412.

CHAPTER XXX.

PASTURE-MAKING AND PASTURE PLANTS

1.—*PASTURE-MAKING, FODDER-GROWING, ETC.*
2.—*GRASSES CHIEFLY SUITED FOR FODDER OR HAY.*
3.—*OTHER FODDER PLANTS.*
4.—*PASTURE PLANTS.*
5.—*BROWSE OR FAMINE PLANTS.*

1.—PASTURE-MAKING AND PASTURE PLANTS.

In many parts of the tropics the scarcity of good pasture, natural or artificial, for grazing stock is a common occurrence. Often the natural grasses grow coarse and wiry, tender herbage is replaced by woody growths, and the essential conditions to good pasturage are generally lacking. The extensive grass-covered patana lands occurring at the higher elevations in Ceylon are of little use for grazing, except perhaps for a short period after the mature grass has been burned off. Not only are the natural conditions for pasture often lacking, but the cultivation of perennial crops, where this occurs, precludes rotation and, therefore, the inclusion of grazing crops in the planting routine. Periods of drought or excessive rainfall, hard and impervious soil without humus, and the lack of suitable grasses or herbage are also obstacles often in the way of good grazing. Fallow land rapidly becomes covered with scrub or arborescent growth if not constantly weeded. In many cases live pests, as ticks and land-leeches (see p. 489), are a serious handicap to grazing conditions.

Yet cattle are of special importance in the tropics, being indispensable for draught, dairy, meat, or manuring purposes, and any measures calculated to provide satisfactory sources of feed for them deserve serious attention. In Ceylon, the small indigenous cattle are often allowed to roam and pick up what feed they can, while the heavier imported animals are invariably stall-fed. Under average conditions, 3 acres of pasture should maintain 1 cow, while one acre well cultivated with fodder grass, as Guinea-grass, supplemented with about 3 or 4 lbs. of concentrated feeding stuff per day each, should support 3 medium-sized cows. A stall-fed cow of medium size requires 40-45 lbs. of green grass a day, whilst a larger animal will require 50-60 lb. a day.

Pasture or Fodder as Intercrops.—The growing of fodder crops, especially leguminous species, between certain perennial tree-crops,

as on coconut plantations, is sometimes recommended and may be beneficial to the main crop. On mature coconut plantations, the ground may with advantage be put under pasture and utilized for grazing cattle. The manure from the latter will benefit the palms, whilst the light filtering shade afforded by the palms favours the growth of tender grasses for grazing. In some countries, as in Fiji, cattle are especially herded and fed on coconut plantations for the purpose of manuring and mulching the crop.

Ravines, Patanas, Jungle Reserve, etc.—On plantations there are often ravines, strips of private roadsides, unopened forests or jungle, etc., which, though often regarded as waste ground, might be utilized for the growth of pasture or fodder plants. Unopened forests or jungle, in many cases, need only have the tangle of undergrowth removed in order to afford suitable conditions for good pasturage.

Patanas and chena land might also, in many cases, be reclaimed for pasturing, while peasants' compounds, or so-called gardens, could often be much improved by clearing away the useless undergrowth and encouraging the growth of fodder or pasture under the shade of trees, a factor which might also conduce to the improvement of local sanitation and the reduction of malaria. Under the seapage of tanks or reservoirs, there are often considerable areas which might well be utilized for grazing purposes or for growing fodder grasses.

Fallow Rice Fields, Conservation of Fodder, etc.—After reaping a harvest of paddy, the *goiya* (Sinhalese farmer) usually leaves his fields bare for a considerable period, in some cases abandoning them for several years. If these were re-irrigated and planted under intercrops of leguminous plants, the latter would not only provide food for cattle during the dry season, but would also have the effect of renovating the soil. See *Green Manuring*, p. 25.

Ensilage.—In some countries it is customary to make provision for seasons of scarcity by converting surplus grass or other fodder into hay or ensilage. Ensilage has the advantage of preserving fodder in its green nourishing state for a considerable period. The following is the usual method of procedure: A large round pit, called a silo, sufficient to hold from 30-50 tons or more of green forage, is excavated; the grass is cut while soft and moist, just as the ears begin to harden, and placed at once in the silo, pressing it down tightly. When quite full, the top is covered with planks and then earth, making the silo as light-and air-tight as possible.

Formation of Pastures.—Any available land, provided it is reasonably moist and not subject to floods, may be made to answer the purpose of pasture. In order to give the grasses, etc., a good foundation, the ground should be well tilled and broken up before planting, being ploughed deeply or dug to a depth of 15 in. or more, removing the roughest stones, roots or other obstacles, and leaving a tolerably smooth surface.

A certain amount of shade is beneficial, both for the growth of pasture and for affording shelter to stock from the sun. Therefore, existing trees should be left at suitable distances apart, or, where these are wanting, light foliaged species should be planted, as *Albizzia moluccana*, *Albizzia Lebbek* ("Woman's Tongue" of the West Indies), *Pithecolobium Saman* (Rain Tree), *Erythrina lithosperma*, &c. Grass seed may be sown broadcast at the rate of about 15 or 20 lbs. to the acre, according as the seed is small or large, and afterwards raked or harrowed into the soil; or roots or cuttings of selected grasses may be planted out in wet weather at distances of about 6 inches apart, the object being to form a close sward in the shortest time possible. Very frequently the latter method is the more suited to the tropics, especially where labour is plentiful. See page 69.

Upkeep of Pastures.—Periodical weeding and occasional manuring are necessary for the maintenance of good pasture. Coarse weeds or woody growths are liable to appear, and these, if allowed to grow unchecked, will soon supersede the grasses. An occasional surface-dressing, consisting of well-decomposed manure mixed with loamy soil, is most beneficial, whilst a stimulating mixture containing certain proportions of nitrate of soda and basic slag usually gives satisfactory results and usually well repays the cost.

The following mixture is especially recommended, the quantities being for an acre, viz : Basic slag, 250 lb ; Nitrate of Soda, 150 lb., and Muriate of Potash, 100 lb. The mixture may be applied at the rate of about 2 or 3 oz. per square yard. Cattle should not be allowed to graze on land so treated for about 2 months after the application. Partial irrigation during dry weather not only greatly increases the yield, but also improves the quality of the feed.

Upkeep of Fodder Grasses. Fodder grasses usually thrive best on moist, alluvial, flat land, as along river banks ; they require good cultivation and liberal manuring in order to afford heavy and regular yields. Occasional irrigation is most beneficial; in dry localities it is indispensable. On steep land, terracing should be resorted to.

The ground having been well tilled, limed and manured, roots may be planted about 20 × 20 in., as for Guinea-grass, or at less or greater distances according to species and locality, always choosing wet weather for the operation of planting. On sloping land or shallow soil the spacing need not be more than 16 in. by 18 in. If the weather should turn dry, it may be necessary to water the plants and shade them with fern fronds, etc., until well established. The first cutting may, under favourable circumstances, be made in about 3 months from planting, and subsequent cuttings at intervals of about 3 weeks or a month.

The ground should be weeded about once in 2 or 3 months, and well manured and forked at least once a year. Pen manure is the best, for it furnishes humus and mulch besides plant-food. 10 tons of such manure per acre is a liberal application. A dressing of lime at the rate of about 1½-2 tons to the acre, say once in 3 or 4 years, will usually prove most beneficial, especially if the ground is of a sour nature. Chopping down the sides of the rows should be done periodically, as at the time of manuring, and it is usually best to replant the field once in 3 or 4 years.

The quality of grasses and their food values depend much on cultivation. Grasses do not succeed equally well in all localities ; certain species are more suited to dry districts, while others will thrive only in moist localities. "English" grasses, it may be said, are seldom, if ever, a success in the tropics, and even at the higher elevations they invariably become, in a comparatively short time, replaced by local species or weeds.

Tall-growing grasses with leafy stems, suitable for cutting and being fed to stock, are generally known as *fodder grasses*, as distinct from *pasture grasses*, the latter being of a creeping, spreading nature and therefore more suitable for grazing. The following is a selection of fodder grasses suited to tropical or sub-tropical conditions.

2.—FODDER OR HAY GRASSES.

Andropogon (Sorghum) halapensis. Johnson- or Cuba-grass.—A tall handsome perennial with creeping rhizomes, largely grown in parts of India, S. America, Australia, &c., being esteemed for green fodder and for hay. In India the seed is eaten by the poorer classes.

Andropogon pertusus. "Sour-grass" of Barbados.—A perennial grass with aromatic leaves, bearded at the nodes, 1½-2 ft. high, common in Ceylon and Trop. Asia generally; naturalised in parts of the West Indies and said to be the chief fodder grass of Barbados, where it is considered "an excellent fodder in a green or dry state, yielding 5-7 tons annually without manure, and 10-12 tons with manure," being cut 3 times a year. It is readily propagated by roots planted 1×1 ft. apart.

Andropogon Sorghum, var. "Sudan Grass."—A tall, erect, annual grass with numerous leafy stems, 5-8 ft. high, similar to "Johnson Grass." Thrives on ordinary soils, but does best on good loam, affording 3 or 4 cuttings a year; considered in S. Africa to be "one of the most drought-resisting hay crops." Seeds may be sown broadcast at the rate of 20-25 lb. (or 4-5 lbs. if in rows) per acre.

Anthistiria australis (*A. imerbis*). "Kangaroo-grass" of Australia.—A perennial, 2-3 ft. high, common in Ceylon, India, and East Africa. In parts of Australia, it is regarded as one of the most useful of indigenous grasses, stock of all kind being fond of it, while in East Africa it is esteemed for green fodder and for making hay.

Chloris gayana. "Rhodes-grass;" "Sweet-grass."—A dense-growing perennial, about 1½-2 ft. high, much in favour as a fodder grass in South Africa, suitable for warm and sub-tropical climates. Commonly cultivated in India for dairy cattle. Thrives at Peradeniya, but apparently is not well suited to a moist, tropical climate.

Coix Lacryma-jobi. Job's Tears; Kikirindi, *S*; "Adlay" of the Philippines, &c. See page 308.

Cynodon Dactylon. "Doob"- or "Doub-grass"; "Bahama-grass;" "Devil's grass;" "Bermuda-grass;" "Arugam-pillu," *T.*—A prostrate or creeping perennial species with fine, narrow leaves and slender stems, found in all tropical countries, especially in arid localities. It resists drought well, makes good hay, and is adapted for covering bare barren land in dry districts or near the sea. In British Guiana, "a crop from one of the lawns in the Botanic Gardens, which had not been manured, gave an average yield of 22 tons of green fodder per acre from 12 mowings." Under ordinary conditions it may be expected to give at least 10 tons per acre. Easily propagated by cuttings or seed. Forms a good sward (see p. 71) and is a favourite lawn-grass in India, Egypt, etc., though a troublesome weed in the Southern United States and elsewhere. Not suited to shady or moist situations.

Eragrostis abyssinica. Known as "Teff," "Jtheff," or "Thaff".—An Abyssinian species, largely cultivated in some countries for fodder; also sometimes for its grain. It is esteemed for dry regions, especially at medium or high altitudes. 8-10 lbs. of seed per acre is required for sowing; the seed, being very small, should be mixed with fine sand or dry soil to facilitate even distribution.

Euchlaena (Reana) luxurians. "Teosinte."—A tall, annual, Maize-like grass of Guatemala, with large angular grains and large, broad leaves, sometimes attaining a height of 10-12 ft. or more; "one of the most prolific of fodder plants, tillering well and, under favourable conditions, yielding very heavy crops." At Madras, under irrigation, a single cutting gave a yield of about 20 tons per acre, while the crop for the year, in 3 or 4 cuttings, was estimated to give 60 to 80 tons. Cattle and horses are very fond of it. See also *Ornamental Grasses*, p. 172.

Ischaemum ciliare. "Rat-tana," *S*; "Nandu-kanni," *T.*—A common perennial grass, found at all elevations in Ceylon; at one time commonly grown under the shade of coconuts near Colombo and brought into town as fodder for cattle.

Ischaemum muticum. A common grass in damp situations near Colombo, large quantities of which, according to Ferguson, used to be collected by the grass-women for horse-food in Colombo. In the jungle, where it obtains support, it is a tall grass, growing to several feet in height.

Ischaemum timorense (*Spodiopogon obliquivalvis*). A slender straggling grass, common in the low-country of Ceylon, usually inhabiting damp and shady places; excellent for green fodder. This grass is remarkable for its aerial roots, which become embedded in gelatinous matter during the monsoon rains.

Melinis minutiflora. "Efwatakala Grass;" "Molasses Grass."—A hairy, viscid, semi-creeping grass, resembling "Mauritius Grass," native of Brazil. It forms a dense mass, 3 ft. or more in height, and is well spoken of in Rhodesia for fodder or hay purposes, "yielding about 5 tons of dried hay per acre." Introduced at the Peradeniya Experiment Station in 1923, and promises to become well estab-

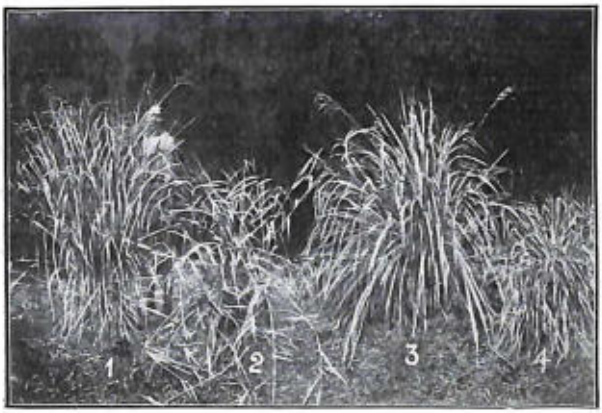
lished here, though it remains to be seen whether it has any advantages over the already naturalised "Mauritius Grass."

Panicum Burmanni. "Pagister-," or "Scotch-grass" of the West Indies. Found chiefly in wet land, very prolific and well spoken of as a fodder-grass.

Panicum Crus-galli, var. "Cockspur Grass"; "Wel-marukku," *S.*—An annual grass, of which there are several temperate and tropical varieties, 2-3 ft. high, found in the low-country of Ceylon and throughout the tropics, esteemed in India, Queensland and elsewhere as fodder. WATT refers to a variety in India as "the quickest growing of all millets, being harvested in some localities within six weeks of being sown." See p. 309.

Panicum maximum. "Guinea Grass;" "Rata-tana," *S.*—This well-known species, a native of Trop. Africa, is cultivated in most tropical countries, and is probably the best fodder grass of the tropics. In Ceylon, it holds first place at low and medium elevations, and is fed to dairy and draught cattle as well as to horses. With liberal cultivation and manuring, it may be cut once in 3 or 4 weeks almost throughout the year. A normal yield under ordinary conditions is about 40 tons per acre, but in rich soil, on flat land, with heavy and regular manuring, a yield of about 80 to 100 tons per acre is said to be obtained, as for example at the Hong Kong Dairy Farm, where all the manure from the cattle is applied to the fields. In British Guiana, it is said to have given an annual yield of 107 tons per acre "in rich though not specially prepared land". At the Experiment Station, Peradeniya, the annual yield is estimated at about 40 tons per acre (see page 454). The grass thrives best on deep, alluvial, moist soil, in the low-country, growing to a height of about 4-5 ft., if left uncut. It is suited to elevations up to about 4,000 ft., but growth is slower and the yield smaller at the higher elevations. It appears to produce but little fertile seed in Ceylon, but is readily propagated by division of the root. Plant out in well-tilled soil, about 20×20 inches apart each way, in average soils, or 22×22 in. in rich soil at low elevations. The first cutting may be obtained in $2\frac{1}{2}$-3 months from planting, and subsequent cuttings once in 3 weeks or a month. If cultivation and manuring are not well maintained, the grass will require replanting once in 3 or 4 years. See p. 447.

Panicum barbinode (=P.—muticum or **P.—molle).** "Mauritius-," "Para-," "Water-," or "Buffalo-grass;" "Diya-tanakola," *S.*—A somewhat coarse, hairy (especially at the nodes), spreading grass with long, creeping, thick stems, thriving and spreading rapidly in moist or swampy ground, often taking complete possession of the soil. It produces soft, succulent growth, which should be cut when young, otherwise the stems become very long and hard. It roots readily at the joints, which sometimes "grow after passing through cattle." In Ceylon, where it is naturalised, it thrives up to 4,000 feet in flat, moist situations, and may be considered to rank next in importance to the Guinea-grass. It is much grown in other tropical countries, as the West Indies, Florida, Mauritius, Bengal, etc. A native of Trop. America, it is considered to have been first introduced to the Eastern tropics about 1850. To cover the ground quickly, cuttings may be planted about $1\frac{1}{2} \times 1\frac{1}{2}$ ft. or closer.



PRINCIPAL FODDER GRASSES IN CEYLON.

1, Guinea-grass; 2, Water- or Mauritius-grass; 3, Paspalum virgatum; 4, Paspalum dilatatum.

Panicum repens. "Couch-grass;" "Etora," *S.* — A widely distributed, deep-rooting, persistent grass with narrow, pointed leaves, common in Ceylon from sea-level to 6,000 ft. elevation, and thriving equally well in dry sandy soil, rocky ground, or marshes. Large quantities of it used to be brought into Colombo for feeding horses and cattle, being considered to be good fodder though scanty, reaching only about 15-18 inches in height. See *Weeds*, p. 474.

Panicum spectabile. "African Wonder Grass;" "Capim-de-Angola."—A valuable fodder plant, long established in Brazil and other parts of Trop. America, supposed to have been first introduced from the west coast of Africa. It is distinguished by long, broad leaves and bearded nodes, and grows 5-6 ft. in height. Readily propagated by division; prefers moist localities and spreads rapidly when once established.

Paspalum dilatatum. Sometimes known as the "Hairy" or "Squat" Paspalum, also as "Golden Crown."—A low, perennial, spreading grass, indigenous to South America, introduced into Australia some years ago, and thence into India and Ceylon about 1900. It is relished by cattle, and suited chiefly to medium or high elevations in the tropics, flourishing in any fairly good soil. When used for green fodder, it is estimated to yield annually from 20-30 tons or more per acre, according to locality. It is especially suited for pastures, and is excellent for binding railway banks and for similar purposes. Left to itself, it attains a height of from 18-24 inches. Propagated by roots, cuttings, or seed. Spacing may be 10 in. × 10 in. for pastures, or 15 in. × 10 in. for fodder purposes. See *Lawns*, p. 72

Paspalum virgatum. "Upright Paspalum," as distinct from the squat or low Paspalum (*P. dilitatum*) above referred to. An erect, bushy, spreading grass, 4-5 ft. high, with leafy stems; leaves hairy at the base; recently introduced into Ceylon. It is an excellent fodder-grass, similar in general appearance to the Guinea-grass; suited to medium and high elevations and adapted to almost any kind of soil. It yields heavy crops, and cattle relish it. In S. Africa, it is said to be "a great milk-producer, especially palatable to cattle." Propagated by seed (at the rate of about 10 lb. to an acre), suckers, or root division; may be planted about 20 in. by 20 in. apart in good soil, or 15 × 15 in. in poor soil or on steep land. It my be cut in 2½ months from planting, and afterwards at intervals of 3 weeks. This grass is also well spoken of in the West Indies.

Pennisetum clandestinum. "Kikuyu-grass."—A slender, creeping, spreading grass, 2 3 ft high, rather resembling Doob-grass and, like the latter, is suited mainly to dry sandy soil. It is not adapted to a moist climate, nor perhaps to be recommended where better grasses will thrive. It appears, however, to be well spoken of in S. Africa, where it is indigenous. Cuttings may be planted about 18 × 18 in. apart.

Pennisetum purpurascens. "Elephant Grass".— A tall, coarse grass, 8-10 ft. high, with leaves 2-2½ ft. long by 2 or 2½ in. broad, native of Uganda, &c.; yields a heavy crop, especially under irirgation; may be cut about 4 months from planting and once every 2 months afterwards or oftener. It may be planted 2½ ft. by 2½ ft. apart, ratoons well, and is not particular as to soil. Other species are known as "Elephant Grass," viz: *Saccharum procerum* (a large coarse grass, 8-10 ft. high), *Typha elephantina* (a tall species of Bulrush), &c.

Pennisetum typhoideum. "Napier Grass." Known to the Tamils in India and Jafina as "Kambu" or "Peria-manjal-cholum." A very large perennial grass, 8-10 ft. high, with long, rather narrow, coarse leaves, each of which has a white line along the centre. It is liked by cattle, and stands drought well.

Sporobolus indicus.—A perennial grass, about 2-3 ft. high, common throughout Ceylon and other tropical countries. Grows well on indifferent soil, affords good fodder or pasture.

Stenotaphrum complanatum.—A creeping leafy grass, 1-1½ ft. high, with smooth glabrous leaves. Thrives best on moist banks or under the partial shade of trees. Grows well under Casuarina trees in Mauritius, and forms good grazing pasture.

S.—americanum. "Pimento Grass."—Similar to the preceding species. Flourishes under Pimento trees in the W. Indies, hence its popular name

Tricholaena rosea. Natal "Red-top Grass."—An elegant perennial grass, 1½-2 ft. high, with pinkish flowering panicles, native of Natal, where it is used chiefly for hay purposes. Naturalised and valued as a hay crop in Brazil. Thrives at medium and high elevations in Ceylon, where it was introduced in 1900 as an ornamental grass, being rather ornamental on account of its rose-pink flowers. It is frequently in blossom, which detracts from its fodder value, and seeds freely.

Tripsacum laxum. "Guatemala-grass."—A medium-sized grass, withstands drought well.

Zea Mays. Maize; Indian-corn; "Bada-iringu," *S.*—This well-known and quick-growing crop, though usually cultivated for its grain, is sometimes grown as green fodder for dairy cattle, etc., being cut when about two-thirds grown. It is a most productive crop, a well-cultivated patch being known to produce about 60 tons of green fodder per acre. Seeds may be sown about 12 inches apart each way, in rows. See pages 307 & 310.



1, Rhodes Grass, *Chloris gayana.*
2, Red-top Grass, *Tricholaena rosea.*

3.—OTHER FODDER PLANTS.

It is sometimes desirable to vary or supplement the grass diet of cattle by mixing with it other nourishing herbage. The following are well known in different countries for their fodder qualities.

"Chou Moellier," "Chou de Burghley," or "Cabbage Broccoli."—Considered to be a cross between the Cabbage and Broccoli, possessing to some extent the characteristics of both and attaining a height of 4-5 ft. It may be used either as a vegetable or as feed for stock, but is cultivated more specially as a fodder plant, the leaves being broken off from the stem from time to time as required. It has become a popular vegetable in some School gardens in the low-country, Ceylon, growing to a height of about 4-5 ft. or more. See p. 319.

Desmodium gyrans. "Chanchala," *S.*; also called "Telegraph plant" (from the rotary motion of the two lateral leaflets, resembling semaphores).—An erect leguminous perennial, about 2-3 ft. high, common in the moist-low-country of Ceylon up to about 3,000 feet; relished by cattle. Other species of *Desmodium* are also valued for fodder, as *D. tortuosum* ("Beggar weed") in Florida, &c. See p. 452.

Glycine hispida. Soya Bean. In sub-tropical countries several varieties of this annual bean attain a height of several feet and furnish valuable fodder, either in the green or dry state. See *Trop. Vegetables*, page 287.

Hedysarum coronarium. "Soola" or "Sulla-clover."—A leguminous plant, 2-3 feet high, much esteemed in Australia for green fodder, said to give a yield of 40-50 tons per acre. Thrives best in moist, deep, calcareous soil.

Pithecolobium (Inga) Saman. "Rain Tree"; "Peni-karal," *S.*—The thick sugary pods of this well-known shade tree are very nutritious and much relished by cattle. They resemble the Locust-bean of commerce, but are coarser and less sugary than the latter, and in South America are collected and exported for cattle-food, being esteemed for fattening purposes. See pages 102, 207, 417.

Medicago sativa. Lucerne; "Alfalfa" of America; sometimes called "King of Fodders." A clover-like leguminous plant, native of S. Europe or N. Africa; adapted to sub-tropical climates, but generally unsuited to the tropics. Under irrigation it gives about 8 cuttings a year, each amounting to about 1½ tons or, under especially favourable conditions, 2 tons of fodder per acre, averaging, according to conditions, between 7 and 10 tons a year. The crop lasts for 12 to 15 years or more without renewal. Thrives best in loamy, marly soil. A small trial plot at Hakgala Gardens (5,500 ft.), Ceylon, gave a small crop, but the cost was out of proportion to the yield, and the plants did not survive long. Like most clovers, the plant requires a soil rich in lime, which if deficient must be supplied.

Mucuna utilis (*Stizolobium deeringianum*). Lyon Bean.—A quick-growing, annual, climbing or creeping bean, with stout velvety pods. This and similar free-growing beans form valuable fodders, and are extensively grown both for this purpose and for green-manuring in the Southern United States and elsewhere. See pages 26, 288.

Polygonum. An extensive genus of leafy, creeping or erect herbs, sometimes large shrubs, found throughout warm countries, usually inhabiting moist localities. Some species are used for fodder, but of the 10 indigenous to Ceylon few, if any, appear to be relished by cattle.

Trifolium alexandrinum. "Berseem" or "Egyptian Clover". (*Leguminosae*). A perennial clover, much esteemed and extensively cultivated in Egypt, being more especially adapted to arid salt lands, where little or nothing else will thrive. In Egypt it affords the principal green food of cattle, horses, camels and donkeys. The crop is ready for cutting in 2-3 months from sowing, a good crop yielding about 8 tons per acre a year. It is also valued for grazing as well as for reclaiming infertile brackish land. Berseem has been tried at different elevations in Ceylon, but without success.

4.—PASTURE PLANTS.

Grasses are not, as a rule, equally adapted for both fodder and pasture purposes, the taller fodder kinds being generally unsuited for close grazing or pasturing, see page 446. The following selection includes well-known pasture plants, though some of these are also adapted for fodder purposes.

Anthistiria australis. "Kangaroo-grass," see *Fodder Grasses* p. 448.

A.—cymbaria. "Karawata-maana," *S.*—An abundant grass on the patanas of upper Dimbula, Ceylon, "often cut and dried for fodder for cattle, being perhaps the best substitute for hay of all grasses found in Ceylon." (FERGUSON).

Astrelba pectinata. "Mitchell-grass".—A perennial, 2-3 ft. high, native of Queensland, where it is much esteemed as a pasture grass, resisting drought well.

Bromus unioloides. "Prairie-grass." A good pasture and hay grass in Australia. Thrives best on moist, heavy soils.

Chrysopogon (Andropogon) aciculatus. "Tutteri," *S*; "Love-grass."—A well-known perennial grass, very common in Ceylon up to 4,000 ft. Resists drought well, forms good grazing, also a good sward. See under *Lawns*, page 71.

Cynodon Dactylon. Doob or Doub-grass. See *Fodder Grasses*, pages 448.

Desmodium heterophyllum. "Maha-undupiyali," *S.* (Leguminosae). A perennial prostrate herb, with trifoliate leaves and pale purple flowers, common in the low-country of Ceylon up to 2,000 feet. An important constituent of pastures, thriving in shade or in the open.

Desmodium triflorum. "Hin-undupiyali," *S.* A very small, creeping, perennial clover, similar to the latter species, but with finer foliage and bright purple flowers. Very common in the low-country of Ceylon; forms a beautiful close sward. See *Ground Covers*, pages 26 & 71.

Eleusine indica. "Wal-mal-kurakkan," *S.* An annual grass, forming good pasture, common in Ceylon.

Eragrostis tenella. A slender, annual, spreading grass, of which there are many forms. Found all over the low-country of Ceylon.

Ischaemum ciliare. "Rat-tana," *S.* See *Fodder Grasses*, page 448.

Justicia procumbens. "Mayani," *S.* (*Acanthaceae*). A prostrate spreading herb, commonly found among grass in the moist region, at all elevations in Ceylon.

Oplismenus (Panicum) compositus. A slender creeping grass, common in the low-country, flourishing especially under the shade of trees; occurs in several varieties.

Panicum curvatum. An elegant slender grass, common in the low-country of Ceylon, also in South India, Madagascar, etc. Good for pasture or fodder. According to FERGUSON, it used to form a large proportion of the fodder collected near Colombo for horses.

Panicum prostratum. "Samay-pillu," *T.*—A slender creeping grass, common in the hotter parts of Ceylon and much relished by cattle.

Paspalum scrobiculatum. "Amu," *S*; Waragu, *T.* A variable grass, some varieties of which reach a height of 6 ft. or more. Several varieties are known by different Sinhalese names. Common in Ceylon from sea-level to 6,000 feet; resists drought well, and cattle are fond of it. See pages 309 & 400.

Paspalum conjugatum. A slender, leafy grass, especially suited to moist shady places, 10-12 in. high, native of the West Indies, naturalised in Ceylon, &c., being common under trees and along road-sides. It is known in the Philippines as the "Bitter-grass" and, according to TRIMEN, as "Sour-grass" in the West Indies. (See *Andropogon pertusus*, p. 448). This grass appears of late to be superseded in Ceylon by *Paspalum obtusifolium*, see below.

Paspalum dilatatum. See page 450.

Paspalum (Digitaria) longiflorum (=P. filiculme). A slender, perennial, creeping grass, common in Ceylon from the sea shore up to 3,000 feet or higher. Resists drought well, and is often the first grass to become established on new clearings in the low-country. An excellent lawn grass; forms a large proportion of the swards about Colombo. See p. 71.

Paspalum sanguinale. "Guruwal," *S.* One of the most common grasses of India, Ceylon, &c.; sometimes a troublesome weed. It forms good pasture, and cattle relish it.

Paspalum obtusifolium. A perennial, shade-loving grass, introduced from Mexico, naturalised in Ceylon and very common in moist shade, as under trees and along road-sides, often to the exclusion of all other grasses, at medium and high elevations; distinct by its broad, sinuate leaves; excellent for grazing.

Pennisetum cenchroides. "Congayam grass." A perennial, 10 to 12 in. high, specially suited to dry districts. Said to afford good fodder or pasture in South India.

Ruellia ringens. "Nil-puruk," *S.* (*Acanthaceae*). A perennial straggling herb, commonly found among grass in the low-country of Ceylon.

Sporobolus diander. A moderate-sized grass, common throughout Ceylon and the Eastern tropics generally.

5.—BROWSE (OR FAMINE FODDER) PLANTS.

In times of scarcity of food, as during a prolonged and severe drought, cattle or stock will eat almost anything that is green or juicy; thus, even the gorse and prickly-pear, as well as rubber trees, tea bushes, palm leaves, &c., may be consumed with relish. The following may be mentioned as well-known browse plants which resist drought well and are sometimes valued as feed for stock.

Atriplex nummularia. Salt-bush. (*Chenopodiaceae*).—This and other species of Atriplex, which are perennial bushy plants and thrive in arid districts, or on dry sandy soil near the sea-coast, form an important food for stock in Australia and elsewhere during periods of drought.

Atriplex repens. "Elechivi," *T.* A small, prostrate, succulent shrub, common on the sandy shores in the dry region of Ceylon and South India. The Tamils of Jaffna eat the leaves as a vegetable.

Cytisus proliferus. "Tree Lucerne"; "Tagasaste."—A small leguminous tree, indigenous to the mountains of the Canary Islands, where the leafy branches are used largely as food for cattle, being cut twice a year. Thrives at Nuwara Eliya in loose sandy soil. *C. stenopetalum* ("Garcia" of the Canary Islands) and *C. pallida* ("Garcia Blanca") are similar species, with yellow flowers, also used for fodder purposes.

Mikania scandens. "Lo-ka-palu," *S*; Mikania Weed; "Mile-a-minute" (referring to the rapid rate of growth). This annual herbaceous creeper, considered to have been introduced from S. America, now a common weed through

out the moist low-country of Ceylon, S. India, and parts of Malaya and Pacific Islands, thriving from sea-level to about 4,000 feet. Yields a quantity of succulent stems and leaves, which are relished by cattle especially in the dry season when food is scarce. Also recommended for green manure. See p. 475.

Opuntia Dillenii. Prickly-pear. (*Cactaceae*). This, as well as other species of Opuntia, which has become a serious pest in certain countries, notably in Queensland, is sometimes turned into a useful food for stock in periods of drought or scarcity of food. It is best when boiled or crushed and flavoured with salt, or mixed with ensilage or other fodder, and in this way is said to have a fattening effect. The pear-shaped fruit is edible. A spineless form, raised by the late Mr. BURBANK in California, is well spoken of as stock feed. See pp. 74, 267, 454, 475, 477.

Prosopis juliflora. Mesquit-tree; Cashaw- or Algaroba-bean. A small Leguminous tree of Trop. America, the leaves, shoots, and pods of which are used to feed cattle, the pods being said to be "as nutritious as corn."

Prosopis pubescens. Screw Mesquit. A tree of similar value to the above, found in Texas and Mexico. See page 268.

GRASSES AT THE EXPERIMENT STATION, PERADENIYA.

Showing yields for 2 years and Food units per acre.

	1921—1922 (12 months.)		1922—1923 (12 months.)		Average per year.	
	Yield per acre.	Food units per acre.	Yield per acre.	Food units per acre.	Yields per acre.	Food units per acre.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Guinea-grass, var. A. (*Panicum maximum*)	40·8	5·80	34·8	4·94	37·8	5·37
Guinea-grass, var. B. (*Panicum maximum*)	39·4	7·52	26·5	5·05	32·9	6·27
Water-or Mauritius-grass (*Panicum muticum*)	33·2	5·41	—	—	—	—
Paspalum dilatatum, "B" (*Paspalum virgatum*)	27·8	4·70	21·5	3·65	24·6	4·16
Rhodes-grass. (*Chloris gayana*)	29·2	4·15	15·9	2·26	19·4	2·76
Paspalum dilatatum "A" (=*Paspalum dilatatum*)	22·7	6·47	34·1	9·58	28·4	8·09

ZOOLOGICAL GARDENS
CALCUTTA.

SECTION 5.

CHAPTER XXXI.

1.—*PERFUME-YIELDING PLANTS, &c.*
2.—*HONEY PLANTS.*
3.—*ORNAMENTAL SEEDS.*
4.—*REMARKABLE FRUITS.*
5.—*INSECTIVOROUS AND FLY-CATCHING PLANTS.*
6.—*MYRMECOPHILOUS PLANTS.*
7.—*SACRED TREES.*

The cultivation of certain plants, or families of plants, for the extraction of essential oils, scents, or other substances used in perfumery forms an important industry in some countries, as in Southern France, Spain, Bulgaria, Northern Africa, Reunion, &c. The cultivation of species of Pelargonium, and the manufacture of "geranium oil" from their fragrant leaves, is carried on extensively in Reunion and Morocco. In England the manufacture of perfumes is but little practised, though the quality of those produced is usually of a high standard, *e.g.* the famous lavender of Mitcham.

The art of perfumery consists largely in blending and diluting in suitable proportions certain volatile oils and odoriferous extracts. Some of these in the pure state may have an objectionable instead of a pleasant odour, *e.g.* the ambergris obtained from the intestines of the pot-whale, and the musk from the musk-deer. Highly volatile perfumes quickly vanish if not mixed with suitable substances to give them a body; therefore certain fragrant balsams or oleo-resins (*e.g.* "storax," "tolu," &c.), as well as certain animal substances (see page 459), are used for giving them durability or body.

Thus numerous products, while not ordinarily included in the category of perfumes, may be of special importance in the manufacture of different forms of scents or perfumes, as for scented soaps, powders, handkerchief perfumes, sachets, &c. Most of the principal spice-oils, as oil of cloves, oil of cinnamon, and many of the commercial essential oils, as citronella oil, lemon-grass oil and others are thus extensively employed in perfumery, in one form or another.

The processes* involved in the extraction of perfumes or volatile oils from vegetable substances may be divided into: (1) *Distillation* by means of stills of different designs, as used for essential oils generally; (2) *Expression*, in which the material is placed in an iron cylinder with sieve-like openings in its circumference; the ram of a hydraulic press, fitting the cylinder, compresses the material, and the volatile fluid escapes

**Perfumes, Essential Oils, & Fruit Essences*, by Dr. G. Martin.

through the perforations; the residue, forming a compact cake, is further freed from oil by steam distillation or by treating it with solvents; (3) *Extraction* methods, including *enfleurage*. Dr. Martin refers to an extraction method "with a volatile solvent such as alcohol, or with olive oil or lard, which is used in the preparation of delicate scents, the essential oils being subsequently separated from the extracts. The solvent used may be benzene, petroleum, ether, chloroform, or carbon disulphide. The process furnishes products which very closely resemble the natural floral odours, and seems to be the only one which does not destroy the delicate fragrance of the jasmine and the violet. Unfortunately the yield by this method is very small, and so the perfumes prepared in this way are often very costly." (See foot-note to p. 455).

Maceration is an older extraction process. "In this the flowers are immersed in a bath of pure neutral fat, such as tallow, lard, or olive oil, which is maintained at a temperature of 65°-70° C. by means of a water bath. Fresh flowers are added as the perfume of a previous charge is exhausted, and the spent flowers are removed. This process is repeated until the desired strength of perfume is attained."

Solid fat is sometimes used for extraction, the product being called a pomade. "When a liquid fat, like olive oil, is used the product is termed an 'huile antique.' The fatty vehicles are sometimes extracted with alcohol, which dissolves the perfume but not the oil, and the product forms the 'extraits' or floral pomade washings of the trade."

Enfleurage is a method of extraction at ordinary temperatures much employed in Southern France. "The fat (usually lard) is spread to a thickness of about ¼ in. on glass plates (3ft. × 2ft. in size), arranged in tiers one above the other. The flowers are sprinkled on the plates and left for one to three days, when fresh flowers are substituted for the old ones, until the fat on the plates has absorbed sufficient scent to make a strong pomade. The process, which is cumbrous and tedious, has been modified by slowly passing a current of air through the flowers contained in a vessel over the successive plates. The absorption of scent is thus rapidly effected, and the flowers do not come into actual contact with the fat on the plates." (MARTIN).

1.—PERFUME-YIELDING PLANTS

The following is a selected list of sources of perfumes:—

Basil Oil (*Ocimum basilicum*).—A herb 2-3 ft. high; volatile oil obtained by steam distillation of the fresh shoots and leaves, used as an addition to violet perfumes. Cultivated in Reunion, Seychelles, &c. See pp. 344, 397.

Bay Oil (*Pimenta acris*). See page 330. Oil distilled from the leaves used as a perfume for shaving soaps, and in the hair-wash known as "Bay rum."

Bergamot (*Citrus Bergamia*. Rutaceae).—A variety of "Bitter Orange" yielding a valuable perfume-oil, known as "bergamot," from the rind. About 1,000 fruits are required to yield 30 oz. of the oil, which is worth from 35s. to 50s. per lb., according to purity. The tree requires much the same treatment as the "sweet orange," and in plantations is generally planted about 12 feet apart each way. Another variety of "bitter orange," called the "Bigardier," is valued for its flowers, a kilogramme of which yields, on an average, 2 grammes of essence, which is worth, according to quality, from £12 to £18 per lb.

Cananga- or **Kananga-Oil,** see "Ylang-ylang," pages 398, 458.

Cassia Oil. (*Cinnamomum Cassia*). See pp. 333, 398. Used in scenting soaps, &c.

Cassia Flowers. (*Acacia farnesiana*).—A small tree, common in the tropics, largely grown in Southern France for the sake of the flowers used in perfumery.

Cedrat or **Citron.** (*Citrus medica*).—A highly scented oil, obtained from the rind of the citron, is worth about 18s. or more per lb. "It is not much used for scenting soaps, being too costly for that purpose, but enters largely into the composition of handkerchief perfumes."

Citronella Oil. See page 399. Used largely for scenting soaps, &c.

Clove Oil. See pages 337, 398. Also used for scenting soaps, &c.

Eucalyptus Oil. Obtained from several species of Eucalyptus. That from *Eucalyptus citriodora*, the "Lemon-scented Gum," has a pleasant odour and is well suited to soap perfumery. See page 398.

Frangipani. The odour of the white, cream, or crimson, fleshy flowers of the "Temple Tree" (*Plumeria spp.*) closely resembles the perfume "frangipanni," and it is considered that it would pay to extract the scent by distillation or by enfleurage. The "Temple Tree" is common at low elevations in Ceylon, especially near Buddhist temples, and is easily propagated by cuttings. See p. 91.

Geranium Oil. (*Pelargonium capitatum.* Geraniaceae).—A shrubby, fragrant plant, suited to a rather dry sub-tropical climate, cultivated extensively in Reunion, Northern Africa, and Southern Europe. A delightful rose-scented oil, obtained by distillation from the strongly scented leaves and stems, is worth about 3*s.* to 5*s.* per oz. In plantations, 3,500 to 4,000 plants are allowed to the acre; three clippings of leaves and shoots are obtained in one season, and replanting is done once in 4 years. Some 80 tons of Geranium Oil are exported annually from Reunion. See p. 399.

Jasmine. (*Jasminum spp.* Oleaceae).—The perfume or otto obtained from Jasmine flowers by absorption on clarified fat is said to be one of those most prized by perfumers, on account of its sweet and delicate odour, which it is said to be impossible to imitate; it is worth about £9 per fluid ounce. In S. France, about 5,000 Jasmine plants go to the acre, "these yielding about 5 cwt. of blossoms, which quantity will perfume 1½ cwt. of fat, valued at about 12*s.* per lb." *J.—Sambac* is especially noted for its strongly scented flowers.

Lemon-grass or **Verbena Oil.** (*Cymbopogon citratus*). See page 400. Oil commonly used in scented soaps, being considered more delicate than Citronella Oil.

Musk Mallow; "Ambrette" of the French. (*Hibiscus Abelmoschus.* Malvaceae). An annual shrub with large, mallow-like flowers. The seeds yield an oil of a musk-like odour, used in inferior perfumes; they are worth about 1s. to 1s. 6d. per lb.

Otto or **Attar of Roses,** obtained from rose petals (chiefly *Rosa damascena* or var's) is perhaps the most valuable of all scents, and forms the basis of most superior perfumes. Cultivated extensively in Bulgaria in the form of hedges about 6 ft. apart. 5,000 to 6,000 plants go to the acre. After the second year, an acre is estimated to produce about 600 lbs. of rose petals a year, and when 5 years old about 3,500 lbs.; 200 lbs. of petals yield by distillation about 3 oz. of rose oil or "otto," which is worth in London from £12 to £15 or more per oz. Some 500 lbs. of otto are imported into England annually from Bulgaria. *Rosa centifolia* is cultivated in the south of France for the production of "Oil of Rose" or "Rose essence."

Patchouly or **Patchouli.** (*Pogostemon Cablin or P.—Patchouli.* Labiatae).—By distillation of the dried leaves and young tops a volatile oil is obtained from which "Essence-of-Patchouli" is prepared. Patchouli scent is highly popular in India as well as in parts of Europe, and is much used in the blending of perfumes. The plant thrives in ordinary soil, in moist localities, and is easily propagated by cuttings. *Pogostemon Cablin* is considered to yield the best quality "patchouli oil." See page 399.

Priprioca. (*Mespilodaphne* (*Ocotea*) *pretiosa.* (Lauraceae).—A Brazilian tree, found in the forests of Amazonia. The leaves when bruised give off an agreeable perfume, "recalling clove, cinnamon, and bergamot at the same time." Considered to be of possible value in perfumery and soap-making.

Rose, see *Otto of Roses.*

Rosemary Oil, obtained by distillation from the herb *Rosmarinus officinalis* (see page 348), and manufactured extensively in Southern France, Spain, &c. The best quality is distilled from the leaves only and commands a high price.

Sassafras Oil, which is used extensively for scenting soaps, is obtained by distillation from the roots of *Sassafras officinale* (Lauraceae), a small deciduous tree of

N. America. Its use, however, has of late considerably diminished owing to the discovery of "safrol" from camphor oil. Sasafras-oil is valued at about 9*s.* per lb. An extract from the bark has stimulant and sudorific medicinal properties.

Tonco-, Tonka- or **Tonquin- bean.** Known in Venezuela as "Serappia." (*Dipteryx odorata.* Leguminosae).—A large tree, native of Brazil, Venezuela, British Guiana, &c., introduced at Peradeniya in 1881. The fruit is a small, oblong, fibrous pod, containing one almond-shaped black or brownish, oily and strongly fragrant seed. The latter is the "Tonka-bean" of commerce which, on account of its odour of new-mown hay (coumarin), is especially valued in perfumery, being used in the preparation of sachet powders, and in scenting soaps, tobacco, snuff, etc. A "tincture of tonka" is sometimes used by pastry cooks and confectioners as a substitute for vanilla. The seeds when dried and cured are subjected to a crystallisation process, being soaked in rum for 24 hours and then slowly dried, when they become covered with white crystals. Tonka-beans fluctuate greatly in price, according to supply and demand, the price ranging from about 4s. to 8s. per lb. The beans are usually brought from Venezuela to Trinidad, where they are cured and re-exported, chiefly to the United States. *D.—oppositifolia* also furnishes the commercial article.

Tuberose (*Polianthes tuberosa.* Liliaceae).—A tuberous, herbaceous plant, much cultivated in the South of France for the perfume obtained by enfleurage from the strongly scented flowers. The plant grows and flowers freely at medium and high elevations in the tropics.

Verbena Oil; "Lemon-scented Verbena." (*Lippia citriodora*). See page 189. A small shrubby plant, remarkable for its strongly fragrant leaves, from which is obtained an essential oil valued in perfumery. See also Lemon-grass, p. 457, &c.

Vetivert or **Vetiver Oil,** distilled from the roots of Khas-khas or Khus-khus grass, *Vetiveria zizanoides,* (formerly *Andropogon muricatus*). It is very costly and is used in perfumery, chiefly for fixing volatile odours and scenting high-class soaps. The powdered roots are used in Indian scents. See page 401.

Wattle-blossom, more especially that of *Acacia decurrens* and *A. pycnantha,* is rich in perfume and is recommended for commercial exploitation for perfumery.

Wintergreen Oil, or "Oil of Gaultheria" (*Gaultheria fragrantissima, G. procumbens,* &c. Ericaceae). Small upcountry shrubs of Ceylon, India, and Malaya. The genuine "Wintergreen" oil, which is the heaviest of all essential oils, is obtained from the leaves by distillation. "Commercial" Wintergreen oil is also obtained by distilling the bark of *Betula lenta,* a species of Birch (Betulaceae).

Ylang-ylang, or **Ilang-ilang;** "Wana-Sapu", *S.* (*Cananga odorata.* Anonaceae).—A large, quick-growing tree, 70 to 80 feet high, native of the Philippines, Java, etc., cultivated in the Philippines and Reunion for the large, greenish-yellow flowers, which are strongly scented and yield by distillation the popular scent "ylang-ylang" or "ilang-ilang". A full-grown tree is considered to yield about 100 lb. of fresh flowers during a season. From 150-200 lb. of flowers produce about 1 lb. of the essence. It is estimated in the Philippines that an acre planted with 150 trees (*i.e.* 17 × 17 ft. apart) should produce some 3,250 lb. of flowers, yielding about 16 lb. of essence. The main supply, however, is from uncultivated trees, from which the peasants collect the flowers, "selling these locally for 2*d.* per lb." The annual export of ylang-ylang oil from the Philippines is valued at about £20,000. The oil is used in the highest grade perfumes and toilet soaps. See p. 398.

Cananga Oil, consists of the early portions of the distillate of "ylang-ilang," and is similar to but cheaper than the latter. Java "Cananga oil" fetches about 12*s.* to 18*s.* per lb.

OTHER SCENTED FLOWERS.

Among other species which furnish scented flowers the following may be mentioned. The scent of flowers, like their colour, varies to some extent according to climate and soil. For further information concerning these, refer to their respective classes.

TREES :

Caesalpinia coriaria. "Divi-divi."
Cassia nodosa. "Pink Cassia."
Citrus decumana. "Pomelo."
Fragraea fragrans. "Tembusu" of Malaya.
Mesua ferrea. Ceylon "Iron-wood."
Michelia Champaca. Champac ; "Sapu."
Murraya exotica. "Ettoriya," *S.*
Myristica Horsfieldii.
Nyctanthes Arbor-tristis. "Sepalika," *S.*, or "Night-flowering Jasmine."
Pterocarpus marsupium.
Haematoxylon campechianum. Logwood.
Tabernaemontana coronaria. Wax-flower.

SHRUBS :

Brunfelsia Hopeana (B.—uniflora).
Cestrum nocturnum. "Queen of the Night."
Gardenia florida. "Gardenia."
Lawsonia alba. "Mignonette Tree."
Magnolia fuscata. "Mathanakama," *T.*
Ocimum sanctum. "Madura-tala," *S.*
Stemmadenia bella.
Talauma mutabilis.

CLIMBERS :

Artabotrys zeylanicus. "Petika-wel," *S.*
Asparagus falcatus. "Hathawariya," *S.*
Camoensia maxima.
Jasminum flexile.
Lonicera Hilderbrandtii. Giant Honeysuckle.
Odontadenia speciosa.
Pergularia odoratissima. Tonkin Creeper.
Stephanotis floribunda. "Stephanotis."

ANIMAL PERFUMES.

Ambergris. This is found in the intestines of the pot-whale, or floating about in the sea and obtained chiefly from the shores of tropical countries, *e. g.* Sumatra, Madagascar, S. America, China, &c. It is a greyish-white, fatty substance, of a penetrating disagreeable odour, but when treated and diluted in alcohol possesses a pleasant perfume, which is of a specially permanent nature. It is insoluble in water, slightly soluble in cold alcohol, but easily soluble in hot alcohol, ether, and in volatile essential oils. It is used in combination with other perfumes, or as an addition to these for the purpose of giving them durability.

Natural musk is found in a small bag secreted in the body of the musk deer, a small animal of the Himalayas, &c. The quantity obtained from each animal is very small, varying from 6 drams to 1½ oz., according to the size of the deer, consequently it is very expensive ; but it is a very concentrated perfume, and has the power of imparting permanency to very volatile odours. Musk is one of the most intense perfumes known and is capable of being greatly diluted; it is extensively used for perfuming fine soaps and sachets.

Civet is a glandular secretion occurring in an outwardly discharging pocket underneath the tail of the civet-cat, which is sometimes bred in captivity in large numbers for the purpose of obtaining the civet, this being collected by means of a small spoon. Fresh civet is a whitish-yellow mass, of a nauseating odour ; but when diluted, as in tincture, it has an agreeable scent, and is valued as a binder for other perfumes.

Castor is a secretion of the beaver, found in two pear-shaped bags on the abdomen of the animal. It is of a strong disagreeable odour, but when diluted has a pleasant odour, and is used in perfumery for fixing other scents.

2.—SELECTED HONEY-FLOWERS OR BEE-PLANTS.

Bees have their likes and dislikes in regard to the flowers they visit for extracting honey from, and the quality of the honey produced by them largely depends on the kind of flowers which they frequent. Persons who have taken up bee-keeping in Ceylon or other tropical countries must have sometimes experienced a difficulty in providing a sufficient supply of suitable flowering plants or trees for their bees; to these the following list of trees or shrubs, especially suited to the purpose, may be a guidance. MR. C. DRIEBERG, who has given the subject much attention, states that Ceylon bees seem to travel great distances in search of honey-flowers, apparently preferring trees to shrubs and smaller plants. In the West Indies, "Logwood" honey is considered to be about the best, though the flowers of the Pigeon-Pea, Orange, Lime and other Citrus trees are also considered to yield honey of excellent quality. The following are a selection.

(T) = Tree; (Cl)=Climber; (S)=Shrub;
(HP)=Herbaceous Perennial; (A)=Annual.

[See also pages 458, 459].

Acacia dealbata. "Silver-wattle." (T).
Angelonia salicariaefolia. Purple & white var's. (H P).
Antigonon Leptopus, & other spp. (Cl).
Azalea indica, var's. (S).
Bassia longifolia. "Mi," or "Illuppai." (T).
Caesalpinia coriaria. "Divi-divi." (T).
Cajanus indicus. Pigeon Pea; "Rata-tora." (S).
Canarium commune. Java-almond. (T).
Caryota urens. "Kitul" or Toddy Palm. (T).
Cassia grandis. Horse Cassia. (T).
C.—nodosa. Pink Cassia (T).
Choisya ternatea. (S).
Citrus, including lime, orange, &c. (S or T).
Cocos nucifera. Coconut Palm. (T).
Cytisus proliferus "Tree Lucerne." (T).
Elaeocarpus serratus. Wild olive. (T).
Euphorbia heterophylla. (H P).
Glycosmis pentaphylla. (S).
Grevillea robusta. Silky Oak. (T).
Guizotia olifera. (A).
Heliotrope (*Heliotropium*). (P).
Humboldtia laurifolia. (S. or T.)
Ipomoea carnea, and other spp. (Cl).
Kleinhovia hospita. (T).
Latania, several spp. and var's. (S).
Logwood (Haematoxylon). (T).
Lupinus, different var's. "Lupines." (A).
Mangifera indica. Mango. (T).
Michelia Champaca. Sapu. (T).
Mignonette. (Reseda odorata). (A).
Murraya exotica. (S or T).
Nasturtium (Tropaeolum). (A.Cl.).
Phlox Drummondi. (A).
Pometia eximia. (T).
Porana volubilis. (Cl).
Portulaca, var's. "Purslane;" "Genda-kola." (A).
Pterocarpus indicus. (T).
Rhus glabra. (T).
Sarcocephalus esculentus. (Cl.S).
Schleichera trijuga. (T).
Strobilanthes, various spp. (S).
Terminalia belerica. "Bulu," *S.* (T).
Turnera elegans. (HP).
Zinnia linearis. (HP).

3.—ORNAMENTAL SEEDS.

In the tropics there is found a large number of curious or ornamental seeds suitable for making articles of ornament or utility, as beads, necklaces, rosaries, mats, buttons, etc. It is noteworthy that the majority of such seeds are furnished by the natural orders of Leguminosae and Palmae, although some are produced also by the orders Euphorbiaceae, Apocynaceae and Scitamineae. Boring the seeds for necklaces, etc., may be done by fixing each seed firmly and using a fine drill, or by passing

a red-hot needle through it. No attempt should be made to soften the seed by soaking in water, which will result in loss of brilliancy in colour, if not in the swelling and splitting of the seed. The following are some of the more striking of such seeds :

Abrus precatorius. "Crabs' eyes"; Olinda-vel, *S.*; Kuntumani, *T.* Small, scarlet seeds with a black spot; used for rosaries, necklaces, goldsmiths' weights, etc. See p. 383.

Adenanthera pavonina. "Bead Tree;" Madatiya, *S.*; Anai-kuntumanai, *T.* Seeds bright scarlet, used for necklaces, etc., also for jewellers' and apothecaries' weights, each seed weighing nearly 4 grains; known as "Mad-eta," *S.*; produced by a tall, erect tree with open, feathery foliage. See p. 214.

A.—bicolor. "Mas-mora," *S.* Seeds smaller than the latter, half-black and half-red, very ornamental; produced by a moderate-sized tree with small pinnate leaves and spreading top, native of Ceylon and Malacca.

Caesalpinia Bonduc. Nicker seeds; "Kumburu-wel," *S.*; Punaikkalaichi, *T.* Large, ash-grey, polished, very hard seeds, which are either globular and of about the size of marbles or ovoid.

Canna indica. "Indian shot;" Butsarana, *S.* (= "Help from Buddha"). Seeds black, round or ovoid, of the size of small peas, very hard; used in rosaries by Buddhist worshippers.

Cocculus macrocarpus. "Atta-titha-vel." Large climber with peltate leaves. By depriving the kidney-shaped fruit of its outer covering (epicarp) the remarkable annular endocarp is exposed.

Coix Lachryma-Jobi. "Job's Tears," "Keekirindee," *S.* Very hard, grey, brown or mottled, polished seeds (fruits); used for rosaries, bead-work, etc. Sometimes made into "bead" curtains. See p. 308.

Corypha umbraculifera. Talipot Palm. Seeds round, of the size of marbles, hard and creamy-white, used for buttons and ornaments. See p. 165, &c.

Elaeocarpus Ganitrus.—The round, warty, brown fruits, bright blue when fresh, may be used, when dry, as heads for hat pins, &c.

Entada scandens. "Elephant Creeper." Very large, flat, brown, polished seeds, used for snuff-boxes, &c. See pages 132, 462.

Erythrina corallodendron. Coral-bean Tree. Seeds scarlet, with a black spot; sometimes strung as beads in chaplets, but are too fleshy to be durable.

Hevea brasiliensis. Para-rubber Tree. The large, roundish, mottled and blotched seeds may be made into heads for hat-pins. See p. 407.

Manihot Glaziovii. Ceara-rubber Tree. Oblong, flattened, hard seeds, mottled grey and brown.

Metroxylon Sagu. Sago Palm. Round or cone-shaped reddish fruits, with a rind formed of hard, polished, brown scales.

Mucuna atropurpurea. "Punaikalaichi," *T.* Large roundish and compressed seed; grey, mottled with brownish black.

Mucuna pruriens. "Horse-eye Bean;" "Cowage" or "Cowitch"; Achariya-pala, *S.* The large ovoid seed considered to resemble the eye of a horse. Pods covered with brown irritant hairs, commonly used as a vermifuge.

Oroxylon indicum. "Totila," *S.* Seeds with thin, white, membranous, flat, circular wing. See page 463.

Ormosia coccinea. "Necklace Tree"; "Gunda-" or "Kunda-mani," *S.* and *T.* Seeds large, ovoid or roundish, hard, bright scarlet, blotched with black or brown. Very popular for making buttons, necklaces and ornaments. Produced by a moderate-sized tree of Trop. S. America, introduced at Peradeniya in 1886. Principal season, Dec.-Feb.

O.—dasycarpa. Seeds similar to the preceding species, but smaller.

Poinciana regia. Flamboyante. Seeds hard, oblong, and mottled grey. See p. 91.

Phyllanthus cyanospermus. "Sudu-liyan," *S.* Medium-sized tree of Ceylon. Seeds rather small, wedge-shaped, bright, shiny, metallic-blue.

Phytelephas macrocarpa. Ivory-nut Palm. The large, hard, white, ivory-like seeds are used for vegetable-ivory, being employed in the manufacture of buttons, etc. Largely exported from S. America. See pages 166, 410.

Raphia Ruffia and other species. Raffia Palm. Round or conical, large, brown, polished, scaly fruits, suitable for ornaments.

Rhyncosperma cyanosperma. Violet-black seeds, used as ornaments by hill people in India.

Sapindus saponaria. "Soap Berry" or "Soap-berry Tree." The round, black seeds are often strung as beads or rosaries; sometimes used as buttons.

Thevetia neriifolia. "Lucky-beans" or "Lucky-seeds," produced by a small tree or large shrub of the West Indies; they are hard, oblong, and sometimes used as pendants or charms.

4.—REMARKABLE OR CURIOUS FRUITS.

Barringtonia speciosa. "Mudilla." (*Myrtaceae*). A large, curious, 4-angled, cube-like fruit. See pages 97, 98.

Cassia Fistula. Pudding Pipe; "Eh-ela," *S.* (*Leguminosae*). Long cylindrical brown pods, up to 3 feet in length. See pages 85, 369.

Castanospermum australe. Moreton Bay Chestnut. (*Leguminosae*). Stout brown pods, 5 to 7 inches long, with hard shells and large, brown, ovoid seeds.

Couroupita guianensis. Cannon Ball. (*Myrtaceae*). Large, round, brown fruits, each larger than a man's head. See pages 87, 88.

Crescentia Cujete. Tree Calabash. (*Bignoniaceae*). Large ovoid or round, smooth-shelled fruit. The hard, smooth shell takes a polish easily; is carved and used for ornaments and for cups, basins and many other articles of household use in Cuba and tropical America. The larger fruits are 8-10 in. or more in diameter. A small tree, native of Cuba, where it is commonly planted around dwellings.



Crescentia Cujete. Tree Calabash.

C.—plectrantha. Tree Calabash. Fruit similar to above, but usually round-shaped.

Curcurbita maxima. Pumpkin; "Wattakka," *S.* (*Curcurbitaceae*). A climbing or creeping gourd, bearing immense, round, smooth fruits, which are generally flattened at both ends. Emptied of the pulp and seeds, the shell becomes very hard, light, and durable, and is commonly used in the tropics for baskets, water-carrying purposes, &c. See p. 292.

Entada scandens. Elephant Creeper; "Pus-wel" *S.* (*Leguminosae*). An immense jungle climber or liane, bearing enormous flat pods, 3½ to 5ft. long by 3-4 in. broad. The large, brown, flat seeds are sometimes made into ornaments, snuff-boxes, &c. Forests of moist low-country of Ceylon. See pages 132, 461.

Hura crepitans. Sandbox Fruit. (*Euphorbiaceae*). Large, upright tree of Trop. S. America, bearing curious, round, hard fruit, flattened at both ends and divided into numerous

rounded sections, each containing one seed; each section dehisces explosively with a loud report. By dropping melted lead through the junctions of the sections at the centre, they are held together and the fruit may then be used as paper-weights.

Hydnocarpus octandra. (*Bixaceae*). Round, jet-black, velvety, pendulous fruits, of the size of oranges.

"Jumping Beans." The maggot of a moth (*Carpocapsa saltitans*) is hatched inside the small, half-round capsule of certain Euphorbiaceous trees in Mexico, whence the "bean" is exported as a curiosity. Warmth renders the maggot active, which makes the "beans" (or rather the maggot inside the bean) begin to roll or jump about.

Kigelia pinnata. Sausage Fruit. (*Bignoniaceae*). Stout pod-like fruit, 14 inches or more in length by 3 in. in diameter, suspended by a long thin cord, 4 to 6 ft. in length; produced by a spreading, medium-sized tree. See page 100.

Lagenaria vulgaris. Bottle Gourd. (*Cucurbitaceae*). Variously shaped, large gourds, often bottle-or club-shaped, 1½ to 2 ft. or more in length. See p. 293.

Lecythis Ollaria. Monkey Pot. (*Lecythidaceae*). A large, hard, woody, brown fruit, furnished with a close-fitting lid at the top, resembling a pot. Produced by a large, handsome tree of Brazil, Venezuela, Guiana, etc. The genus is remarkable for its curious fruits. See page 242.

Lodoicea sechellarum. Double-Coconut; Coco-de-mer. (*Palmae*) Each of the immense fruits, which sometimes weigh up to 50 lbs. or more, is covered with a thick fibrous husk, black when ripe, and contains from 1 to 3 of the large, hard, remarkable 2-lobed nuts. Peculiar to Seychelles. See pages 167-168.

Martynia diandra. Snake's Head; Tiger's-claw; "Naka-tali," *T.* (*Pedaliaceae*). Hard, woody, oblong fruit, 1½-2 in. long, ends in 2 strong, curved spines. Shrubby annual with beautiful flowers, native of Mexico, naturalised in Ceylon.

Ochroma Lagopus. Down Tree. (*Malvaceae*). Curious, brown fruits, borne erect on the branches; when the fruit dehisces, it resembles a brush of soft, brownish down. See page 217.

Ochrosia acuminata. (*Apocynaceae*). Bright red, ovoid, fleshy fruits, 1½ to 2 in. long. Ornamental but poisonous. Produced by a small tree of Java.

Oroxylum indicum. "Totila." (*Bignoniaceae*). Immense, slightly curved pod, almost the size of a cricket bat. See p. 461.

Pandanus Leram. Nicobar Bread-fruit. (*Pandanaceae*). Huge, fleshy fruits, borne at base of leaves, orange-yellow when ripe, produced by a large Screw-pine tree of Nicobar Islands. See pages 102-103.

Pangium edule. "Pangi" of Malaya (*Bixaceae*). A large Malayan tree with large, broad leaves. The large, rusty-brown, woody fruits are of the size of small coconuts. See pages 102, 267.

Parmentiera cerifera. (*Bignoniaceae*). Remarkable, candle-like, pale yellow fruits, borne in great profusion on stem and branches. See pages 102, 104.

Sarcocephalus esculentus. (*Rubiaceae*). —A large, climbing shrub, producing round, fleshy "balls" in which the small white flowers are studded, like a pincushion; introduced at Peradeniya in 1883. See illustration, also p. 270.



Sarcocephalus esculentus.
SIERRA LEONE PEACH.

Sterculia Balanghas. "Nawa" *S.* (*Sterculiaceae*). Large, bright orange-yellow or scarlet, shell-like fruit; when dehisced, it exposes shiny, jet-black seeds, suspended from the margins of the carpels. See p. 95.



Sterculia Balanghas. NAWA.
A, scarlet fruits, unopened; B, fruit open, scarlet inside, showing jet-black seeds.

Tabernaemontana dichotoma. Forbidden Fruit; Eve's Apple; "Divikaduru," *S.* (*Apocynaceae*). A small tree of Ceylon, S. India, &c., with pale-grey bark and white, scented flowers (throat and tube yellow), common at low elevations. The curious pendulous fruit, orange-yellow when ripe, is half-round, with a clean-cut depression along one side, which has suggested the popular names, being supposed to resemble a partly eaten fruit. Some even imagine they see in it the marks of Eve's teeth. See page 387.

5.—INSECTIVOROUS & FLY-CATCHING PLANTS.

Aldrovanda vesiculosa. Water Fly trap. (*Droseraceae*).—A rootless, floating water-plant of S. Europe, remarkable for the inflated extremities of the sensitive leaves, which act as floats and for capturing minute water animals, which the plant digests.

Aristolochia, many species. "Fly-catching Plants." (*Aristolochiaceae*).—A remarkable family of plants, mostly climbers, with variously shaped flowers, which in some species are very large (see p. 124); most have an offensive odour, which attracts flies. In many species the flowers are adapted to entrap the latter which, once inside, are unable to escape, owing chiefly to the numerous hairs in the tube which point inward. The flies are usually essential to the pollination of the flowers, and when this is effected, the hairs collapse, enabling the flies to escape. See pages 123-125; also Petch in *Annals of the Royal Botanic Gardens, Peradeniya*, for May, 1924.

Cephalotus follicularis. "Pitcher Plant" of Australia. (*Cephalotaceae*).—A remarkable marsh plant of W. Australia, bearing two kinds of leaves, one form being transformed into pitchers, which capture insects much in the same way as Nepenthes.

Darlingtonia, several species. Californian "Pitcher-plant." (*Sarraceniaceae*).—A remarkable genus of perennial herbs, found inhabiting marshy places in California. The leaf-petioles, as in Sarracenia, are formed into long pitchers, with the divided lamina or blade at the top.

Dionaea muscipula. "Venus's Fly-trap." (*Droseraceae*).—A small, remarkable marsh plant of S. United States. The spathulate leaves are furnished along the margins with peculiar bristles, which are extremely sensitive and when touched by an insect close immediately and imprison the intruder; the latter being imprisoned until dead, the plant absorbs the product of its decay, and the leaves open again. The leaves, however, will close if touched by any solid substance.

Dischidia rafflesiana. "Leaf Pitcher Plant." (*Asclepideae*).—A climbing plant with two forms of leaves, indigenous to Malaya and Trop. Australia; the tubular leaves are formed into closed pockets, each 3 to 5 in. long, with a small aperture at one end, into which an adventitious root from the stem is usually developed.

Drosera, many species. Sundew. (*Droseraceae*).—A genus of small swamp plants, found in most countries. Three species are indigenous to the montane zone of Ceylon. Leaves thickly set with glandular hairs, which are slightly sensitive, being tipped with a small drop of viscid fluid, by means of which insects are caught, when the surrounding hairs close in and combine to imprison them.

Drosophyllum lusitanicum. "Sundew." (*Droseraceae*).—A striking plant with characters similar to the foregoing, inhabiting the sandy hills of Portugal.

Nepenthes. Several species. "Pitcher Plant;" "Bandura-wel," *S.* (*Nepenthaceae*).—A genus of climbing plants, inhabiting moist swampy places in the tropics, mostly in Borneo, Malaya, &c. *N. distillatoria* is indigenous to Ceylon. A prolongation of the midrib is modified into curious pitcher-like structures, each with a lid at the top. These pitchers are, in some species or varieties, as much as 8 to 10 in. long; they generally contain a quantity of water, in which a number of dead or dying insects are usually found captured, the product of their decay being assimilated by the plant.

Pinguicula vulgaris. "Butterwort." (*Lentibulariaceae*). A bog plant, indigenous to the British Isles, furnished with radical leaves of a sensitive character, incurved at the margins; "stimulated by the presence of proteid bodies, the leaves close over, when the sessile glands secrete a ferment and digest their prey."

Sarracenia, several species. "Side-saddle Flower." (*Sarraceniaceae*). Marsh plants of North America, the leaf-petioles of which are modified into remarkable, erect, often brightly coloured pitchers, each of which is surmounted by a lid formed by the small lamina. These, like other leaf-pitchers, usually contain a quantity of water in which flies and other insects are drowned, to the benefit, it is supposed, of their captor.

Utricularia, several species. "Bladderwort." (*Lentibulariaceae*). Water-or bog-plants, without roots, found in swamps of most countries; some nine species are indigenous to Ceylon. The leaves are furnished with small bladders, which have a trap-door entrance and thus capture small crustacean and other animals.

6.—MYRMECOPHILOUS OR ANT-PLANTS.

These plants are furnished with cavities or other adaptations for attracting and protecting ants for mutual benefit.

Acacia Hindsii. (*Leguminosae*). A small tree, indigenous to Trop. Central America. The hollow, formidable spines are generally inhabited by ants.

Acacia sphaerocephala. Bull's Horn Acacia. Similar to latter species.

Cecropia peltata. (*Urticaceae*). "Trumpet Tree" of Trop. America. Hollow internodes often inhabited by ants; also used by natives for making musical instruments. See p. 433.

Coccoloba, several species. (*Polygonaceae*). Small trees, mostly of S. America and the West Indies. Hollow stems usually occupied by ants.

Cuviera, several species. W. Trop. Africa. Hollow swellings on stems inhabited by ants.

Duroia hirsuta. (*Rubiaceae*). S. America. The hollow stems are furnished with entrances into which colonies of ants gain admission.

Humboldtia laurifolia. "Gal-karanda," *S.* (*Leguminosae*). A shrubby small tree, indigenous to Ceylon and S. India, with hollow internodes which are generally inhabited by ants, which enter by a small aperture at base of internode.

Hydnophytum montanum, and other spp. (*Rubiaceae*). Epiphytic plants, indigenous to Malaya, etc., remarkable for their large, tuberous-looking, woody base, which is hollow and provides a home for ants.

Muehlenbeckia platyclada. (*Polygonaceae*). A scrambling shrub or climber, with hollow internodes; indigenous to the Solomon Islands. See p. 121.

Myrmecodia Beccari, and other spp. (*Rubiaceae*). Epiphytic plants with a hollow tuberous base, indigenous to Malaya.

Triplaris surinamensis. (*Polygonaceae*). A tree of Surinam, the young stems and branches of which are hollow and usually occupied by ants.

7.—SACRED TREES OF INDIA, CEYLON, ETC.

The worship of certain plants or trees, supposed to possess supernatural qualities, was at one time practised in many parts of the world, and the custom has still survived among certain races or religions in tropical countries. This is more especially the case in India, where numerous trees or plants are held more or less sacred, or in high esteem for temple offerings. Sacred trees are not always those which serve useful purposes;

on the contrary, utility would appear to be a disadvantage, for if intensely sacred, as, for example, *Ficus religiosa*, no part of the tree may be cut or utilised by its devotees. In parts of Africa, the worshipped spirits of ancestors are supposed to inhabit certain species of trees, which consequently are held sacred and not allowed to be cut or injured. The following are well-known "sacred" species:—

Ficus religiosa. Bo-tree; Peepul; Aswatha, *S*; Aracha, *T*. (*Urticaceae*). The most sacred tree of India and Ceylon, being especially venerated by Buddhists as well as by Hindus. Devout Buddhists will not cut or injure the smallest seedling or branch of this tree. The specimen at Anuradhapura, Ceylon, is probably the oldest historical tree in the world, having been brought from India in B.C. 288. When a Bo-tree is in a dangerous position, or seedlings grow spontaneously, as they frequently do, in the crevices of buildings, bridges, &c., a non-Buddhist person must be found to deal with the offending tree or plant. The tree is practically of no economic, and but little ornamental, value.

Butea frondosa. "Palas" or "Parasu." (*Leguminosae*). A beautiful tree, especially sacred to the Brahmins in India. See pages 85, 417.

Kigelia pinnata. Sausage Tree. (*Bignoniaceae*). A large, spreading tree with large, curious gourd-like fruits, indigenous to tropical Africa, in parts of which it is held sacred by the Natives. See pages 100, 101, 462.

Melia Azedarach. "Neem" or "Nim Tree"; Persian Lilac; Bead Tree. (*Meliaceae*). A handsome small tree with small bipinnate leaves, and small, ovoid, 5-ridged indihiscent fruits.

Nandina domestica. "Nandin"; "Sacred Bamboo" of China. (*Berberideae*). An erect shrub with numerous radical stems, and small, handsome, bipinnate leaves, producing large panicles of creamy flowers followed by red berries; native of S. China, and much esteemed in that country as well as in Japan for use in temples. See pp. 122, 184, &c.

Nyctanthes Arbor-tristis. "Sepala" or "Sepalika,"; "Night-flowering jasmine." (*Oleaceae*). A small tree of Central India; the flowers are much used in Hindu worship as votive offerings. See p. 459.

Ocimum sanctum. Sacred Basil; "Tulsi." (*Labiatae*). A herbaceous perennial, 2 to 3 ft. high. This is said to be the most sacred plant in the Hindu religion, and is consequently found near every Hindu house throughout India.

Stereospermum xylocarpum. "Padri Tree" of India.

Sterculia colorata. "Malaiparutti," *T*. (*Sterculiaceae*). A handsome flowering tree, indigenous to the dry region (Eastern Province) of Ceylon. The aboriginals (Veddahs) of Ceylon sing odes to it.

Plumeria acutifolia. Temple Tree. (*Apocynaceae*). A small tree, commonly planted near Buddhist temples in Ceylon, the highly scented flowers being greatly esteemed as temple offerings. See p. 91.

Prosopis spicigera. "Sami Tree" (=Sacred Tree). (*Leguminosae*). A small tree, "sacred to the Hindus generally all over India."

Nelumbium speciosum. "Sacred Lotus"; "Nelun" *S*; "Tamarai, *T*; (*Nymphaeaceae*). A handsome water-plant with large, round, peltate leaves, and very large, pink or white flowers, borne on erect stalks about 1-2 ft. above the water. It has been held sacred by the Egyptians from time immemorial, and is also venerated in parts of India, Burma, Ceylon, China, etc. See p. 174.

CHAPTER XXXII.

ENEMIES & FRIENDS OF GARDENS & PLANTATIONS

1.—*ENEMIES OF GARDENS, &c.* 4.—*PRINCIPAL WEEDS OF CEYLON.*
2.—*FRIENDS* „ „ 5.—*SOME NOXIOUS WEEDS*
3.—*NOXIOUS WEEDS.* *OF OTHER COUNTRIES.*

1.—ENEMIES.

Besides destructive insects, there are numerous animal pests which the cultivator of the soil has to contend with in the tropics, of which the following are some examples.

Squirrels.—These are frequently very destructive to fruit crops, often doing considerable damage to cacao pods, mango fruits, pine-apples, etc., and sometimes to seeds in nursery beds or boxes. Shooting, or scaring them away, are about the only practical remedies, unless recourse is had to poisoned baits, which is generally risky.

Rats are often very destructive, especially to fruit and root-crops, sometimes to timber trees and coconut palms, eating the tender bark of the former and destroying the young nuts of the latter. Trapping, or placing baits poisoned with arsenic, are perhaps the only practical ways of dealing with them, though special care is necessary in dealing with poisoned baits. Rats may be prevented from climbing coconut palms and other trees by nailing a collar of tin, about 10 to 12 inches wide, on to the trunk.

Hares.—These sometimes do considerable damage in a garden. A fence of close wire-netting is the best protection against them, whilst shooting and hunting them with dogs should also be adopted. A low temporary fence of palm leaves or other material will often scare hares away and serve as a protection against them.

Civet-and **palm-cats.**—These are often destructive to edible fruits, especially pine-apples. Watching for them at night and shooting them with the aid of a lamp is perhaps the most practical remedy. The glare of a lamp lures these animals, whose eyes glisten in the reflected light and offer a good target.

Deer or **elk.**—These sometimes do a great deal of damage, especially in the hill districts, by barking trees or browsing on all tender plants that come within their reach. A substantial wire-fence of about six strands serves as a barrier against them.

Porcupines.—These are among the worst animal pests, more especially of up-country gardens. They root up bulbs and tubers of every des-



FLYING-FOXES AT REST,
hanging by their clawed feet, during the day.

cription, sometimes doing serious damage in a single night. Poisoning and entrapping are the usual methods adopted for their destruction, though these appear to be seldom effectual. Spring-guns are sometimes very effective, and answer the purpose when the above methods fail.

Wild-pig.—A very destructive animal in some localities, especially to young rubber and other plantations, as well as root-crops, such as Cassava, Yams, &c. Barbed-wire fencing around the field, or shooting the animals, are about the only remedies.

Cattle.—Trespassing cattle are in many places a most troublesome nuisance. A close, double hedge of some thorny shrub (see *Barrier Hedges*, page 73) may afford some protection against them, though nothing short of a barbed-wire fence or a solid wall will form a complete barrier. Impounding when caught trespassing, may tend to greater vigilance on the part of the owners.

Elephants sometimes commit serious depredations on estates or gardens, especially on young clearings or plantations, by pulling up or trampling down the plants. A close, barbed-wire fence is a great deterrent to them.

Flying-Foxes (*Pteropus Edwardsii*).—These are often an annoyance in the low-country of Ceylon. They commit their depredations on ripening or fleshy fruits by night, and usually do a



FLYING-FOXES ON THE WING.

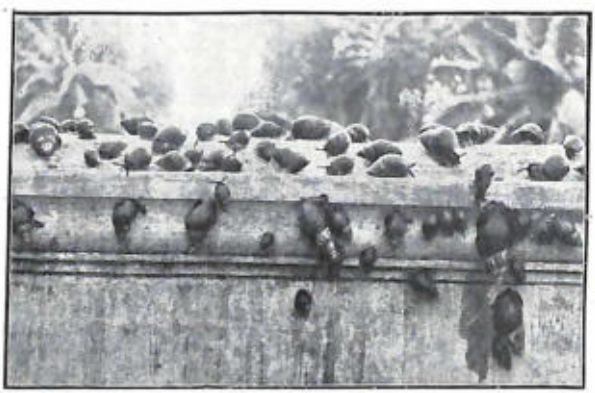
considerable amount of damage to the foliage of trees which they inhabit, sometimes entirely defoliating and killing these. A net seems the only safeguard against them. Frequent firing at them with a gun scares them away for a time. In Queensland, it is reported that poisoned baits (fruits with strychnine placed inside) have resulted in destroying large numbers.

Crows are sometimes formidable enemies to bulbs and certain young plants. The usual protective means is to shoot one occasionally and hang it up where it is desired to scare others. When they occur in large numbers, it is best to get at the source or rookeries, *i.e.* where they breed, and destroy them by shooting or by poisoned baits. It may sometimes be necessary to protect plants or seeds against them with a net. A method sometimes adopted in California to prevent crows from attacking tubers or seed, is to dip these in very dilute tar before sowing. (See *Journal of Economic Entomology*, Aug.. 1909).

Sparrows.—These, as well as other birds when they abound in great numbers, are a very destructive pest. They have a special fondness for tender annuals, and in a short time will do considerable damage by demolishing young seedlings. Stringing the seed-beds or rows with black cotton has sometimes the effect of scaring them off, but nets are about the only reliable protection.

It is sometimes recommended to dress the seeds, before sowing, with red-lead made into a thin paste with water, or with a form of dilute tar. Ordinary coal tar, thinned down to ½ its volume with kerosine, is sometimes used, drying the seed off with powdered lime. Acetone tar is, however, a more protective and safer form to use. Among other grain-feeding birds, the following are the principal species in Ceylon:—Weaver Bird (*Ploceus philippinus*); Black-bellied Munia (*Munia malacca*), Spotted Munia (*Munia punctata*); White-backed Munia (*Munia striata*): Brown Munia (*Munia malabarica*); Ceylonese Lorikeet (*Loriculus indicus*); Alexandrine Parakeet (*Palaeornis eupatrius*); Rose-ringed Parakeet (*Palaeornis torquatus*).

Snails.—An epidemic of what are commonly known as Kalutara Snails (*Achatina fulica*), first noticed in Ceylon in 1910, has spread from the sea coast to inland districts as far as Kandy, Nawalapitiya, &c. The snails propagate rapidly in wet weather, laying their eggs under the surface soil in clusters of 200 to 300 or more. They cover tree trunks, walls, &c., by thousands, devouring vegetable crops, and stripping the leaves or bark off ornamental plants. Among the few plants they do not so far attack are Roses, Tomatoes, Salvia, Torenia, Coleus and Caladiums. The snails in all stages, as well as their eggs, should be collected and destroyed. The soil, where they abound, should be frequently turned over, and



SNAILS ATTACKING PERADENIYA BRIDGE.
A RECENTLY IMPORTED PEST IN CEYLON.

kept as free from weeds as possible. A sprinkling of dry ash on the ground around the crop is a deterrent, and contact with copper sulphate is rapidly fatal to them. Lime appears to be rather beneficial to them than otherwise. Mr. Bemelmans recently drew attention to a natural parasite on these snails, viz. the grub of the fire-fly, which kills them in large numbers. Therefore these grubs should be encouraged to multiply wherever found. I have been informed that pounded snails and their shells make a good flesh diet for poultry. The Buddhist religion, which forbids the destruction of life, does not tend to keep the pest in check.

Lizards are sometimes supposed to cause damage by eating young seedlings, but I am unable to confirm this. Green, late Govt. Entomologist, Ceylon, considered lizards beneficial rather than otherwise in a garden, "as they feed mainly on beetles, grubs, &c." See page 471.

Thieves.—Unlike the other pests named, the depredations of these are not confined to edible products, but may include anything movable. Catching them in the act and inflicting a suitable punishment is not, unfortunately, always an effectual deterrent. Fruit crops especially, such as coconuts, cocoa, etc., are liable to attack by night-thieves, and the employment of night-watchers is therefore indispensable. Dried coconut leaves tied round the stems of the trees (as often adopted in Ceylon), give a loud rustling noise if a person attempts to climb the latter, and so give a warning of the presence of pilferers. Probably the greatest obstacle to fruit-growing in the tropics is the difficulty of protecting the crops from thieves.

2.—GARDEN AND ESTATE FRIENDS.

Injurious insects, fortunately, have natural enemies which under normal conditions usually keep them in check, thus maintaining a balance in nature. These should be encouraged, and may sometimes be introduced with success when not already present. The following are among the worst enemies of insects, and therefore the best friends of gardens and plantations. See also *Carnivorous insects*, page 471.

Insectivorous birds.—These play an important part in the prevention of insect pests by feeding on grubs, caterpillars, etc. It has been estimated that one bird, on an average, will consume at least 50 caterpillars a day, so that a family of five would account for 250. Green gives the following as among the more useful insectivorous birds in Ceylon :—

(1) "The Common Hawk Cuckoo (*Hierococcyx varius*): (2) Blue-tailed Bee-eater (*Merops philippinus*); (3) Black Drongo (*Buchanga atra*); (4) Ceylonese White-bellied Drongo (*Buchanga leucopygialis*); (5) Grey-headed Fly-catcher (*Culicicapa ceylonensis*); (6) Magpie Robin (*Copyschus saularis*); (7) Grey-backed Titmouse (*Parus atriceps*); (8) Common White-eye (*Zosterops palpebrosa*); (9) Ceylonese White-eye (*Zosterops ceylonensis*); (10) Ceylon Myna (*Acridotheres melanosternus*); (11) Black Crow (*Corvus macrorhyncha*). No. 1 feeds principally upon caterpillars. No's 2-9 are generally insectivorous. The large species may often be observed taking toll of the winged termites when these are in flight. No's 10 and 11 frequent cattle and help to rid them of biting flies and ticks."

The scarcity of bird-life in the higher districts of Ceylon has often been commented upon, and attributed, among other causes, to the felling of extensive tracts of forest land for growing tea, etc. One of the best means of encouraging birds to increase is to extend the growth of trees or shrubs which produce fruit for bird-food, such as *Aberia* or Ceylon-gooseberry (Ket-embilla), *Antidesma*, *Bridelia*, *Duranta*, *Eugenia*

(different species), *Stellingia sebifera* (Tallow Tree), *Ficus* (several species), Guava, Lovi-lovi, Mulberry, *Debregeasia* (Gas-dul) with orange-red berries, Wampi, Lantana, etc.

Carnivorous insects.—In maintaining the balance of insect life in Nature, there occur in different countries various insects of carnivorous habits, and these may as a rule be regarded as the friends of the cultivator. Amongst the most beneficial check-insects are the lady-bird beetles (*Vedelia*), which live on scale-bugs, etc.

Pollinating insects.—In the cultivation of fruits, flowers, and vegetables, bees play an important part; they carry the pollen from one flower to another, thus ensuring the fertilisation or cross-fertilisation of the plants, thereby making fruit or seed more plentiful than would otherwise be the case. A large number of plants are partly or wholly dependent on insects for the fertilisation of their flowers. Thus the successful cultivation of the Smyrna Fig, which is dependent on a wasp (*Blastophaga*) for the fertilisation of its flowers, in California is due to the artificial introduction of this insect, the cultivation having previously proved a failure. See p. 278.

Insects as weed-killers.—Certain insects, as species of Coccids, may in some cases prove a valuable check on the spread of certain pestiferous weeds, and these sometimes confine their tastes to definite species of plants. Thus *Dactylopius indicus*, when present in large numbers, has been found in Ceylon to destroy a species of Prickly-pear (*Opuntia monocantha*), whilst leaving alone the similar plant *O.—Dillenii*. The allied insect *D—tomentosus*, on the other hand, is said to affect *Opuntia Dillenii* only and has been found to destroy this in large quantities in Queensland. See p. 476.

Frogs and Toads.—These are most useful creatures in the garden, for they destroy many injurious insects. In Europe and America, toads are often specially protected and encouraged to multiply for the purpose of consuming beetles, snails, wire-worms, weevils, and other destructive insects. It is said that in England the value of toads in gardens is now so well recognised that a high price is sometimes paid for them for colonising purposes.

Lizards of all sorts are considered beneficial as well as interesting creatures in a garden. They feed mainly on beetles, grubs, etc., and therefore should be encouraged to multiply. See p. 470.

Rat-snakes are somewhat of a mixed blessing, most people having a repulsive feeling against all snakes. Yet rat-snakes in particular, which are not poisonous, are very destructive to rats.

3.—NOXIOUS WEEDS AND MEANS OF THEIR CONTROL.

Weeding, or the destruction of weeds, enters largely into the economy of garden and estate work in the tropics. A weed is generally defined as a plant out of place; thus a plant which may be otherwise useful may in certain circumstances become a weed. Any plant deemed a weed, in a garden, should of course be suppressed as far as practicable; but on estates the proper degree of weeding and the best system of carrying it out are sometimes disputed points. Most planters believe in continuous clean-weeding, while others, either for reasons of economy or soil erosion, prefer periodical or annual weeding combined with tillage of the soil, rather than a continuously weeded surface. Not only do weeds compete with the crops for light, air, and the soluble constituents of the soil, but they may also harbour insect pests and possibly parasitic fungi.

Weeds are usually provided with rapid means of natural distribution, their numerous seeds being readily carried either by wind or water or by animals; or their tuberous roots may be of a prolific and persistent character, rapidly multiplying underground, *e.g.* "Oxalis" or "Manickwatte Weed." Manure and grain crops are frequent carriers of weeds, while even man may sometimes introduce a serious pest unconsciously as an ornamental or curious plant. Neglected vacant ground often becomes a harbour of pestilential weeds and a danger to neighbouring plantations or gardens. Weeding becomes less necessary as crops cover the ground, and in

the case of Rubber, or other trees which almost entirely cover the ground, it may be almost dispensed with. The growing of green-manure or cover crops (see page 25), or raising annual between perennial crops, as in the case of Rubber and Coconuts, during the earlier years of their growth, have the effect of economising weeding in addition to enriching the soil or providing interim returns. Where this is not adopted, at least a clear space should be maintained free of weeds around each tree or plant, the space varying according to the size of the latter.

Weeds may sometimes serve as a ground-cover, preventing excessive surface-wash or erosion, *e.g.* "Oxalis" on steep hill sides up-country. On the other hand, the operation of weeding on flat or sloping land may also serve a useful purpose in that it ensures tillage and aeration of the soil, while the weeds removed may in some cases be utilised as a mulch. The "Lantana" weed occupies waste and impoverished land, which in course of time it enriches considerably with humus. Therefore "weeds" may have redeeming qualities.

On estates in Ceylon, the usual system of performing the weeding is to lease out certain areas on contract to the kanganies (headmen of the labour force). The amount paid depends on local conditions and the nature of the crop ; thus Rs. 1.50 to Rs. 2 per acre a month is about the usual contract price for weeding established Tea fields, but in a weedy locality or on new clearings it may be as much as Rs. 4 to Rs. 6 or more per acre. It is estimated that the average cost of weeding Tea in Ceylon ranges from 3 to 4 cents per lb. of made tea.

An excellent method, though not always capable of applicatien, of killing out or preventing pernicious weeds, is to grow a crop of some quick-growing annual which forms a dense ground-cover, the weeds thus becoming choked out. Any close- and quick-growing plant that is obtainable in sufficient quantity will answer the purpose, though it should by preference belong to the Leguminous family, which has the effect of restoring fertility in the soil. See under *Green Manuring*, page 25.

The first principle in controlling weeds is to prevent their seeding; but there are some weeds which are not dependent upon seed for their reproduction, as the " Illuk " or " Lalang " grass (so troublesome in Malaya), and the "Oxalis" in up-country districts in Ceylon, which is reproduced chiefly by small tubers. Therefore, in dealing with these, recourse must be had to starving out the roots by persistently cutting down the leaves, which at the same time prevents, of course, the plants from seeding. Continuous cutting down of the leaves and stems has been found effectual in Ceylon in exterminating such noxious weeds as the " Sensitive Plant " (*Mimosa pudica*) and the Mexican Sunflower (*Tithonia*), which is troublesome along the Railway. The same effect may be obtained by placing a layer of maana-grass or other covering over the affected ground. An old maxim, which shows the importance of preventing weeds from seeding, runs thus :—

One year's seeding,
Is seven years' weeding.

In some cases, as in Coconut cultivation, it is possible to control weeds by means of grazing cattle, which at the same time benefit the palms by their manure. (See p. 446). These may have the effect not only of suppressing rank weeds, but also, if not too numerous, of forming a smooth sward.

Poison weed-killers.—Destroying weeds by means of poisons or weed-killers is not practicable among crops, except perhaps on young

clearings. Bamber recommends arsenate of soda for killing out weeds on young Rubber clearings, when it is impossible to eradicate these by ordinary means. For roads, paths, railway tracts, tennis-courts, "compounds," etc., posion weed-killers can, however, be effectually applied. Of commercial weed-killers, there are various kinds, some in powder form, others in liquid. Those consisting of compounds of arsenic, carbolic, or sulphuric acid (about 10% solution) are the most effective, but other substances, as sulphate of copper, kerosine, common salt, etc., are also sometimes used with more or less success and at less cost and risk. Arsenic trichloride in a gaseous form is reported to be used with much success in exterminating the "Prickly Pear" (*Opuntia*) in Queensland, where the gas may be obtained at £22 per ton. It is applied by means of an "atomiser," and is said to be comparatively harmless to other plants owing to their water content being usually much lower than that of the "Prickly Pear" and similar succulent plants.

Where a commercial weed-killer is not available, any of the following simple mixtures may be employed for the purpose, viz: (1)—Mix 1 oz. carbolic acid with one gallon water, and apply through the rose of an ordinary watering can. (2)—Take one part kerosine to three of boiling water, and emulsify with soap. (3)—Dissolve one pound common salt in one gallon of boiling water, and apply as hot as possible through the rose of a watering pot, at the rate of one gallon to every two square yards of weedy surface. (4)—Take 9 lb. white arsenic and 3 lb. washing soda, boil in one gallon of water till dissolved; for use, add ½ pint of the solution to one gallon of water. In using poisonous weed-killers, gloves should be worn to prevent contact with the skin; care should be taken to keep the solution clear of one's clothes and boots, whilst going too near grass verges, plant-edgings, etc., must also be avoided.

To destroy weeds in ponds.—Large or deeply submerged weeds are best overcome by "dragging," or by draining the pond and removing the pest by hand. Small weeds, however, can sometimes be destroyed, or at least checked, by a solution of copper sulphate. Break up the copper sulphate (1 lb. to every 100,000 gallons of water), and enclose it in a bag of loose texture. Tie this behind a raft or boat, and then draw it backwards and forwards through the water in parallel paths about 10 feet apart. The copper sulphate will thus become dissolved and kill the weeds, which will sink and disappear. The sulphate is very little, if at all, injurious to fish, and will, in any case, disappear from the water soon after application. Spraying the surface with a solution of copper sulphate is also effective for surface weeds or pond scum.

4.—PRINCIPAL NOXIOUS WEEDS OF CEYLON.

Those Marked * are introduced.

Adiantum cuneatum. Maiden-hair Fern. Up-country, among Tea, &c.

Ageratum conyzoides. "Hulantala," *S*; "Pum-pillu," *T*; "Goat-weed." (*Compositae*). Annual, with strong, objectionable odour; all elevations. See *Medicinal Plants*, page 377.

Aloe vera, var. littoralis. "Katalai", *T*. (*Liliaceae*). Dry region, sea-coast.

Amarantus spinosus. "Kalu-tampala," *S*. (*Amarantaceae*). Semi-dry region.

Aponogeton crispum. "Kekatiya," *S*.—A water weed, chiefly up-country.

Artemisia vulgaris. "Wal-kolondu," *S*. (*Compositae*). Erect perennial with deeply pinnatisect leaves, resembling Chrysanthemum in young state; leaves aromatic. Waste places, medium to high elevations.

A.—Roxburghii. Similar to latter species, 5 to 7 ft. high, commonly used as temporary hedges round coolies' gardens up-country.

Bidens pilosa. "Wal-té-kola," *S*; "Spanish-needle." (*Compositae*). Throughout moist region, in cultivated ground.

Blumea membranacea. (*Compositae*). Annual, 5-6 ft. high. Up to 4,000 ft.

Cardamine hirsuta.—"Kadavi," *T.* (*Cruciferae*). Small annual, up-country generally.

Cassia mimosoides. "Bin-siyambala," *S.* (*Leguminosae*). Annual, 2-3 ft., resembling "Sensitive Plant." Throughout tropics; low-country, waste ground.

*Chenopodium ambrosioides. (*Chenopodiaceae*). An erect perennial, 2-3 ft. high, with strongly aromatic, pointed, segmented leaves, common at medium and high elevations. First noticed in Ceylon in 1882 (Trimen). See p. 398.

Cuscuta chinensis. "Dodder;" "Aga-mula-neti-vel," *S.* (="a creeper without beginning or end"). (*Convolvulaceae*). A parasite on grass, shrubs, &c., forming a tangled mass of pale yellowish stems without leaves. Common in Tropics, up to about 2,000 ft., also in Ceylon, often on Mikania. See pp. 453, 475.

Cyperus rotundus. "Kalanduru," *S*; "Kora," *T*; "Nut-grass." (*Cyperaceae*). A low sedge with numerous underground, edible tubers, found at all elevations in moist region, often as a pernicious weed. The only way to eradicate it is by digging up the tubers. "The most troublesome weed in Bengal" (Watt).

Elephantopus scaber. "Et-adi," *S*; "Elephant's foot." (*Compositae*). Low-country, lawns and pastures. Tropical Asia.

Erigeron sumatrense. "Alavanga-weed." (*Compositae*). Annual with erect stems, 5-6 ft. From medium to high elevations.

*Eryngium foetidum. "Fit-weed." (*Umbelliferae*). Herbaceous annual of Trop. America, with foetid, prickly, feathery leaves; amongst grass in moist shade. Peradeniya, Kandy, &c.

Euphorbia hirta. (=E.—pilulifera). "Bu-dada-kiriya," *S*; "Palavi," *T*. Small annual, in cultivated ground. See *Medicinal Plants*, page 378.

Ficus parasitica. "Gas-netul," *S.*—An epiphyte in a young state, growing in the forks of trees or on the stems of palms, it not infrequently surrounds its host and becomes a tree with spreading branches. In the accompanying illustration it has almost completely surrounded a Palmyra palm, only the crown of which is seen remaining at the top.

*Galinsoga parviflora. (*Compositae*). Small annual of Peru, 10-15 in. high; waste ground, medium and high elevations.

*Gnaphalium multicaule. "Wild Mignonette." (*Compositae*). A perennial, 1½-2 ft; up-country, introduced into Ceylon about 1880. (Trimen).

Hydrilla ovalifolia, for some time known as "Colombo Lake weed," which at one time turned the Colombo Lake into an unsightly mass of weeds, causing a plague of flies, being kept in check only at considerable expense to the Municipality. It is a pestiferous plant in lakes and ponds, and for some years formed a dense mass in the pond in Peradeniya Gardens, where it was impossible to suppress it. It suddenly disappeared in 1916 owing, it is surmised, to the introduction of "gourami" fish, which are greedy feeders on water-weeds.



Ficus parasitica.

Began as a small epiphytic creeper, now a tree surrounding its original host (Palmyra palm), the latter still keeping its head up above its enemy.

Imperata arundinacea. "Illuk," *S*; "Lalang" of Malaya. Erect grass, 3-4 ft. high, often a pest in the moist low-country, generally in badly drained, sour, or neglected land. The strong, rigid leaves make excellent thatch. See p. 472.

*Lagascea mollis.—(*Compositae*). Annual of Cent. America. Introduced in 1852; now a common weed about Kandy, Teldeniya, Negombo, sea-coast near Colombo, etc.

*Lantana aculeata. "Katu-hinguru, *S*; "Lantana-weed." (*Verbenaceae*). Prickly, slender shrub, 5-8 ft. high, up to about 4,000 ft., especially in semi-dry districts. Perhaps the most familiar plant in Ceylon, considered to have been introduced about 1826 as an ornamental plant, by Sir Hudson Low. A weed in waste or neglected ground only. See also page 113.

Leucas zeylanica. "Tumba," *S*. (*Labiatae*). Low-country, waste ground.

Limnanthemum indicum. "Olu" or "Maha-ambalu," *S*. Water-weed with floating, round leaves, resembling those of *Nymphoea*. Ponds and streams up to about 1,500 ft.

Loranthus. "Bird-vine"; "Pililla," *S*; "Kuruvichai," *T*. (*Loranthaceae*). Semi-parastic on trees and shrubs, like mistletoe; found on trees, &c., of woody growth. Distributed by birds, which carry the seed and deposit it on branches, where it germinates and takes root. Only remedy is to lop off and burn the affected branches. 6 species are indigenous to Ceylon low-country, 3 to up-country, and 3 to the dry region.

*Mikania scandens. "Mikania-weed"; "Loka-palu," *S*. (="World-ruin"); "A mile-a-minute." (*Compositae*). A quick-growing and rapidly spreading her-



PRINCIPAL WEEDS IN CEYLON.

1, "Goat Weed" (*Ageratum conyzoides*); 2, "Prickly Pear" (*Opuntia Dillenii*); 3, Fruit of "Prickly Pear"; 4, "Lalang" or "Illuk" (*Imperata arundinacea*); 5, "Alavango-" or "Crowbar-Weed" (*Erigeron sumatrense*); 6, "Musal-katha," *T*. (*Sonchus arvensis*); 7, "Loka-palu," *S*. (*Mikania scandens*); 8, "Koray," *T*. (*Cyperus rotundus*); 9, "Couch-grass" (*Panicum repens*); 10, "Manickwatte Weed" (*Oxalis latifolia*) 11, "Lantana Weed" (*Lantana aculeata*); 12, "Kurunegala Daisy" (*Tridax procumbens*).

baceous climber, native of Trop. America. Low-country generally, up to 4,000 ft. Also a scourge in South India, as well as in parts of Malaya, Fiji, &c. See p. 453. The parasite *Cuscuta* (see p. 474) may become a natural check on it.

*Mimosa pudica. "Sensitive-plant"; "Nidi-kumba," *S*; (*Leguminosae*). Introduced from Brazil before 1804. Stems thorny, creeping; leaves small, bipinnate, very sensitive, closing immediately on being touched or with the rain. Often a troublesome weed in pastures, neglected lawns, &c. Low-country generally and up to about 4,000 ft. Root used as an antidote for cobra-bite. See p. 472.

Nymphoea stellata. "Manel," *S*; Water-lily. (*Nymphaeaceae*). Common in ponds, tanks, &c., especially in low-country, often to the exclusion of all other plants. Difficult to eradicate when once established. Flowers pale blue.

*Opuntia Dillenii. "Katu-patuk," *S*; Naka-kalli, *T*; "Prickly Pear." (*Cactaceae*). Sharp spines, 3-5 in. long, in bunches. Dry region, chiefly Jaffna district, used as a barrier hedge. See p. 454.

*O.—monocantha. Southern Province. Similar to latter species; spines usually single, especially on older portions. (Petch). See p. 471.

*Oxalis corymbosa. "Manick-watte Weed"; "Embuldeena," *S*. (*Geraniaceae*). Tuberous stemless perennial, with fleshy, trifoliate leaves, 6-10 in. long; chiefly between 3,000 to 5,000 ft., in cultivated ground, especially in wet region. Leaflets rounded; flowers pink. Spreads rapidly by means of numerous, small, underground tubers. Native of S. United States, introduced before 1824. Though an uncontrollable weed in some districts, on steep slopes it may be a useful check on soil erosion. See p. 472.

*O.—latifolia. Distinct from the latter by the triangular leaflets, but similar to it in habit, &c. Commoner than former species about Hakgala and Nuwara Eliya.

Polygonum punctatum. "Snake-weed." (*Polygonaceae*). Semi-creeping, deep-rooting weed; hill districts up to 6,000 ft. Pink flowers.

Portulaca oleracea. "Genda-kola," *S*; "Pulik-kirai," *T*. (*Portulaceae*). Dwarf plant; low-country, cultivated ground.

Panicum repens "Couch grass"; "Etora," *S*. Low, deep-rooted, persistent grass, chiefly at medium and high elevations. See p. 450.

Solanum indicum. "Tibbatu," *S*. Shrub, 1-3 ft., fl's purple; waste ground.

*Sonchus arvensis. "Sow-thistle"; "Musal-katha," *T*. (*Compositae*). In stony, gravelly ground and crevices of walls, &c.; chiefly medium elevations.

*Synedrella nodiflora. (*Compositae*). An annual of Mexico. Waste ground, moist low-country; Peradeniya, etc.

Tithonia diversifolia. See pp. 27,117,118. Ornamental herbaceous plant, 6-7 ft. high, growing in continuous mass and spreading by rhizomes as well as seed; introduced into Ceylon in 1851, now a common weed along roadsides, railways, river-banks, &c., up to about 4,000 ft. See pp. 27, 118, 364, 472.

*Tridax procumbens. "Kurunegala Daisy." (*Compositae*). Low and medium elevations, chiefly dry districts. Native of S. America.

5.—SOME NOXIOUS WEEDS OF OTHER COUNTRIES.

Amarantus spinosus. Ann., 4-5 ft. high, whole plant spinous. Hawaii, &c.

Carduus arvensis. Californian or Canadian Thistle. (*Compositae*). N. America.

Clidemia hirta. "Koster's curse." (*Melastomaceae*). Fiji.

Cryptostemma Calendulaceum. "Cape-weed." (*Compositae*). A troublesome weed in New South Wales, East Africa, &c. Native of S. Africa.

Eichhornia (Pontederia) crassipes. "Water Hyacinth"; "Lilac Devil." (*Pontederiaceae*). Native of Brazil. A floating, troublesome water-weed in Florida, Queensland, parts of Java, Burma, &c., sometimes blocking rivers and water-

ways. A beautiful plant with erect racemes of bright mauve or lilac flowers. The leaves and bladder-like leaf-stalks are rich in potash and are used for manure; they are employed in Malaya for feeding pigs, and in the W. Indies as feed for donkeys. Spraying with white arsenic (arsenious oxide) and soda (sodium carbonate) is used in Florida for controlling the pest. Its cultivation in Ceylon, where it was introduced in 1905 as an ornamental plant by Lady Blake, wife of the Governor at that time, is prohibited by law. See page 174.



WATER HYACINTH. *Eichhornia crassipes.*

Erigeron canadense. "Cobblers' Pegs." (*Compositae.*) N. South Wales.

Imperata arundinacea. "Lalang." Malaya, &c. See p. 474.

Opuntia Dillenii. "Prickly Pear." Queensland, Northern India, etc. See pages 454, 475.

Panicum Curtisii. "Maiden Cane." A grass, native of Florida, etc.

Phytolacca sp. "Poke-weed." (*Phytolaccaceae*). N. South Wales, etc.

Polygonum tomentosum. (*Polygonaceae*). Ootacamund, etc.

Pteris aquilina. Bracken-fern. N. South Wales, etc. Common in the tropics at elevations of 4,000 ft. upwards.

Sida retusa. "Paddy's Lucerne." (*Compositae*). N.S. Wales, &c.

Sorghum halapense. "Johnson-" or "Sorghum-weed." A tall grass. West Indies, Central India, &c.

Tagetes minuta. "Mexican Marigold." (*Compositae*). South Africa.

Vittadinia australis. "Australian Daisy." N. South Wales, Queensland, etc.

Xanthium spinosum. "Bathurst-burr"; and X.—strumarium, "Cockle-burr." (*Compositae*). N. S. Wales, &c.

CHAPTER XXXIII.

INSECT AND OTHER PESTS

The extent of the destruction to crops by various insect pests in different countries is incalculable, running in many cases to millions of pounds or dollars. Though Ceylon possesses a large variety of insect life, it has practically no insect-pest of an alarming nature as compared with some other countries. Spasmodic outbreaks are, however, liable to occur here as elsewhere, and it should always be remembered that prevention, if possible, is better than cure. There are many simple precautions which are sufficiently obvious to anyone who practises agriculture or horticulture intelligently, and the following hints may afford some guidance; these may be adapted or modified according to the nature of the crops or local circumstances.

Good cultivation, rotation of crops and intercropping when possible, green-manuring, and the application of suitable fertilisers are important means of controlling insect pests as well as fungus diseases. In other words, to maintain a vigorous condition of the plants or crops is one of the best safe-guards. Thus, in reference to shot hole-borer, the worst pest of tea in Ceylon, it has been observed that a healthy vigorous condition of the plant, as induced by good pruning, cultivation, &c., has an excellent preventive or remedial effect.

PREVENTIVE OR REMEDIAL MEASURES.

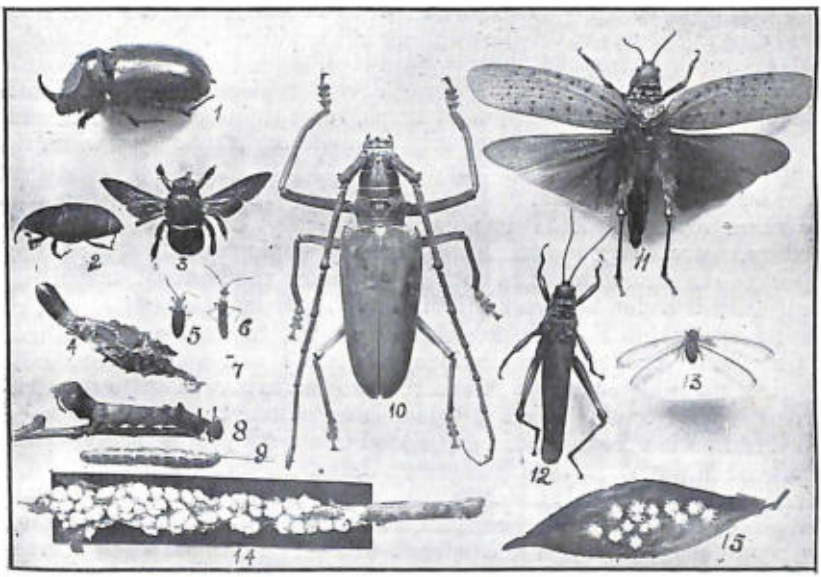
Handpicking of insects is recommended wherever practicable, as in the case of large borers, caterpillars, etc. In some cases it is easy to remove these from the plants by knocking the branches or foliage with a stick, afterwards collecting the creatures in a box and destroying them in diluted kerosene oil, boiling water, or in a pot of tar. A hand-stick with one end covered with a gummy substance is sometimes useful for catching insects. See *Willughbeia*, p. 133.

Hand-nets.—The use of these, whenever practicable, is to be recommended, more especially for flying insects.

Light-traps and Smoke.—Lights or glares are useful traps for certain insect pests, especially such as fly at night. *Acetylene lamps* are thus used with good effect in the vineyards of Europe for catching moths and other injurious insects. The method adopted is to set the lamps out at night, preferably on dark nights, at distances of about 500 yards apart. The insects are attracted in swarms by the flame, and are killed in a

weak solution of kerosene which is placed in a shallow basin adjusted a few inches below the burner. In a similar way an ordinary *kerosene lamp* with reflectors, hung over a tray containing jaggery or other sugary substance and water, or water with a film of kerosine, may be used for catching cockchafers, moths, ants, etc.

Rolling pasture-land, net-dragging, etc.—For caterpillar pests on paddy, it is recommended to draw wooden rollers over pasture land in the neighbourhood, if practicable. The use of a bag or a net dragged over the ground is also advised. Such a net-bag can be made with a width of about 12 ft. and an opening about 3 ft. wide; it may be attached to a frame of bamboos and drawn between the rows of crops, along grass strips, or in any narrow spaces. The simplest pattern, says the Imperial Entomologist of India, has only two upright bamboos, to hold open the sides; a better one has four bamboos, the two cross ones having projecting handles, and this pattern closes up automatically at the end of each sweep. In some cases it may be desirable to smear the inside of the bag with oil or dilute tar to catch the insects as they fly in.



SOME INSECT PESTS OF CEYLON.

1, RHINOCEROS BEETLE (*Oryctes rhinoceros*); 2, RED WEEVIL (*Rhynchophorus ferrugineus*); 3, CARPENTER BEE (*Xylocopa tenuiscapa*); 4, FAGGOT WORM (*Clania variegata*); 5, RED COTTON BUG (*Dysdercus cingulatus*); 6, PADDY BUG OR FLY (*Leptocorisa varicornis*); 7, SHOT-HOLE BORER (*Xyleborus fornicatus*); 8, LOBSTER CATERPILLAR (*Staeropus mauritia*); 9, PADDY SWARMING CATERPILLAR (*Spodoptera mauritia*); 10, LONGICORN BEETLE (*Batocera rubus*); 11, SPOTTED LOCUST (*Aularches miliaris*), wings open; 12, SPOTTED LOCUST (*Aularches miliaris*), wings closed; 13, TERMITE OR "WHITE ANT" (*Calotermus militaris*); 14, MEALY BUG (*Phenococcus iceryoides*); 15, STAR OR SCALE-BUG (*Phenococcus ornatus*).

Close Season for Crops.—In the case of annual crops, the close season principle, by which no old plants are allowed to be left in the ground or new ones to be planted during a certain recognised period, is obviously sound practice. It has been adopted in some countries for the cotton crop, the "close period" varying from a month to six weeks, during which period no cotton plants are allowed to be in the ground.

Entomogenous Fungi.—Many insects, as locusts, scale-bug, grasshoppers, beetles, &c., are usually kept in check by natural enemies, as by parasitic or entomogenous fungus diseases; but it has not yet been found practicable to employ these artificially as a means of controlling insect pests.

Trap-crops, Poison baits, vegetation belts, etc.—A successful way of warding off an attack by insects of an omnivorous nature, is to sow a quick-growing trap. crop intermixed with the main crop; thus the former, furnishing food for the insects, will attract their attention from the latter. Locusts are sometimes destroyed in large masses by planting belts of quick-growing plants, *e.g.* Castor-oil plant, which at the season of the locust attack are heavily poisoned by a strong insecticide, such as arsenic compounds.

Insect Traps.—Trenches or holes cut in the earth are sometimes found to be successful as traps for grubs or caterpillars, which, falling into these at night, are unable to climb out again, and at daylight may be collected and destroyed. Empty jam-tins, sunk level with the surface soil, form good pitfalls. Also large leaves or pieces of cut vegetation laid on the ground act as useful traps, as the insects will often hide under these during the day, especially in the early morning, when they should be looked for and destroyed.

Mechanical protection against insect pests.—In spite of all precautionary measures it is often necessary, especially in Ceylon up-country gardens, to protect young tender seedlings by placing a collar of tin or stout paper (the lower end sunk 1½ to 2 inches under the surface) around each plant until it has outgrown its liability to be attacked by cutworms, etc.

Plants as insect-preventives.—Certain plants have the reputation of possessing properties obnoxious to insects and having the effect of driving the latter away. Thus tomato leaves are, in some countries, spread around tender plants, their strong odour being considered to afford protection from certain injurious insects. **Derris elliptica* ("Tuba-root" of Malaya), *D. fuliginosa* ("Kalawel," *S.*, both Leguminous climbers), species of Alocasia ("Habarala," *S.*), and ***Acorus Calamus* ("Wada-kaha," *S.*) are all considered to be effective against termites, the roots being pounded and spread around the crops. The first and last named species especially are commonly employed in Malaya for this purpose. In up-country gardens in Ceylon, the chopped-up leaves of the "Wild Lobelia" or "Kiri-bamboo," *S.* (*Lobelia nicotianaefolia*) are sometimes used as a protection against the "black-grub" or "cut-worm," while in the low-country, tobacco leaves are sometimes similarly employed for other pests.

Palm Beetles.—The crown or "cabbage" of the coconut and other palms is often attacked by large beetles, more especially the "black beetle," which disfigure the fronds and sometimes permanently injure the

*See p. 385. **Ridley in *Agric Bull. of F.M.S. & S.S.*, 1904, No. 5.

tree. These beetles, says Green, may be harpooned or extracted by a stiff piece of sharp wire (or a long hat-pin) with a barb at the end, the hole being then filled with very fine dry sand. The latter acts also as a preventive, disabling the beetles by getting into their joints. The "Red-beetle" is sometimes a serious pest of the Coconut palm, attacking in enormous numbers and breeding rapidly inside their host. If a tree becomes badly infested with this pest, it has usually to be cut down and destroyed. Beetles in general are best caught at night with the aid of a lamp.

Cut-worm or **Black-grub** (*Agrotis ypsilon*).—A fat, brownish-black caterpillar, 1¼ to 1½ in. long, which attacks at, or just below, the ground-level almost any young seedlings, especially those of flower or vegetable crops, in Ceylon up-country gardens. Land reclaimed for garden crops, &c., should be thoroughly cleared of all weeds and undergrowth, and left fallow for about 6 weeks, burning grass, weeds, etc., on the surface.

Locusts (*Aularches miliaris* and other species).—A serious pest in many tropical, or sub-tropical countries, especially in North and South Africa, &c., occurring in enormous swarms. The female lays from 80 to 120 eggs, in a hole bored in the ground, which take from 16 to 36 days, according to temperature and moisture, to hatch. Control measures: Stir up the soil to expose egg-masses; collect adults and egg-masses; destroy nymphs by driving or baiting them into prepared trenches, then burying or spraying them with a contact poison. Small epidemics of "Spotted Locust" occasionally occur in Ceylon, chiefly in the dry region.



PLAGUE OF LOCUSTS IN SOUTH AFRICA.
(See *Kew Bulletin*, 1908, p. 198).

Eelworms or **Nematodes.**—A microscopic group of translucent animal-life which infest the ground and often cause considerable injury, or even death, to plants before their presence is detected. They first attack the roots and rootlets, which in time become knotty, bearing small gall-or wart-like excrescences. Tomatoes, cucumbers, and melons are especially liable to their attack. Plants that are badly affected should be removed and destroyed by fire; the soil should be opened up and treated with Vaporite or a dilute disinfectant. Liming the soil, change of plants or rotation of crops are also recommended. In preparing the ground, it is recommended to use carbon bisulphide (3 to 4 oz. per square yard), placed in holes 8 to 12 in. deep and a foot apart each way; fill in with soil as soon as the chemical is placed in the hole. See p. 483.

Wireworms.—The larvae of various kinds of beetles, seldom reaching 1 in. in length. They are often a troublesome pest, gnawing the stems

and roots of plants just below the surface. They live in the soil in the worm state for about 5 years, and feed voraciously on the roots of almost any plants. Soils that have been long undisturbed, as fallows and pastures, are usually affected by them. An application of "vaporite," nitrate of soda, or of unslaked lime is recommended. See p. 79.

Leaf-galls, which are common in the tropics but do not usually cause much harm, are often due to the action of mites and small insects on the leaf-surface, causing pockets or blisters in the leaf-tissue. Some trees are more prone to these than others, *e.g.*, *Eugenia malaccensis* and *Canthium didymum.* In the latter, the galls closely resemble fruits. See p. 498.

Mosquito preventives.—The breeding of mosquito larvae is specially favoured by stagnant water, as is often found in drains, roof-gutterings, discarded tins, broken vessels, bamboo stumps, etc. Moist shade, as under heavy foliage, and plants with water-collecting adaptations, as sheathing leaves or floral receptacles, also offer facilities for the pest.

In addition to guarding against these sources as far as possible, free use should be made of a larvicide which leaves a film on the surface of the water, as kerosene, Jeye's, Cyllin, Phenyl, and Izal disinfectants. These may conveniently be applied by soaking up the liquid with sawdust, say 30 per cent. disinfectant and 70 per cent. of sawdust by volume. Small fish, such as "millions," are among the principal natural enemies of mosquitoes. For driving away mosquitoes, the fumes of burning pyrethrum or other insect-powder are efficacious; while for protecting the body, a mixture of citronella oil (2 oz.), spirit of camphor (1 oz.), cinnamon oil (½ oz.), coconut oil (2oz.), is recommened as an application. Mosquitoes, it need hardly be stated, are the recognised method of conveying malaria and yellow fever to human beings.

USEFUL INSECTICIDES.

Insecticides act in two ways, viz. as a *stomach poison* when taken internally by the insect with its food, or as a *contact poison*, as in the case of insects which obtain their food by sucking, as "scale-" or "mealy-bugs," &c. Some contact poisons also kill by *asphyxiation*, *i.e.* by forming a coating around the insects and preventing the latter from breathing. Scale-insects may be attacked chiefly in this way. Generally speaking, the remedies for aphis (green-fly, etc.) are in the nature of a contact poison, as emulsions, tobacco juice, etc., while for beetles, caterpillars, and grasshoppers, stomach poison, such as "Paris Green," "London Purple," etc., are more effectual. Insecticides in liquid form (with water) may be applied by a fluid sprayer or a syringe capable of emitting a fine spray or mist, distributing the liquid evenly over the whole plant; while those in the form of powder, mixed with lime, dust, flour, etc., may be dusted from a powder-sprayer or bellows.

Arsenate of Lead This compound is considered to have special advantages over "Paris green;" it is much lighter than the latter, does not scorch the foliage, and can therefore be used more freely. Satisfactory results have been obtained by using a solution of 2 lb. arsenate of lead to 100 gall. of water. The following formula is recommended:—Acetate of lead ("Sugar of lead"), 3 oz.; arsenate of soda, 1 oz.; water to make up to 10 gallons. Place the two former in the water, stir till dissolved, when it is ready for use. One pound of treacle may be added to render the mixture adhesive.

Arsenate of Lime.—As a substitute for the above the following may be used:—1 lb. arsenic, 4 lb. washing soda, and 2 gallons of water. Add one pint of the mixture to 4 gallons of water, and to this add 4 oz. unslaked lime.

Borer Wash.—1 pint crude carbolic or phenol, 2 lb. soft soap (or 2½ lb. hard soap), 1 gallon water. Dissolve the soap in hot water, add enough clay to thicken it, and apply with a brush.

Carbon Bisulphide.—A highly volatile and inflammable clear liquid, the vapour of which is driven off at a low temperature and is fatal to insect life. It is used successfully in the destruction of ground-insect pests, where these occur in colonies, as in the case of termites; also against grain pests, &c. The poison is best applied to termites' nests by saturating balls of cotton wool with it, and dropping one of these in each burrow, the latter being then quickly closed up. The vapour, being heavier than air, sinks to the bottom of the crevices and permeates the whole " nest."

Caustic Soda.—A white solid substance, very soluble in water, acts as a caustic, is powerfully alkaline, and is deliquescent on exposure to the air. It is sometimes used in orchards, in conjunction with potash, as a fluid-spray on trees in a dormant state, when, in addition to cleansing the trees, it proves destructive to many forms of insect life. The solution is made up thus :—Caustic soda, 1 lb.; soft soap, ½ lb.; carbonate of potash, 1 lb.; water, 10 gallons. Dissolve the soft soap in hot water, and add to cask or vessel containing 10 gallons of water in which the soda and potash have been dissolved.

Emulsions.—Kerosene (paraffin or petroleum) in the form of emulsion affords one of the most effective insecticides for sucking insects. Many formulae have been devised, but the following will serve practical purposes :—Kerosine, 1 gallon; soft-soap, 3 lb.; boiling water, ½ gallon. Dissolve soap in boiling water and add, boiling hot, to the kerosine. Churn the mixture thoroughly until a cream-like emulsion is formed. This, on cooling, should thicken to a jelly and adhere without oiliness to the surface of glass. The hotter the mixture, the easier the emulsion is formed. For use, add 1 part emulsion to 10 of water. Apply hot through a fine syringe or sprayer, after sunset or in shade, keeping mixture well stirred.

Gondal-fluid.—"4 oz. gum, 8 oz. asafoetida, 8 oz. bazaar aloes, 3 oz. castor-cake. Mix well with water, add clay to thicken, and paint on the base of trees which are liable to be attacked by white-ants or other insects." (Watt). Gondal-fluid is an Indian preparation, and has been recommended for applying to Tea bushes &c., as a preventive against white-ants.

Hot Water and Soap.—Up to a temperature of 170 or 200 Fah., hot water with soap will kill certain insect pests, as green-fly, &c., without injuring their host plants. Very hot water, applied with a syringe, will usually cool sufficiently between syringe and plant to avoid injury to the latter, though fatal to insect-life. See *Disinfection of seeds*, p. 496.

Paris Green.—Also known as "Scheele's Green," "Emerald Green," "Mitis Green," and "French Green." A powerful irritant and poisonous compound of arsenic, copper, and acetic acid, having the appearance of fine powder with a clear-green colour. For use, take 1 oz. of the powder and mix in 6-8 gallons of water. Like other arsenite compounds, it should be applied in the form of a fine spray, the liquid being meantime kept constantly stirred. It should be regulated in strength according to the nature of the plants sprayed.

Quassia, Quassia-chips, or Bitterwood.—A vegetable insecticide, consisting of the intensely bitter juice of the West Indian tree, *Picraena excelsa* (Simarubaceae), which is fatal to many forms of sucking-insects, particularly aphides. For use, take 1 lb. quassia chips, 1 lb. soft-soap, and 5 gallons of water; boil for 2 hours, strain the liquid, and add 5 gallons more water. This solution has been especially successful in Jamaica against black-ants; but it should not be sprayed on trees bearing edible fruit or leaves, as the quassia imparts a bitter taste not easily got rid of.

Resin or Rosin.—This enters into the composition of several valuable spray-fluids for different forms of scale-insects. It acts by depositing a covering over the insect, thus killing the latter by preventing its breathing (see p. 482). The following formula is recommended :—Resin, 4 lb.; fresh oil, 2 pints; caustic soda, 1½ lb.; water, 10 gallons. Boil the first 3 ingredients, mixed with the water, until the resin is dissolved; then make up to 15 gallons of water. The solution should be diluted with nine times its quantity of water before using. It is especially recommended for use against the " sooty-mould " on Orange and other Citrus trees.

Tobacco-juice.—This is often used with good results against thrips, aphides, animal-lice, &c. Take ½ to 1 lb. of cured tobacco leaf or waste; place in 3 to 4 gallons of water; bring to the boil and allow to simmer for a time. The liquid, after being strained, may, if not too strong, be used direct for spraying; otherwise it should be diluted with water until of the desired strength to suit the plants concerned. To render it more effective, about ½ oz. of soap may be added for each gallon. Several commercial preparations of tobacco juice are obtainable.

Tobacco-smoke is used for fumigating plants in glass-houses, being a powerful insecticide for certain insects. It is obtained by burning tobacco, or paper steeped in tobacco juice, without flame. Better effects are, however, obtained from the nicotine vaporisers, as the "XL. All Vaporisers" and others, which are probably compounds of nicotine and alcohol. These are proprietary remedies, and directions for their use are issued by the makers.

Vaporite.—A powdered preparation, made by the Vaporite Coy., London, and a very efficacious insecticide for applying to the ground, being destructive to grubs, eelworms, millepedes, cockchafers, etc. It may be applied by simply mixing with the surface soil or by inserting small portions in holes, several inches apart, made with a crowbar, or in a weak solution with water for pot-plants.

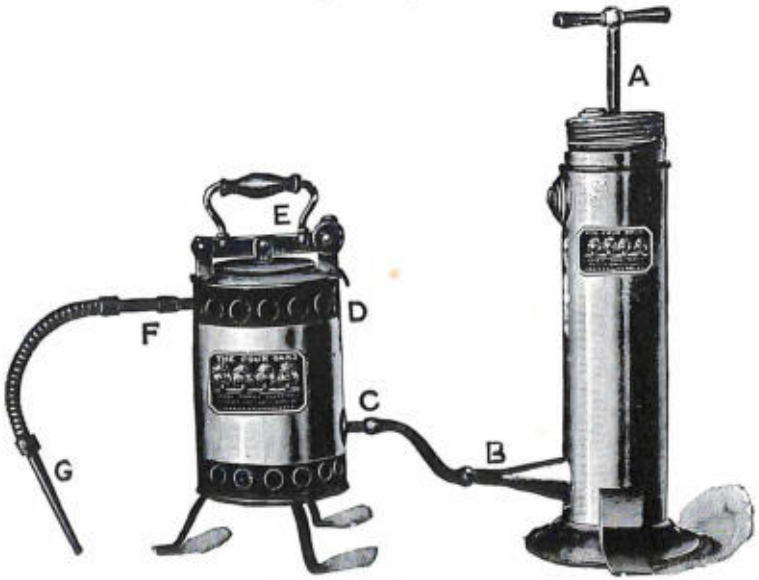
"Silvertown".—A liquid preparation which has been found very effectual as a wood preservative. In a well diluted state it may be applied through a rose to beds, borders, &c., preferably before planting, where ants, termites or other ground pests are troublesome. It may also, if desired, be used as a weed-killer on paths, tennis courts, &c. See p. 514.

Quick-lime.—Fresh-slaked powdered lime, especially coral lime, is of great value as an insecticide when dusted over the ground or mixed in with the soil. It also serves as a useful diluent of poisonous powders, being used to a large extent in the preparation of some of the more active insecticides and fungicides to neutralise their caustic action on foliage. When quick-lime is applied in the form of a wash or spray, it leaves a thin film over the parts so treated.

Gas-lime and **Gas-liquor,** both waste products from gas factories, are much employed in countries where obtainable as a remedy for ground pests and root diseases. Gas-lime may be applied at the rate of ½ to ¾ lb. per sq. yard, and gas-liquor, 4 times diluted with water, at the rate of 1 gallon to 10 sq. yards. In either case the ground must be fallow when applied, and must remain so for six weeks after the application. Both articles have also a manurial value, especially the former, which becomes converted into sulphate of lime.

MEANS FOR DESTROYING TERMITES AND ANTS.

The "Ant-Exterminator."—Of the various devices as yet adopted for destroying termites, this is probably the best. It consists of a small



ANTIPEST FUMIGATOR.

charcoal furnace and a pump with a nozzle for forcing smoke charged with poison fumes into holes or crevices. The charcoal (in C D) being set alight, a handful of a mixture, composed of arsenic (85 %) and sulphur (15 %), is thrown over it and the lid firmly clamped into position. A flexible nozzle (G in figure) is pushed into the main entrance of the nest, and all other holes are plugged with clay. The pump (A) is then worked, and drives the vapour into the nest, forcing it into all the ramifications of the galleries. If little jets of smoke soon arise from crevices and unsuspected openings, these should be immediately stopped with clay or pounded earth. After a few minutes of pumping, the nozzle may be withdrawn and the hole plugged with clay. The nest should remain undisturbed for a week, when the mound may be levelled. If opened immediately after the application some of the insects will revive. In some few cases there may be feeble signs of renewed activity, in which event a second application should complete the work of destruction. The "exterminator" may also be used for driving snakes or rats out of their nests, or for asphyxiating them in their holes.

Poison baits for ants.—Destroying ants and termites by laying down poison-baits is often recommended. The latter may consist of a mixture of arsenic, sugar, flour, tallow, etc., made into a paste and strewn about in small pellets where the pest is troublesome; or of a stiff dough made of "Paris Green" (1 oz.), flour (8oz.), and sugar (3 oz.), formed into small lumps and placed in holes near the plants attacked. Where it is dangerous to use arsenic, a paste made of 2 oz. borax and 6 oz. sugar may answer the purpose.

Ants attacking seed boxes, pots, etc.—The boxes or pots may be placed on a stand, with the legs of the latter standing in tins containing kerosene, as is often used for cupboards, &c., in bungalows.

Preventives against termites or white-ants, etc.—It is always advisable when sowing seed, planting out or transplanting plants in a locality which is subject to termites, to fork in with the soil a mixture which will act as a preventive against this destructive pest. Lime and sulphur, or lime alone, have been recommended, but a more drastic application is sometimes necessary. A sprinkling of vaporite or carbolic disinfectant-powder has been found efficacious in Peradeniya Gardens. Watering the ground with a weak solution of Cyllin or "Silvertown" is also a good preventive. The smell of tar is obnoxious to most insect life, and water impregnated with tar may sometimes be applied to the ground with good effect. For painting on the base of trees as a preventive against termites, dilute tar and "Gondal Fluid" (see p. 483) are sometimes used in India with good results.

Black-ants.—These are sometimes very troublesome in a garden, undermining roads, lawns, etc. According to the "Jamaica Bulletin" nothing has been so successful in expelling them as a solution of bitterwood. See *Quassia*, page 483.

Ants in Lawns.—An application of sulphate of ammonia, say 1 oz. to a square yard, has been found to have good results in driving these away.

FUMIGATION.

Destroying insect pests by means of fumes of poisonous gas, tobacco-smoke, etc., is commonly practised wherever plants are grown in closed

structures, and sometimes also in the field where fruit-growing is practised on systematic lines. For efficiency and facility of application, the hydrocyanic gas process is the most satisfactory yet discovered. It is especially suited for fumigating grain or other seed affected by weevil; also for nursery stock, more especially against scale-insects, which are difficult to destroy by other means. The gas is a deadly poison, and the greatest care is needed in using it. It is generated from cyanide of potassium (sometimes sodium cyanide) and sulphuric acid, and is fatal to all animal life by inhalation. When applied to trees or shrubs in the open, special collapsible tents are used for enclosing these. Small or movable plants may be treated in any enclosure, provided it is sufficiently air-tight.

An ordinary wardian case with a capacity of about 8 cubic feet is sometimes used for the purpose at Peradeniya, the proportions of chemicals being: ¼ oz. cyanide of potassium (90%); ¼ fluid oz. sulphuric acid; and ½ fluid oz. water. All crevices are closed with wet clay to prevent the gas escaping. After the expiration of half an hour, the case is opened and left for several hours. The principle is the same when the process is applied on a larger scale. In the Colombo fumigatorium, the following proportions are used, viz. for every 100 cubic feet of space:—1 oz. cyanide, 1 fluid oz. sulphuric acid, 3 fluid oz. water. Add the sulphuric slowly to the water in a porcelain basin or bowl; wrap the cyanide in a thin paper bag and drop into the acid and water, by means of a string passing through a trap-door and released from outside. The proportions of cyanide, sulphuric, and water as given above, should always be about the same, but the amount may be varied according to the nature of the pest.

An essential condition in fumigating is, contrary to spraying, that the foliage must be dry; otherwise the plants are liable to be injured. The latter should not be watered immediately before fumigation, or exposed to the sun for several hours after treatment. Fumigation should be carried out only after sunset, unless the plants are in the shade under cover.

Spraying.—See pages 493, 500.

COMMON INSECT PESTS OF CEYLON,

ARRANGED ACCORDING TO CROPS OR PLANTS ATTACKED.

Parts usually attacked are indicated thus: (L) = leaves; (St.) = Stem; (Br.) = branches; (F) = fruit; (P) = pods; (Fol.) = foliage; (R) = roots; (Rh.) = rhizomes; (Sh.) = shoots.

Only brief and provisional remedies can be given here; these are omitted where more complicated or expert treatment is required.

Crop.	Name of Pest, parts usually attacked, and Simple treatment.
	GENERAL CROP-PESTS.
ANNATO.	.. Mosquito Blight or Bug. *Helopeltis antonii.* (Young sh.) Catch by hand-net; emulsion spray.
CACAO.	.. Borer. *Arbela quadrinotata.* (St.). Plug holes in bark with tar.
"	.. Helopeltis Bug or Mosquito Blight. *Helopeltis antonii.* (F. & young fol.). Collect by hand-net. Emulsion spray.
"	.. Pod-Borer. *Dichocrocis punctiferalis* (F). Collect and destroy affected pods.
CAMPHOR.	.. Caterpillar. *Papilio clytia.* (L.). Spray with lead arsenate.
"	.. Shot-hole borers. *Xyleborus spp.* (St. & br.). Cut and destroy affected parts.
CARDAMOM.	.. Bug. *Ischnodemus noctulus.* (Fol.). Emulsion spray.
"	.. Pod-borer. *Lampides elpis.* (Fr.). " "
"	.. Root-borer. *Hilarographa caminodes.* Rh.).
"	.. Stem-borer. *Dichocrocis punctiferalis.* (St.). Cut and destroy affected stems.

CASTILLOA-RUBBER.	Mealy Bug. *Pseudococcus crotonis.* (Young br.). Emulsion spray, &c.
CASTOR-OIL PLANT.	Bug. *Aleyrodes ricini.* (Fol.). Emulsion spray, &c.
" " ..	Caterpillar. *Arctia ricini.* (Fol.). Lead arsenate spray.
CINNAMON. ..	Gall-mite. *Eriophyes boisi.* (Fol.). Sulphur spray.
CITRONELLA GRASS.	Scale Bug. *Chionaspis graminis.* (Fol.). Emulsion spray.
COCONUT PALM.	Red Weevil. *Rhyncophorus ferrugineus.* (St. & crown). Collect and destroy. See Palm beetles, p. 480.
" ..	Black-or Rhinoceres-Beetle. *Oryctes rhinoceros.* Tender part of crown. Harpoon in their burrows and destroy.
" ..	Coconut Caterpillar. *Nephantis serinopa.* (Fol.). Cut and burn infested fronds.
COFFEE, "ARABIAN,"	Green Bug. *Lecanium (Coccus) viride.* (Fol.). Emulsion spray.
" "ROBUSTA," & OTHER VAR'S.	Brown Coffee-bug. *Lecanium (Saissetia) hemisphaericum.* (Fol.) Emulsion spray.
" ..	Coffee-borer. *Zeuzera coffeae.* (St. and br.). Cut and destroy infested parts.
" ..	Cockchafer-grubs, various species. (R.). Vaporite.
COTTON. ..	Black-bug. *Lecanium (Saissetia) nigrum.* (Br.). Emulsion spray.
" ..	Cotton Bugs or Stainers. *Dysdercus cingulatus, Serinetha augur, Oxycaraenus lugubris.* (Lint). Spread lint in sun.
" ..	Pink Boll-worm. *Platyedra gossypiella.* (P.). Destroy infested bolls.
" ..	Mealy-bug. *Pseudococcus virgatus.* (Fol. & young br.). Emulsion spray.
CROTON-OIL PLANT.	Defoliator. *Amyna selenampha.* (Fol.). Lead arsenate spray.
GROUND-NUT. ..	Pod-borer. *Dorylus orientalis.* (Fr.). Vaporite.
" ..	Leaf-miner. *Stomopteryx nerteria.* (Fol.). Emulsion spray.
HEVEA, see Para Rubber.	
LAGOS-RUBBER .. (*Funtumia*).	Leaf-roller. *Caprinia conchylalis.* (Fol.). Lead arsenate spray, &c.
MAHOGANY. ..	Caterpillar. *Attacus atlas.* (Fol.). Lead arsenate spray.
" ..	Shoot-borer. *Hypsipyla robusta.* (St. or br.). Cut off and burn affected parts.
MULBERRY. ..	Scale Bug. *Aspidiotus aurantii.* (Br.). Emulsion spray.
NUTMEG. ..	Flat Bug. *Lecanium expansum.* (Fol.). Emulsion spray.
PARA RUBBER. ..	Cockchafer-grub. *Lepidiota pinguis.* (R.). Vaporite.
" ..	Stem and Root-Borer. *Batocera rubus.* (St. and R.).
" ..	Black-bug. *Lecanium nigrum.* (Fol. and young branches) Emulsion spray, &c.
PEPPER. ..	Scale Bug. *Lecanium marsupiale.* (Fol.). Emulsion spray.
" ..	Scale Bug. *L.—peradeniyense.* (Fol.). Emulsion spray.
RHEA OR RAMIE. ..	Leaf-roller. *Sylepta sabinusalis.* (Fol.). Lead arsenate.
RICE (PADDY). ..	Arrakkodian (*T.*) Worm; "Godavellu," *S.*; "Swarming Caterpillar." *Spodoptera mauritia.* (Fol.). See page 479.
" ..	Paddy-Bug. *Leptocorisa varicornis.* (Fl. heads). Catch by hand-nets, or trap by screens smeared with gum.
" ..	Paddy-Weevil. *Calandra oryzae.* (Grain). Place naphthaline balls in bags with grain.
TEA. ..	Shot-hole Borer. *Xyleborus fornicatus.* (Mature br.). Cut out and destroy affected branches; burn prunings on fields. Plants are not affected till about 9 months after pruning.
" ..	White-ant or Termite. *Calotermes militaris.* (Live or dead st.) See "Vaporite," "Silvertown," &c., pp. 484,485.
" ..	Helopeltis or "Mosquito Blight." *Helopeltis antonii.* (Fol.).
" ..	Fringed Nettle-grub. *Natada nararia*, etc. (Fol.). Hand-pick.; lead-chromate spray. See *Year Book, Dept. of Agric.*, Ceylon 1923.

TEA.	..	Bag-, Faggot-, or Case-Worms. *Psychidae.* (Fol.). Hand-pick.
,,	..	Tea-tortrix. *Homona coffearia.* (Fol.). Collect and destroy egg masses. Lead chromate spray.
,,	..	Lobster Caterpillar. *Stauropus alternus.* (Fol.). Hand-pick.
,,	..	Thrips. *Heliothrips rubrocinctus.* (Fol.). Sulphur spray.
TEAK.	..	Leaf-eater. *Hybloea puera.* (Fol.). Lead arsenate spray.
TOBACCO.	..	Stem-borer. *Gnorimoschema heliopa.* (St. base). Cut out grub; destroy badly-attacked plants.

FRUIT PESTS.

CHERIMOYA, CUSTARD-APPLE, JAMBU, ROSE-APPLE, ETC.		Black Scale-bug. *Lecanium nigrum.* (Br.). Emulsion spray.
		Gall-fly. *Psylla sp.* (Fol.).
MANGO.	..	Fruit Fly. *Chaetodacus ferrugineus.* (Fruit). Collect and destroy infested fruits.
,,	..	Mango Weevil. *Cryptorhynchus mangiferae.* (Fr.). Collect and destroy infested fruits.
,,	..	Scale Bug. *Lecanium mangiferae.* (Fol.). Emulsion spray.
ORANGE, LIMES, LEMONS, ETC.	..	Scale or Sooty-mould Bug. *Coccus viridis*; *Lepidosaphes spp.* and *Aleurocanthus spp.* (Fol.). Emulsion spray.

VEGETABLE PESTS.

TOMATOES.	..	Gall Worm *Heterodera radicicola* (R.). Vaporite, which see.
BANDAKKA (*Hibiscus*).		Leaf-roller. *Sylepta derogata.* (Fol.). Lead arsenate spray.
BEANS (*Phaseolus*).	..	Fly Maggot. *Agromyza phaseoli.* (St. & fol.). Destroy affected plants; apply vaporite as preventive.
,,	..	Sucking Bugs. *Coptosoma cribaria* and *Riptortus fuscus.* (Fol.). Hand-pick.
,,	..	Blister-Beetle. *Mylabris pustulata.* (Black beetle with red bands.). Hand-pick with a leaf or rag, or by hand-net.
BRINJAL. (*Solanum.*)	..	Stem-borer. *Leucinodes orbonalis.* (Young sh.). Cut off and destroy infested shoots.
,,	..	Sucking Bug. *Urentius echinus.* (Fol.). Syringe or spray with emulsion.
CABBAGES, (*Brassica* family).	..	Caterpillar. *Plutella maculipennis.* (Fol.). Hand-pick.
,,	..	Caterpillar. *Crocidolomia binotalis.* (Fol.). Hand-pick.
,,	..	Black Grub or Cut-worm. Grub of noctuid moth. *Agrotis spp.* (Young seedlings). See p. 481. Collect and destroy. See *Insect traps*, p. 480.
GOURDS, PUMPKINS, ETC.		Sucking Bug. *Leptoglossus membranaceus.* (Fol. & young st.). Collect and destroy. Arsenate spray.
,,	..	Leaf Beetle. Several species of *Chrysomelidae.* (Fol.). Arsenic spray.
,,	..	Fruit Fly. *Dacus ferrugineus.* (Fr.). Hand-pick; destroy infested fruits.
MAIZE.	..	Borer. *Chilo simplex.* (St.). Destroy affected plants; employ light-traps for catching moths. See p. 478.
POTATO.	..	Bulb-borer. *Dorylus orientalis.* (Tuber). Vaporite.

PESTS OF ORNAMENTAL PLANTS.

AMARYLLIS.	..	Caterpillar. *Polytela gloriosae.* (Fol.). Lead arsenate spray.
BAMBOOS.	..	Scale-Bug. *Asterolecanium bambusae.* (St.). Emulsion spray.
,,	..	Aphis. *Oregma bambusae.* (St.). Tobacc-juice spray.
CYCAS.	..	Caterpillar. *Cyaniris puspa.* (Fol.). Lead arsenate spray.
,,	..	Caterpillar. *Catachrysops pandava.* (Young fol.). Lead-arsenate or kerosene spray.
DAHLIA.	..	Bulb-borer. *Dorylus orientalis.* (Tuber). Fork in vaporite around the plants.
FERNS.	..	Flea-beetle. *Hypnophylla flavipennis.* (Fol.). Lead arsenate.

FERNS.	..	Scale. *Lecanium (Saissetia) hemisphaerica.* (Fol.). Emulsion spray.
HIBISCUS.	..	Leaf-roller. *Sylepta derogata.* (Fol.). Lead arsenate ; destroy infested flower buds.
,,	..	Flower-beetle. *Mylabris pustulata.* (Fl. buds). Lead arsenate, &c.
IPOMOEA, Different spp.	..	Hairy Caterpillar. *Euchromia polymena.* (Fol.). Lead arsenate spray ; shake plants, collect and destroy caterpillars.
JASMINUM PUBESCENS.		Bud-borer. *Hendecasis duplifascialis.* (Fl. buds). Lead arsenate or kerosene spray.
LAGETTA (LACE-BARK TREE)	..	Caterpillar. *Heortia vitessoides.* (Fol.). Arsenate spray.
PALM, IN POTS.	..	Fringed Bug. *Cerataphis lantaniae.* (Fol.). Syringe with emulsion, or kerosene &c
,,	..	Caterpillar. *Elymnias fraterna.* (Fol.). Hand-pick, or lead arsenate spray.
,,	..	Scale Bug. *Lecanium hemisphaericum.* (Fol.). Syringe with emulsion. The brown dead scales remain adhered to the surface and shelter numerous eggs underneath.
PERGULARIA	..	Scale Bug. *Lecanium caudatum.* (Fol.) Syringe with emulsion, &c.
PORTLANDIA (SHRUB).		Caterpillar. *Caprinia conchylalis.* (Fol.). "Paris Green" or lead arsenate spray.
ROSES.	..	Scale Bugs. *Chrysomphalus aurantii* and *Icerya aegyptiaca.* (St. & fol.). Syringe with emulsion.
,,	..	Rose Beetle. Several spp. (Fl. & young fol.). Collect and destory, or lead arsenate spray.
SALVIA, THUNBERGIA &c.		Lantana Bug. *Orthezia insignis* (Fol. & st.). Emulsion spray.

LAND LEECHES.

The common land-leech (*Haemadipsa zeylanica*) occurs in Ceylon up to about 5,000 feet elevation, where the rainfall is sufficient, being a particularly troublesome pest to human beings and animals during the wet weather. It does not occur near the sea, and its distribution has recently extended to Nuwara Eliya, over 6,000 feet elevation. In India, leeches occur up to about 4,000 feet in the wet region. The Ceylon leech is brown in colour, about 1 inch in length and $\frac{1}{8}$ inch in breadth. Reproduction is by means of eggs laid in cocoons in the ground, several young leeches developing within each cocoon.

The leeches rest, by means of a posterior sucker, upon the tops of grass and other leaves or stems and await the passing of a warm-blooded animal, the approach of which is detected with extraordinary rapidity by all leeches in the immediate vicinity and to which they travel without delay. They are extremely persistent, working their way to the skin of human beings through clothing and even tightly rolled puttees, and also cause considerable annoyance to domesticated animals. Their bite is usually painless and may remain undetected until indicated by a stream of blood which flows from the wound. When fully fed, they drop from their host. If discovered feeding, they should not be forcibly pulled off, as portions of the mouth-parts are liable to be left in the wound, giving rise to considerable inflammation and, possibly, suppuration. If touched with a little salt or vinegar, or a lighted match or cigarette, they will rapidly release their hold, and it is advisable to treat their bites as early as possible with tincture of iodine, milton, or ordinary salt.

Leeches do not occur in dry weather, except in moist localities, as by the side of streams or pools, but they rapidly appear on the arrival of rainy weather. In the dry region, however, they are seldom if ever seen, even during the brief rainy period. Where they occur naturally

it is difficult to prevent them, though much may be done to keep them in check, if not to exterminate them, by keeping the grass closely cut, attending to the removal of leaves or rubbish, reducing the shade of trees, and by draining swampy or wet land.

Leeches may easily be destroyed by spraying with contact poisons, as tobacco juice, copper sulphate, kerosine oil, various disinfectants and insecticides (see page 482), but it is hardly practicable to apply these in sufficient strength and quantity without killing the grass. Lime and salt are a deterrent to them, but the application of these in sufficient strength is also scarcely practicable. Smearing one's legs with citric acid or lime-juice, citronella or other pungent aromatic oil, affords protection from leech-bites. A tobacco leaf (cured) wrapped round each leg, inside the stocking or puttee, is a preventive well-known to sportsmen. Mr. F. Lewis mentions the oil of *Kokoona zeylanica* ("Kokun" or "Pottu-eta tel," *S.*) as being much used by pilgrims to Adam's Peak for protection against leeches; whilst coolies in India sometimes use crude or fuel oil emulsion for the purpose.

CHAPTER XXXIV.

FUNGUS AND OTHER DISEASES

Many extensive and insidious diseases of garden and plantation crops are due to the attacks of a class of lowly organised plants known as Fungi.

Structure of Fungi.—The vegetative portion of a fungus, termed *mycelium*, consists of long thin filaments or threads called *hyphae*. When the hyphae are abundant, the mycelium resembles a loose tangled mass of soft white threads. Such mycelia may commonly be observed among dead leaves, on decaying wood, etc. In cases where the hyphae have penetrated the tissues of a plant, microscopic examination is necessary to demonstrate their presence.

Reproduction is by means of spores, which vary considerably in size, shape and mode of origin. Each spore is capable of giving rise to a new plant like its parent. They may be borne directly on the mycelium, but in many species, *e.g.* mushroom, they are produced on a conspicuous structure termed a *sporophore* or *fructification*.

Mode of Life.—Fungi are all characterised by a complete absence of green colouring matter (*chlorophyll*). They are therefore unable to manufacture the complex carbon compounds necessary for their nutrition, and so are compelled to obtain these compounds ready-made from the bodies of living or dead animals or plants. The fungi which obtain their nutriment from the tissues of living animals or plants are termed *parasites*; those which feed upon dead organic material, *saprophytes*. All parasites cause disease and consequently loss. The loss may be insignificant or of national importance, according to the virulence of the attack.

How Fungus Diseases are spread.—Fungi produce spores in immense numbers; these are light and easily carried by various agents, such as wind, water, insects, birds and other animals. In many ways man is an active disseminator of fungus diseases. He is known to have carried disease from one district to another on his clothes and on agricultural implements, and from one country to another on shipments of seed and nursery stock. Therefore, growers should take precautions against introducing diseases with new stock from other countries or districts. Recognising the possibility of introduction of virulent diseases from other countries, Governments have adopted legislative measures to prevent, as far as possible, the further introduction of diseases with imported seeds or plants.

Conditions Favourable For Infection.—Fungi grow best in damp, warm weather, and in shady places. Direct sunlight inhibits fungus growth. Conditions which restrict the entry of sunlight and prevent free circulation of air and evaporation of moisture—as by crowding plants together, or by growing them under dense shade—are consequently favourable to fungus diseases. The "Damping off" disease (*Pythium*) of seedlings usually occurs under these adverse conditions.

Epidemics.—A disease which has previously done little damage may, when favourable conditions occur, become virulent and spread rapidly, becoming epidemic and causing great loss. Several such epidemics are well known in history. The failure of the potato crop in the British Isles in 1845 was due to the ravages of Potato-blight (*Phytophthora infestans*); while the attack of Coffee leaf-disease (*Hemileia vastatrix*) had a disastrous effect on the coffee industry in Ceylon in the years 1875 to 1885. An epidemic can only occur where large numbers of the same kind of plant are growing in close proximity, as in the cultivation of single crops.

PREVENTIVE MEASURES.

Prevention Better than Cure.—It is usually easier to prevent than to cure diseases. A disease which is of little economic importance today may, under favourable conditions, rapidly become very destructive. By avoiding conditions known to encourage disease, much can be done to prevent it. On the first appearance of a disease, immediate steps should be taken to prevent its further spread.

Good Cultivation.—Many fungi attack only plants in a weakly condition. Vigorous growing plants can often withstand attack, while plants of feebler vitality succumb to it. It follows, then, that good cultivation, as secured by proper draining, manuring, careful pruning, etc., is an effective means towards the suppression of fungus diseases, in so much that it tends towards the production of vigorous plants.

Destruction of Diseased Plants.—A diseased plant is a source of infection for neighbouring plants, as large numbers of spores, which are carried by the air, are produced on the diseased individual. The early destruction of diseased plants is, therefore, a primary means of checking plant disease. Fire is the only satisfactory method of destruction. The burning of diseased material can often be made possible by the use of kerosene or petrol. Where such material is too wet to burn, even with the aid of kerosene, it should be buried deeply with lime; it should never be left lying about to dry, or thrown on the rubbish heap to decay. If roots are attacked they should be dug up and burnt, otherwise there is a risk of the fungus spreading through the soil to neighbouringr oots.

Sanitation.—Many disease organisms persist from year to year on weeds, neglected trees, and debris of the fields. Old stumps and logs make excellent nurseries for fungi which attack rubber, cacao, coffee and many other plants. The clearing up of places which harbour disease is, therefore, essential for good sanitation. Where a temporary crop has been badly attacked, the debris, after harvesting the crop, should be collected and

burnt, thus destroying great quantities of spores and mycelium and diminishing the risk of recurrence the following year.

Rotation of Crops.—Many disease organisms are capable of attacking only one species or one family of plants. Thus neither the potato-blight nor "club-root" ever attacks peas or cereals. Where rotation of crops is practised, an interval of several years separates two successive crops of one kind on the same ground. This interval allows the disease organisms in the soil to perish for want of suitable food material. For this reason, rotation of crops has been found to be an effective preventive of certain diseases and should be practised whenever possible. In arranging a rotation, care must be taken not to plant in succession closely related species; *e.g.* tomatoes should not follow potatoes, chillies, or brinjals ; nor should cabbages follow turnips, cauliflower, and other members of the same family. See pp. 30, 31.

Wounds.—Many fungi can obtain entrance into the host plant only through a wound. Needless or promiscuous wounding of plants, particularly trees, should therefore be avoided. Where a wound has been caused accidentally or by pruning, it should be painted with white-lead, tar, or other antiseptic preparation to prevent the entry of disease organisms.

Clean Seed.—As fungus spores are very minute, and so escape observation, disease organisms are often sown with the seed, *e.g.* the " smut disease " of wheat. To obviate this, only clean seed, selected if possible from healthy plants, should be sown. In some cases it is advisable to disinfect the seed before sowing. See *Disinfection of Seeds*, p. 496.

Isolation of Infected Areas.—See under " Root disease," page 497.

Disease-resistant Varieties.—Some varieties or species of plants are more or less immune from disease, while others, cultivated under the same conditions, are specially susceptible to it. Therefore varieties which are the least susceptible, consistent with other desirable qualities, should be selected for cultivation. The raising or selection of disease-resisting varieties is now recognised as a matter of considerable importance in horticulture and agriculture.

Influence of Manures.—The spores of certain disease-causing fungi will pass through the digestive tract of an animal and yet retain their vitality. Disease may thus be disseminated in the manure. If diseased tubers,fruits, or other material are fed to pigs or other stock, care should be taken that the manure is used only for crops which will not be affected by the disease. It is preferable, however, to destroy the fungus spores by boiling the diseased material before feeding to stock.

Artificial Manures are known to increase or diminish the power of disease resistance of certain plants. Generally speaking, an excess of nitrogenous manure predisposes plants to disease, particularly leaf-disease ; phosphates and potash increase resistance to disease, but cases of the opposite effect have also been observed with phosphates.

Spraying.—The main purpose of spraying is preventive rather than curative. (See p. 500). If the organism is confined to the surface of the plant, it may be possible to effect a cure by the use of a spray; but where it is more deeply situated and beyond the reach of the fungicide, a cure is impossible. The spray will, however, kill the spores of the disease as

they are produced, and so neighbouring plants are protected against infection. By spraying healthy plants, the germination of spores which may happen to lodge on them is prevented. As soon as an attack is noticed, spraying should be resorted to. Some of the principal sprays or fungicides in use are given below.

Co-operation.—In the fight against fungus diseases, co-operation is absolutely necessary. It is impossible to stamp out disease in a garden when every breeze carries spores from neighbouring gardens or estates, whose owners take no active preventive measures. "Plant Pest Laws" have now been instituted in most countries to compel negligent land-owners to take active measures towards eradicating certain scheduled diseases.

FUNGICIDES.

Bordeaux Mixture.—This is the most important and most commonly employed fungicide. It consists of copper-sulphate, lime, and water, in various proportions, according to the strength required. The following formula makes a good standard mixture: Copper sulphate, 5 lbs; lime, 5 lbs; and water, 50 gallons. Dissolve the copper sulphate in 25 galls. of water in a wooden tub, place the lime in another vessel and add a few pints of water, or sufficient to slake the lime and form a thick creamy paste. Then add water to make 25 galls. The lime must be of the best quality, in lumps, and as freshly burnt as possible. Powdered air-slaked lime will not make good Bordeaux-mixture. When ready to commence spraying, pour together equal quantities of the copper-sulphate solution and lime-water (after stirring) through a strainer tied across the top of a clean barrel. The two streams should blend as they fall to ensure a good mixture with fine grain, which will hang in suspension long enough to permit of spraying.

Where large quantities of the mixture are required it is convenient to make up concentrated solutions of the two ingredients (which, apart, will keep indefinitely), and mix them together when required. If for this purpose, 50 lbs. of copper-sulphate be dissolved in 50 galls. of water, each gallon then contains 1 lb. sulphate. Lime solution should be made of similar strength. Always dilute the concentrated solutions to the required strength before mixing, otherwise a coarse precipitate which settles quickly is formed. Bordeaux-mixture will not keep, and only freshly made mixtures should be used.

Before using, the Bordeaux-mixture should be tested to determine whether there is an excess of copper-sulphate or lime. An excess of the former has an injurious burning effect on the leaves, whilst a large excess of lime reduces the efficiency of the mixture. A test is easily carried out by the use of litmus paper. An acid reaction (see last para of p. 7) denotes excess of copper sulphate, while excess lime will give an alkaline reaction. Another simple test is to immerse a bright knife-blade or iron nail in the liquid for a few minutes; if a deposit of copper forms on the blade or nail, the mixture is unsafe and more lime should be added.

Adhesive Mixture.—Bordeaux-mixture adheres well to sprayed plants, but when heavy rains are expected it is advisable to increase the adhesive properties by the admixture of the following solution. Dissolve 1 lb of washing soda in 1 gallon of boiling water, then add 2 lbs, of resin and boil for about an hour, stirring continually. This when cool should be added to 30 galls. of "Bordeaux."

Burgundy Mixture.—Where good, freshly burnt, stone lime is difficult to obtain, "Burgundy mixture" may be used instead of "Bordeaux." In the preparation of this mixture, a solution of washing soda is used in-

stead of lime-water, otherwise the method of preparation is the same. A good formula is : 5 lbs. copper sulphate, 6¼ lbs. washing soda, and 50 gallons of water. An excess of soda will scorch the leaves, so that the solution before use should be tested with red litmus paper. If this turns blue, more copper sulphate solution should be added. Tests for excess copper sulphate are given under Bordeaux-mixture. Burgundy-mixture is more expensive than "Bordeaux," but it is more easily made ; it adheres better, and is not so liable to clog the sprayer. Commercial preparations of Burgundy-mixture, which merely require the addition of water, are obtainable. These preparations are usually quite efficient and as a rule better than the commercial preparations of Bordeaux-mixture.

Lime-Sulphur Solution.—This fungicide has proved effective against many plant diseases, particularly surface mildews. It also has an insecticidal value, and has been used with good effect on scale insects. The following is one method of preparation.

Put 4 lbs. of good quick-lime in an iron boiler capable of holding more than 10 gallons of water ; mix 4½ lbs. of flowers-of-sulphur into a thick paste with water, and pour the paste over the lime. As soon as slaking has begun, add 5 gallons of water and thoroughly stir the mixture. When slaking and mixing is complete, make up to 10 gallons, bring to the boil and keep boiling for one hour, replacing all water lost by evaporation. When cool, this forms a stock solution and should be strained and diluted with ten times its volume of water before use. If it is desired to keep the stock solution, it should be done in full, air-tight vessels. This solution should not be used in copper spraying-machines.

Ammoniacal Copper Carbonate.—When the staining of foliage or fruit from the use of Bordeaux-mixture or lime-sulphur washes is objected to, as on ornamental plants and on fruit nearing maturity, an ammoniacal solution of copper carbonate is sometimes used instead. This is made by dissolving 5 oz. copper carbonate in about 3 pints of ammonia. Only sufficient ammonia to dissolve the copper carbonate should be used. Dilute this solution with 50 galls. of water. This fungicide should be used with care, as some plants are more susceptible to injury by it than by Bordeaux-mixture.

Potassium Sulphide.—This fungicide, made by dissolving 1 oz. of potassium sulphide in 3 or 4 galls. of water, is effective against powdery mildews. It is sometimes used where it is undesirable to have the foliage discoloured by other sprays.

Flowers of Sulphur.—Powdered sulphur is an effective fungicide against mildews. It is applied by sprinkling the powder on the leaves and stems while wet with dew. It has fallen into disuse in combating diseases of field crops, now that more effective fungicides, such as "Bordeaux mixture" and "Lime-sulphur wash", have been devised, though it is still used in small gardens and in artificially heated glass-houses.

Lime.—Heavy applications of quick-lime are very effective against fungi which live in the soil and cause root diseases. It is the most effective agent known against the "club-root" or "slime fungus" disease (*Plasmodiophora Brassicae*), which is so destructive to cabbage and other members of that family, and should always be applied to the soil where root diseases occur. For root diseases of rubber, 60 lbs. per tree is commonly used, while for tea root diseases 6 lbs. per bush is applied. For general herbaceous crops, 1½-2 tons per acre is a suitable quantity. See pp. 20, 284, 447, &c.

Tar.—Gas-tar and Stockholm-tar are used for disinfecting wounds of woody plants. They should be applied to the exposed wood only, care being taken that the tar does not run down over the healthy bark, as it is liable to burn it. Tar forms a water-proof antiseptic covering on the wood, preventing the entry of wood-rotting fungi and of insects, and allows the wound to heal over cleanly. Gas-tar is a product obtained in the process of coal gas manufacture; it is more liquid than Stockholm tar obtained from pine pitch.

Brunolinum, Izal, Agrasol, and other similar disinfectants are used to protect bark wounds. On rubber estates, where bark-rot is prevalent, one or other of these disinfectants is applied regularly after every tapping during wet weather. The strength of the disinfectant varies with the kind used, as they differ considerably in their antiseptic value. Generally speaking, 5% solution may be used as a preventive of bark rot, and 20% for a cure.

Corrosive Sublimate (Bichloride of mercury) is one of the best known disinfectants, being extremely poisonous to all forms of animal and vegetable life. It is recommended for disinfecting pruning-instruments when working in blight-infested orchards, and is sometimes used as a steep for seed potatoes against Potato-scab. The seed potatoes, before sowing, are immersed in a solution of 2 oz. corrosive sublimate to 15 galls. of water for 1½ hours. It is also employed for disinfecting grain, but owing to its poisonous nature is being supplanted by formalin for this purpose. It should never be sprayed on plants. It is often used in the following form for poisoning books and specimens against mould and insects, viz: corrosive sublimate ½ oz., carbolic acid ½ oz., methylated spirit 1 pint; apply the solution with a soft brush.

Disinfection of Seeds.—As a preventive of certain diseases, such as the "smuts" of cereals, the seed should be disinfected before sowing. The chief disinfectants used for this purpose are the following.

Formalin: Soak the seed for 2 hours in a solution made with 1 pint of formalin in 50 gallons of water, and then spread out to dry. *Copper sulphate*: Soak the grain for 12-16 hours in a solution of copper-sulphate (½ lb. to 10 gallons of water), then remove the grain and spread it out to dry for 24 hours. Treatment with either of these substances is considered to diminish the germination capacity of the seed, but the injurious effect of copper-sulphate can be diminished by immersing the grain for 5 minutes in *milk of lime* (made by adding 7 lbs. of good quick-lime to 10 gallons of water) after treatment with copper-sulphate and before drying. *Corrosive sublimate*: Soak the seed for 15 minutes in a solution consisting of 1 part corrosive sublimate to 1,000 parts water. *Hot water*: The seed, enclosed in a coarse sack, should first be steeped in a tub of water kept at 120° F. until thoroughly wet; it should then be immediately transferred to water at 138° F. After 5 to 10 minutes, it must be taken out and plunged into cold water and then spread out on a floor to dry before sowing.

Disinfection (sterilization) of soil for seed beds. Considerable losses have been experienced through disease occurring in seed beds. These diseases live in the soil, and the only way of eradicating the organisms, and so produce healthy seedlings, is by sterilising the soil before sowing. The sterilization of seed beds is now recognised as an important feature in tobacco-growing. Sterilization may be carried out in many ways, of which the following are the most important.

By burning: This is the oldest method and consists of laying brush-wood over the prepared soil and then burning it. If the burning is thoroughly done, the resulting heat is sufficient to free the soil of fungi and weed-seeds to the depth of

several inches. The organic material in the soil is, however, to some extent destroyed by this method. *By steam*: This is the most satisfactory method where considerable areas have to be sterilized. Steam at about 100 pounds pressure is forced into the soil for about 30 minutes by various contrivances. By this method the soil is sterilized to a depth of 6 or 8 inches. *By hot water*: A useful method for seed boxes or pots is to soak them thoroughly, when filled with soil and ready for sowing, in boiling water, which should be used in sufficient quantity. *Formalin*: One gallon of formalin (40% formaldehyde solution) is diluted with 50 gallons of water. This solution is applied at the rate of 2 quarts per square foot of seed bed, using an ordinary watering can. When the solution is absorbed, the bed should be covered with matting or other material for 24 hours to confine the fumes. The latter should then be allowed 8-10 days to escape, and the seed sown when all traces of formalin have disappeared *Bordeaux Mixture*: At the first sign of disease in a nursery-bed of plants, spraying with Bordeaux-mixture with excess of lime should be done. Sufficient mixture should be used to wet the plants and surface of the soil thoroughly.

Diagnosis of Plant Diseases. It is important that plant diseases should be treated immediately they are noticed, and good treatment will depend upon accurate diagnosis. The part which appears diseased to the eye is not necessarily the seat of the trouble, *e.g.* the discolouration and falling of leaves may be primarily due to root trouble, caused possibly by stagnant or unsuitable soil. If the position of attack can be located, remedial treatment may often be devised by the practical man, though whenever possible expert advice should be obtained.

Root Disease.—When roots of herbaceous plants are attacked by disease, the whole plant usually dries up and the leaves drop as though suffering from lack of water. This type of disease is commonly known as "*Wilt*", *e.g*, tobacco-wilt, tomato-wilt, etc. Trees usually exhibit signs of root disease by the leaves drying up and falling. Early stages of attack will be noticed by the topmost branches becoming bare. It is, as a rule, impossible to cure root disease, and treatment must be mainly directed towards preventing its spread. The roots of dead and dying plants should be removed and burned, the soil opened up and treated with quick-lime, which should be lightly forked in. For affected trees, like Hevea, 60 lbs. of lime per tree may be used, and for shrubs, *e. g.* Tea, about 6 lbs. per bush. See p. 495.

Isolation of infected areas. Where the fungus is capable of growing independently through the soil (*e. g. Fomes* on Hevea), a trench 2 ft. deep should be dug around the area, the earth from the trench being thrown within the affected area. Similar plants should not be grown on that ground for several years, otherwise the disease is likely to recur.

Leaf Diseases.—The indications of leaf disease are the presence of various coloured spots or irregular patches on the leaves. Though leaf diseases may not kill the plant, they greatly weaken it and reduce the crop. The treatment is spraying; healthy plants also should be sprayed as a preventive. Where spraying is impracticable, much may be done by gathering and burning diseased leaves as soon as the attack is noticed. The destruction of fallen diseased leaves must not be neglected. Leaf diseases may be roughly classified under the headings of "Powdery mildews," "Downy Mildews," "Rusts," and "Leaf-spots."

"*Powdery mildews*" are easily recognised by the presence of white powdery dust on the leaves and stems. These may be effectively treated by dusting with flowers-of-sulphur or by spraying with lime-sulphur spray. "*Downy mildews*" *or* "*Blights*": The leaves are covered by white fluffy masses of mycelium; spray

with Bordeaux or Burgundy mixtures. "*Rusts*" are so named because of the preeence of rust-coloured areas on the leaves. They cause considerable loss and are difficult to treat. The use of resistant varieties is the most effective method of prevention. "*Leaf spots*" and blotches are discoloured areas of varying shape, size, and colour. When the circular patches of dead tissue fall from the centre of leaf-spots, the perforations so produced are known as "shot-holes." Spraying with Bordeaux-mixture is the most effective treatment.

Stem or Branch Diseases.—The diseases affecting the stems of herbaceous plants are similar to the leaf-diseases described above. The effects of disease on woody plants are usually distinct, and vary according to the nature of the organism. The chief types are dieback, canker galls, and witches' brooms. The affected tissues must be excised and the wounds painted with tar. In *dieback*, as the name indicates, the stem is killed back as the disease progresses. Affected branches must be cut out below the point the disease has reached, and burned. *Cankers* are malformations in the bark, generally resulting in a wound which exposes the wood. *Galls* (see p. 482) are enlargements or outgrowths of the tissues of stems, roots, &c. They sometimes occur on leaves or fruits and are caused by many agents, such as insects, bacteria, slime moulds as well as fungi. *Witches' brooms* are malformations consisting of masses of distorted twigs.

Fruit Diseases commonly occur as spots, scabs, or rots. The recognised method of preventing fruit diseases is to spray with "Bordeaux" or Lime-sulphur sprays. Much may be done to prevent the spread of the disease by collecting and burning diseased fruit. Care must be taken in this operation that none but diseased fruit are touched, otherwise spores may be conveyed to healthy fruit by the hand.

Smut is a common disease of cereals. The grain is entirely destroyed and in its place is a black sooty powder (spores), which gives the disease its name. Sterilization or pickling of the seed before sowing has been found to be very effective against this disease. See *Disinfection of Seeds*, p. 496.

Dry-rot.—The disease known as "dry rot," often due to *Merulius lacrymans* and other fungi, frequently attacks timber in bungalows or other buildings. Soaking the wood in creosote, "silvertown," or other efficient wood preservative is the best preventive.

Damping-off disease.—The common disease known as "damping-off" is due to a fungus (*Pythium*) which affects young and small, tender plants, especially seedlings from thickly sown seed. It usually attacks the plants just above the ground level and, the tissues becoming destroyed, the plants fall over at that point. Excessive dampness, insufficient light or ventilation, overcrowding, and imperfect drainage are conditions to avoid, as they are conducive to the disease. See p. 492.

Sooty Mould.—Orange trees and other members of the Citrus family are peculiarly liable to this fungus disease, which forms a thin black crust on the foliage, sometimes covering the entire leaf, and often blackening the fruits also. It is, however, a superficial growth and does not penetrate the tissues of the plant. Its presence is due to scale-insects (often *Lecanium viride*, or "Green-bug") which must be got rid of in order effectually to dispose of the mould. Spraying with petroleum emulsion or a resin wash, followed by syringing with clean water, is the best remedy.

PHYSIOLOGICAL DISEASES.

Many diseased conditions are not associated with any particular organism, but are due to a derangement of the life processes of the plant, owing to unsuitable physical conditions, such as excess or insufficiency of water, unsuitable soil or subsoil, absence of a necessary element in food supply, insufficient light, etc., or to causes which are at present

little understood. Common examples are the "mosaic disease" of tobacco, cotton, and other plants, and "brown bast" of *Hevea*.

Mosaic disease is characterised by the mottling of the leaves with different shades of green, the boundaries between the lighter and darker green patches being sharp and distinct. The mosaic disease of tobacco occurs practically wherever tobacco is grown, but no parasite has been detected associated with it. It is probably due to some innate alteration in the function of the plant due to the presence of an enzyme, and is highly contagious, a minute quantity of sap from a diseased leaf being sufficient to inoculate a healthy specimen. Seed from healthy plants only should be used for sowing. When plants with mosaic disease have to be handled, care must be taken that healthy plants are not touched after diseased ones, as the disease may be conveyed from diseased to healthy plants by merely touching them.

Brown Bast is a little understood disease of *Hevea*. The latex-producing bark tissue dries up and becomes affected with a brown discolouration. It is believed that this disease is caused by the repeated wounding of the bark by tapping; or it may be the result of the continual removal of latex from the bark. The treatment commonly practised is to scrape or strip off the bark from the affected area, and to rest the tree.

Chlorosis or Pallor is due to various causes and is generally associated with poor, marly soils. It is characterised by the absence or deficiency of the normal green colouring matter (chlorophyll) in the leaves, so that they appear yellowish or white. It may be caused by a deficiency of iron in the food of the plant, iron being a necessary ingredient for the formation of chlorophyll. Where this is the cause, it may be cured by the application of sulphate of iron to the soil. Yellowing of the leaves may also be caused by injurious quantities of soluble salts, poisons, or acid gases, and frequently accompanies wilting and attacks of wire-worms or other root-feeding insects. When the pallor is due to absence of light, it is known as *etiolation*. By covering celery and other edible plants with soil, etiolation is induced and the covered parts become white or blanched, whereas otherwise they would be green, a character not desired for table use.

Dwarfing.—The reduction in size of the entire plant or of some particular organ is known as "dwarfing" or "nanism." In some cases it is associated with particular disease organisms, but in others it is due to physiological causes. It is frequently a sign of malnutrition due to impoverished soil. The repeated maiming of plants by browsing cattle will cause a similar condition. The miniature trees of the Japanese are produced artificially by nipping off the buds as they are formed, and, it is claimed, live for centuries. Valued as a curiosity, these often fetch high prices. With alpine plants, dwarfing is due to climatic conditions.

Gumming or Gummosis.—The exudations of slimy or gummy substances from trees, caused by fungus attacks, wounding, and unknown causes are known by various names according to the nature of the exudation, as "gummosis," "resinosis," "slimy flux," etc. *Gummosis* is the exudation of a clear, amber-coloured, gummy substance, and is well known on the Citrus family, as well as on the Cherry, Almond and many other trees. It is one of the commonest diseases of the Orange,

and has been attributed to numerous causes, as poor soil, bad drainage, &c. Treatment consists of thorough aeration of the soil, the cutting away of diseased parts, and painting with a solution of equal parts of crude carbolic acid and water, then covering the wounds with wax. The "sour-orange" appears to be very resistant to this disease, and should therefore be used as stock on which to bud less resistant varieties. Some exudations (*e.g.* gums, resins, balsams, &c.) are of economic importance. See pp. 411-413.

Malformations or Abnormalities are very numerous and cannot be attributed to any direct cause. Only a few of the commonest can be mentioned here. When a normally cylindrical stem or other axis becomes flattened or ribbon-like, it is said to be *fasciated*. Some fasciations, *e.g.* "Cockscomb," are heritable, whereas others (*e.g.* Hevea) are not. *Proliferation* is a term used to denote a central or lateral outgrowth from a flower or inflorescence, *e.g.* proliferation of the Rose. One of the most striking malformations is the spiral twisting of the stem, known as *spiral torsion*. This character is frequently heritable. In some cases normally coloured parts, or a flower, may become green, as in the case of green roses and dahlias. Stamens or sepals may become *petaloid*, as in Hibiscus and so cause "doubling" of the flower. Two or more leaves or leaflets may arise in the place of one, as in four-leaved clover, and so on.

SPRAYING.

The object of spraying is to distribute a poisonous fluid in a finely divided form over plants, either for the purpose of ridding them of injurious insects, or for checking the spread of fungus disease. (See p. 493). It is carried out by means of hand-pump sprayers, "knapsack-" or other sprayers with compressed air, or by special syringes. Where only a limited number of plants have to be treated, a garden syringe with a fine rose will answer the purpose. In the case of fungus diseases, it should be remembered that spraying is essentially a preventive, which, to be successful, should be applied at the first signs of the outbreak. Spraying operations are generally best carried out when the foliage is in a moist condition. Emulsions containing kerosene in any form should be used in cloudy weather only, or after sunset or in shade.



KNAPSACK SPRAYER.
Ejecting a fine spray by compressed air.

Dangers of Spraying.—As all insecticides and fungicides are necessarily of a poisonous character, discretion must be used in applying them over fruits or vegetables that are intended for consumption as food. As the fruit approaches ripeness, the spray-fluid should be very dilute, finally withholding it altogether before the fruit is quite ripe. Fruit trees should not be sprayed

when in blossom, as, apart from any possible danger of the poison lodging in the calyx, it may seriously affect the setting of the fruit. It is, of course, unsafe to apply any poisonous sprays to quick-maturing vegetables or salads which are intended to be eaten uncooked.

Dilute lime-wash is sometimes applied by a syringe or brush to trees or bushes when deciduous, or after pruning, as on Tea fields. This acts as a check on the growth of moss as well as on certain insects and fungi.

SOME COMMON DISEASES OF PLANTS IN CEYLON.

These are arranged according to the plant or crop attacked. Where only the scientific name of the pathological organism is given, there is no common name for the disease. The following abbreviations are used to denote the part of the host plant attacked: (R)=roots, (L)=leaves, (S)=stems, (F)=fruits, (Sg)=seedlings. (B) denotes that the pathological organism is a bacterium, (A) an alga, (P) that the disease is due to physiological causes.

CROP OR HOST-PLANT:	NAME OF DISEASE & PARTS ATTACKED.
ACACIA. ..	Armillaria fuscipes (R.); Fomes applanatus (R); Irpex subvinosus (R); Nectria pulcherrima, "Canker" (S); Cercosporella Theae (L).
ALBIZZIA. ..	Botryodiplodia Theobromae (R.); Fomes lucidus (R.); Poria hypolateritia (R.); Ustulina zonata (R.); Nectria pulcherrima, "Canker" (S.); Ceratophorum Albizziae (L. Sg.).
BANDAKKAI. ..	Cercospora Hibisci (L.); Oidium sp., "Mildew," (L.).
BEANS, BROAD. ..	Uromyces Fabae, "Rust" (L.).
BEANS, FRENCH OR KIDNEY. ..	Pseudomonas Phaseoli, "Bacterial blight" (L. S. & F.B.); Cercospora cruenta, "Leaf-spot" (L.); Uromyces appendiculatus, "Rust,"(L.); Colletotrichum lindemuthianum (F).
BREAD-FRUIT. ..	Sphaerostilbe repens (R.); Phytophthora sp. (F.).
BRINJAL. ..	Fusarium sp., "Dieback" (S.); Bacillus Solanacearum, "Wilt" (S.B.); Oidium sp. "Mildew" (L.); "Little-leaf" (P.).
CABBAGE FAMILY.. .	Plasmodiophora Brassicae, "Club-root" (R.); Pseudomonas campestris, "Black-rot (S.B.).
CACAO. ..	Fomes lamaoensis, "Brown Root-disease" (R.); Botryodiplodia Theobromae, "Die-back," (S.); Phytophthora Faberi, "Canker" & "Pod-rot" (S. & F.).
CAMPHOR. ..	Fomes lamaoensis, "Brown Root-disease" (R.); Rosellinia arcuata (R.); Corticium salmonicolor, "Pink Disease"(S.).
CASTOR-OIL PLANT.	Melampsorella Ricini, "Rust" (L.); Sclerotinia Ricini, "Grey-mould." (F.).
CHILLI. ..	Rosellinia arcuata (R.); Bacillus Solanacearum, "Wilt" (R.B.); Oidium sp., "Powdery-mildew" (L.); Vermicularia Capsici (F.).
CITRUS FAMILY. .. (Oranges, Limes, &c.)	Ustulina zonata (R.); Colletotrichum gloeosporioides, "Wither-tip" (S.); Corticium salmonicolor, "Pink Disease" (S.); Pseudomonas Citri, "Canker" (L.B.); Oidium tingitaninum, "Powdery Mildew" (L.); Macrophoma Mantegazziana (L.); Phyllosticta disciformis (L.); Cladosporium Citri, "Scab" (L.); Fusarium epithele (F.); Oospora Aurantii (F.).
CINNAMON. ..	Exobasidium Cinnamomi (S.); Cephaleuros parasiticus, "Red-rust" (L.A.); Gloeosporium sp. (L.); Pestalozzia palmarum, "Grey Blight" (L.).

CLOVE.		Fomes Caryophylli (R.); Cephaleuros parasiticus (L.A.).
COCONUT.	..	Fomes lucidus (R.); Thielaviopsis paradoxa, "Stem bleeding-disease" (S.); Botryodiplodia sp., "Leaf-break" (L.); Helminthosporium incurvatum (L.); Bacillus coli, "Bud-rot" (B.); Phytophthora sp., "Bud-rot" and "Nut-fall" (L.S.F.).
COFFEE.	..	Colletotrichum incarnatum, "Twig disease" (S.); Gloeosporium coffeanum (L.); Hemileia vastatrix, "Rust" (L).
COLOCASIA.	..	Phytophthora Colocasiae, "Blight" (L.); Sclerotium zeylanicum (L. & R.).
COTTON.	..	Fomes lamaoensis, "Brown Root-disease" (R.); Uredo desmium, "Rust" (L.).
CROTALARIA.	..	Cercospora Crotalariae (L.); Colletotrichum Crotalariae (L.); Parodiella grammodes (L.); Phyllosticta Crotalariae (L.); Sphaerella Crotalariae (L.).
DADAP.	..	Fomes lamaoensis, "Brown Root-disease" (R.); Fomes lignosus (R.); Poria hypobrunnea (R.); Coleosporium Erythinae (L.); Phyllosticta Erythrinae (L.).
DIOSCOREA.	..	Uredo Dioscoreae, "Rust" (L.).
GREVILLEA.	..	Botryodiplodia Theobromae (R.); Fomes lamaoensis, "Brown Root-disease" (R.); Ustulina zonata. (R.).
GUAVA.	..	Cephaleuros parasiticus (L.A.); Gloeosporium Psidii (F.).
HEVEA.	..	Botryodiplodia Theobromae, "Die-back" (R. & S.); Fomes lamaoensis, Brown Root-disease (R.); Fomes lignosus (R.); Poria hypobrunnea (R.); Sphaerostilbe repens (R.); Ustulina zonata (R. & S.); Corticium salmonicolor, "Pink Disease" (S.); Gloeosporium alborubrum (S, L. & F.); Pestalozzia palmarum, "Grey Blight" (S. & L.); Phoma Heveae (S.); Phytophthora Faberi, "Die-back," "Claret-coloured Canker," "Leaf-fall" and "Fruit-rot" (S. L. & F.); "Brown Bast" (P.); Ascochyta Heveae, "Rim-blight" (L.); Cephaleuros parasiticus, "Red-rust" (L.); Colletotrichum Heveae (L.); Helminthosporium Heveae, "Birds'-eye spot" (L.); Pestalozzia palmarum, "Grey Blight" (L.); Phyllosticta Heveae (L.).
MANGO.	..	Gloeosporium Mangiferae (F.); also a bacterial "Fruit-rot."
MAIZE.	..	Helminthosporium turcicum (L.); Puccinia Maydis, "Rust" (L.).
MULBERRY.	..	Uredo moricola, "Rust" (L.).
NUTMEG.	..	Marasimus equicrinis, "Horse-hair blight" (S. & L.). Marasmius pulcher, "Thread-blight" (L. & S.).
PADDY.	..	Sclerotium Oryzae (S.); Ustilaginoidea virens, "False Smut" (F.).
PAPAW.	..	Phytophthora Faberi (F.).
PEAS.		Ascochyta Pisi (L. & F.); Erysiphe Polygoni, "Mildew" (L.).
PLANTAIN OR BANANA.		Fusarium sp. (S.); Marasmius semiustus (S.); also "Bunchy-top Disease" (P. S. & L.); Cercospora Musae (L.); Glomerella Musarum (L.); Leptosphaeria Musarum (L.); Macrophoma Musae (L.); Scolecotrichum Musae (L.); Gloeosporium Musarum (F.).
SUGAR.	..	Hendersonina Sacchari, "Collar Rot" (S.); Leptosphaeria Sacchari, "Ring Spot" (L.).
TEA.	..	Botryodiplodia Theobromae (R.); Fomes lamaoensis, "Brown Root-disease" (R.); Fomes lignosus (R.); Irpex subvinous (R.); Polyporus interruptus (R.); Poria hypobrunnea (R.); Poria hypolateritia (R.); Rosellinia arcuata (R.); Rosellinia bunodes (R.); Ustulina zonata (R.); Aglaospora aculeata, "Thorny-stem blight" (S.); Corticium salmonicolor, "Pink Disease" (S.); Macrophoma theicola, "Branch Canker" (S.); Didymostilbe

Coffeae, "Die-back" of plucked shoots (S.); Irpex destruens, "Stump-rot" (S.); Pestalozzia Theae (S. & L.); Cephaleuros parasiticus (S. & L. A.); Corticium invisum, "Black-rot" (S. & L.); Cercospora Theae, "Birds'-eye Spot" (L.); Cercosporella Theae (L.); Colletotrichum Camelliae, "Brown Blight" (L.); Phoma theicola (L.); Rhizoctonia sp., "Collar-rot," "Bitten-off" root disease (Sg.).

TOBACCO. .. Bacillus Solanacearum, "Wilt" (S. B.); Phytophthora Nicotianae (S.); Cercospora Nicotianae (L.); Oidium Tabaci (L).

TOMATO. .. Bacillus Solanacearum, "Wilt" (S. B.); Cladosporium fulvum, "Leaf-mould" (L.); Oidium sp., "Mildew" (L.); Phytophthora infestans, "Blight" (L. & F.); Septoria Lycopersici (L.); Gloeosporium phomoides (F.); Vermicularia Capsici (F.); also "Leaf-Curl" (P.).

VINE, GRAPE. .. Cercospora viticola, "Leaf-spot" (L.); Oidium Tuckeri, "Mildew" (L.); Pestalozzia viticola (L.); Plasmopara viticola (L.).

CHAPTER XXXV.

1.—*PACKING AND TRANSPORT OF PLANTS, SEEDS, BULBS, Etc.* 2.—*PACKING FLOWERS, SPECIMENS, INSECTS, &c., FOR TRANSMISSION BY POST.*

3.—*STORING OF SEEDS.*

The conveyance of plants or seeds over long journeys, or from one country to another, is a question which not infrequently confronts one in the tropics, and upon it may depend the beginning or development of a planting industry. In cases where seeds are not procurable, or are of a particularly perishable nature, recourse must he had to plants to meet requirements. Unquestionably the best, though rather costly, means so far invented for transmitting growing plants over long journeys, especially by sea, is that of wardian cases, by the aid of which the exchange of live plants between widely separated countries has been greatly facilitated. Thus the introduction of Rubber, Cacao, and other useful plants from the Western to the Eastern tropics, and others *vice versa*, is due largely to the excellent wardian cases which for many years past have been sent out from the great emporium, Kew Gardens, England.

A wardian case consists of a large box, with two sloping, glazed sides which meet at the top to form a ridge, the two ends being carried up like an inverted "V", thus—A. The sides are movable, and the glass panes fitted in grooves with putty, being protected on the outside with narrow strips of thin wood, nailed on about an inch apart. A small circular hole, covered with a piece of perforated zinc or other metal, is made in each end, near the top, for ventilation, and over each of these (inside) is nailed a small box, which is open at the top, so as to catch any sea spray that may get in. Therefore, a wardian case when travelling is nearly air-tight, so that very little evaporation or change of air can take place within. The bottom of the case is filled with light soil, or a mixture of soil and sawdust, in which the plants are packed or planted close together; these are held in position by narrow strips of wood placed transversely, which are firmly secured in position by means of a longitudinal strip placed along on both ends of the latter and nailed to either side of the case, inside. Light but strong wood should be used for such cases.

Wardian cases may be made of any size to suit large or small plants. When seeds are of too perishable a nature to withstand a long journey, as in the case of Cacao, they may be sown in a wardian case and despatched so as to germinate *en route*; or the seedlings may be allowed to become established before despatch. The soil, &c., may in this case be kept in position by means of thin bamboo twigs placed over the surface and held down by narrow strips placed longitudinally. See next page.

For transport on land, or over a journey which does not involve a long sea voyage, a simple form of case or even an improvised packing case, answers the purpose; but the plants should be covered with sacking or hessian securely fastened or nailed on, and firmly held in position by means of cross battens. If the case is heavy, it should be provided with a handle at each end, or a strip of wood nailed on, so as to facilitate removal, see below.

Dry Method of Packing.—For plants in a dormant or semi-dormant condition, a dry method of packing is the most suitable, for they will thus stand greater degrees of heat or cold than if in an active growing state with moist packing. Plants which do not naturally assume a dormant state may be prepared by getting them first into a good healthy condition, each with a compact ball of roots, or, preferably, established in pots; they may then be hardened off by gradually withholding water from them and exposing them to full light.

When thus prepared or seasoned, each plant is taken separately and the roots or pots wrapped well with moss or shavings. Taking an oblong case, the plants are laid flat in tiers at each end, all the foliage ends towards the centre but not quite meeting, leaving a few inches of air space; each tier is separated from the next above it by cross battens (nailed to the sides), to which the plants are securely fastened in position. A few holes may be made in the centre of the sides of the case for ventilation. The plants should not be watered before packing, and the case may be placed in any cool and dry part of the ship.

CARE OF PLANTS IN TRANSIT.

The success of any method of packing and transporting plants will largely depend upon the position and the treatment accorded to these on board-ship. Obviously they must have access to light and air, but must be under shade or cover; they should not be placed on the lower or main deck if on a long voyage, as they would thus be liable to be injured or killed by sea spray or breakers. Any of the upper decks, except in the forepart of the ship, is therefore preferable, so long as it is not too near the engines. Plants in an active state of growth will be benefited by an occasional watering, if this can be given by an intelligent person. Much also depends on the season. Tropical or hot-house plants can only be transported safely over long journeys during the summer months; while deciduous plants, or those of temperate countries, *e.g.* Roses, travel best in a dormant state, as in the autumn or spring.

Treatment of plants in transit.—Wardian or other cases of live plants should be kept on *deck, under awning* and away from the engines; direct exposure to the sun, especially if the cases are closed, will injure the plants. Plant-cases of whatever description should be made so as to admit of opening *en route*, so as to water the plants if necessary. A wardian case is easily opened by unscrewing one or both of the glass sides. In tropical seas, during fine weather, one of the glazed sides may, with advantage, be left partly or fully open during the day, but should be closed at night. The plants may be lightly watered or sprinkled with fresh tepid water at least once in 2 or 3 days. In cool latitudes less watering is required, and the case should then be protected at night with tarpaulins or other covering.

Treatment of plants after a long journey.—When plants are received, after a long journey, it is best as a rule to pot them at once, or, if this is not practicable, to place them into plant-baskets or bamboo-joints. They should then be watered and sprayed with tepid water, and kept shaded and protected until well established. Heavy watering has to be guarded against, until at least the plants are in active growth.

PACKING SEEDS, CUTTINGS, &c.

FOR TRANSMISSON BY POST.

In regard to imported seeds of annuals, vegetables, etc., of temperate countries, it has been found that, provided the seed is properly dried, the best means of transport is in air-tight tins. Seedsmen who make a speciality of sending such seeds on long journeys pack them in

hermetically sealed tins, in a dry atmosphere, so that the seeds are not affected by heat and sweat on the voyage. No packing material of a preserving kind is thus required. A similar method will suit certain tropical seeds; but these are often of a fleshy non-driable character, naturally unadapted to a dormant period, and are best packed with a slightly moistened absorbent material, as saw-dust, coir-dust, burnt-rice, &c. The addition of powdered charcoal has an excellent preservative effect; in the case of fleshy or oily seeds, this may be used alone.

Thus, seeds of Para rubber (*Hevea brasiliensis*), which are normally of short vitality, packed in ordinary biscuit tins, with a mixture of dry powdered charcoal and fine soil or coir-dust, have been transported over journeys of six to eight weeks, and at destination gave germinative results of 70 per cent. or more. Tins or boxes containing such seeds as these should not be hermetically sealed, as this may cause fermentation and decomposition of the seeds.

Seeds which are surrounded by a mucilaginous substance, *e.g.* Cacao, *Nephelium*, *Garcinia*, &c., should have the latter washed off, then be partly dried in the sun, after which they should be rolled in dry charcoal powder, which will thus form an effective preservative coating around them. Dr. van Hall, late Director of Agriculture for the Dutch West Indies, records success in sending Cacao pods in paraffin wax to Java, a voyage of over six weeks, and describes his method thus:

"The pods were first thoroughly washed with a tooth-brush and soapy water, then placed in 70% alcohol for a minute, and afterwards in a 5% solution of corrosive sublimate for a few minutes, so as to kill the germs on the surface. A piece of string being then attached to the stalk end of the pod, the latter was dipped in the liquid paraffin; it was taken out immediately and hung carefully by the string, so as not to break the thin coating of the wax adhering to it. When cold, each pod was again dipped in the paraffin, making the coating more complete. The pods were then packed in dry sawdust and despatched by post."

Cacao seeds, when shelled, rapidly lose their germinating power and decompose (see p. 256), but for journeys not exceeding about a fortnight, pods may be transported in open crates; the fruits being placed vertically in tiers, and separated and held in position by thin strips of wood or bamboo, a convenient-sized crate would hold three dozen pods.

Seeds of aquatic or water plants, as *Victoria regia*, are best transported in small tubes or bottles filled with water or wet mud; the tube or bottle being made water-tight with wax, it may be packed with straw or shavings in a section of bamboo or wooden box, and despatched by post.

Palm seeds and most **fruit-tree** seeds are best packed with slightly moistened sphagnum moss, in tins, or well wrapped in oil-paper.

Cuttings or scions, especially those of a succulent nature, as Cassava (*Manihot*), Hibiscus, Crotons, etc., may often be safely sent by post if prepared and packed in the following manner. Take cuttings about 12 to 15 inches long, furnished with about 4 or more eyes (buds) and taken from mature stems or shoots; they must not be too slender, nor under the size of a lead pencil in thickness. See that each cutting is healthy and not affected by any insect-pest or fungus disease. About 3 cuttings may be placed together, the ends wrapped in slightly moistened moss (sphagnum) or fine shavings and surrounded with oil-paper; these may be placed in small bundles in a close fitting tin tube or hollow bamboo-section, wrapped in hessian, and despatched. In the absence of sphagnum, a wrapper of lint or cotton wool slightly damped will answer the purpose. Closing up the ends of the cuttings with sealing-wax, to prevent the evaporation of moisture, or fixing the ends in a potato or other tuber, are also methods sometimes adopted.

Transport of bulbs or tubers.—These are always best transported when in a dormant or resting state. In the tropics, however, this is not always practicable,

as the plants may be said to be seldom in that condition. In this case the bulbs or tubers should be gradually dried in the sun until all the leaves have thoroughly withered, when they should be cut away. The bulbs may then be packed in dry sawdust or coirdust, in an empty biscuit box, and sent by Parcels Post.

Packing Orchids.—Epiphytic species, which grow on trees, should be placed in layers, in a box, the roots of each layer being arranged the reverse of those of the former. Dry shavings or moss should be placed between the plants, and a few small holes bored in the box for ventilation. Keep the package in a dry, cool place. Ground (terrestrial) orchids should be partly dried, then packed in fairly dry earth or moss and wrapped in waterproof paper. For short journeys, a large leaf, as that of Banana (Musa), Heliconia, &c., answers the purpose of oil-paper quite well.

Avoid as much as possible an air-tight condition and excessive moisture, which will lead to fermentation and decomposition. Therefore the box, whether of tin or wood, should have some ventilating holes at the top or sides. Evergreen ground-orchids, as *Anoectochilus* ("Wana-raja"), should be placed upright and firmly secured in position, with free space for the leaves, which should not be removed. Empty biscuit-tins, with perforated sides, are useful for sending small orchids like these by post. Do not disturb the roots of any orchids more than necessary when packing for transport; it is preferable to send if possible a portion of the material to which the growing roots are attached. Do not pack too many plants together.

Packing and despatch of Flowers.—Flowers should be cut with a sharp knife, not broken off; cutting with scissors is apt to squeeze and close the tubes of the stalks, thereby preventing the absorption of moisture when placed in water. Cut the flowers in the early morning, when they are full of moisture; when packing do not sprinkle water on them, and if wet, shake them gently. In packing, the box should be lined with oil-paper, moss, or fresh leaves; no cotton-wool or similar absorbent substance should be used as packing, the best material for the purpose being moss or fresh leaves. The flowers should be packed quite closely, for they will shake down in transit, and if loose the jolting will bruise them; they are best not tied in bunches, except in the case of small flowers, as violets. A tin box, rather shallow, or, if deep, provided with movable trays, is the best receptacle for sending flowers long distances either by rail or post, but a card-board box may answer the purpose if strong enough.

Sending Specimens by post or rail.—Parcels containing specimens for identification, &c., should always bear the name of the sender. It is important that such specimens should arrive in as fresh a condition as possible. They should be packed in a closely fitting tin or wooden box, without air holes, both for the purpose of keeping them fresh and of preventing the escape, if present, of insects or injurious fungus spores. Specimen plants for identification may be packed flat, between absorbent paper, as blotting paper. Ample material should be allowed for full examination, and when flowers or fruit are available they should accompany the specimen, as in many cases it is impossible to determine the identity of the latter with certainty unless accompanied by these. Full notes of the locality from which the specimen comes, with elevation, &c., should be given.

Despatching insect-pests, etc., by Post.—Small insects may be enclosed and despatched in an empty cigarette-tin, a few leaves being

enclosed with them to prevent damage by shaking during transit; loose pieces of wood or earth should not be included, as these may injure the specimens. If holes are made in the tin or box for ventilation, they should not be large enough to allow the insects to escape. The address and postage stamp should be on a separate label attached to the package. The sender's name should always be written on the label.

Transporting live Fish.—The fish should be caught with great care, as by a net, then transferred immediately to chatties or tubs containing fresh water, which should be ready at hand. It is not advisable to place many fish in one vessel. During transport, fresh water should be frequently added to the vessel or, where this is not practicable, the water in the latter should be kept aerated. This can be done by means of a syringe or a bicycle inflator, which should be dipped every ¼ of an hour into the water and pumped for 2 or 3 minutes. The process should be continued until the fish are deposited in a pond or tank.

3.—STORING OF SEEDS.

Except for convenience, it is perhaps never advisable to keep seeds for a long time, as most, if not all, seeds germinate best when fresh, provided they are perfectly matured. All seeds may be divided into dryable and non-dryable classes (see p. 35). To the latter belong a large proportion of seeds of tropical species, and these are best sown as soon as possible after they are ripe. Their vitality may usually, however, be prolonged for a limited period by placing them in a dry porous mixture, such as charcoal, burnt paddy-husk, coir-dust, saw-dust, or finely sifted dry soil, etc.

Grains, pulses, and small dryable seeds, if properly matured and dried, are best kept in stoppered bottles or air-tight tins until required, being thus afforded protection from weevils and other destructive insects, as well as from the baneful effects of damp and mould. Imported seeds, especially those of annuals and vegetables, which are not sown immediately after arrival, should always be stored in air-tight tins or stoppered jars, and kept in a cool place until required; or better still, they may be kept over calcium chloride in desiccator jars. Where this is impracticable, as in the case of paddy and other grains stored in bulk, naphthalene balls placed among the seed are a good preventive against weevils and other insects.

CHAPTER XXXVI.

1.—*RECIPES FOR JAMS, JELLIES, PRESERVES, ETC.*
2.—*USEFUL REFERENCES.*
3.—*NATIONAL FLORAL EMBLEMS.*
4.—*TABLE OF SEED WEIGHTS, &c.*
5.—*WEIGHTS, MEASURES, AND COINAGE.*

JAMS :—

Billing Jam.—Prick the fruit well over with a fork ; let it soak in a basin of water for a night. Then squeeze the fruit slightly to get rid of some of the acid juice; throw away the liquid, and boil the fruit with its weight of sugar until it is of the proper consistency. See *Preserves*, page 510.

Camaranga or Carambola Jam.—Cut off the acute edges, then cut into pieces about ¾ of an inch thick ; for 2½ lbs. of fruit add 1½ pints of water ; boil till tender, which will take about 15 minutes, then add 2 lbs. best granulated sugar, and boil for 15 or 20 minutes. The small seeds are considered to improve the flavour. See also *Preserves*, p. 510.

Cape Gooseberry or Tippari Jam.—Wash the fruit and put in a pan with sugar, allowing a cupful of sugar to every cupful of fruit ; add a cupful of cold water, and boil till done. See *Jellies*, p. 510.

Melon Jam.—For every 18 lb. of fruit allow 12 lb. of sugar, 6 lb. lemons, ¼ lb. bruised ginger tied in a muslin bag. Peel fruit over night and cut into small blocks ; put into a large basin (after weighing), and sprinkle over a little of the sugar. Next morning, put into the preserving pan with the remainder of the sugar, and while it is boiling pare the lemons and squeeze out the juice ; strain the latter and add to the melon. Put the lemon rinds on to boil in plenty of water, and when they become soft cut into strips with a sharp knife and add to above. Boil for 4 hours, and remove the ginger bag. The jam should be transparent and of a golden brown colour. This is also known as " Lemon and Melon " Jam.

Papaw Jam.—Choose fruit three-quarters ripe ; remove all skin and seeds ; chop up the fruit into small pieces. Weigh, add equal weight of sugar, also some green ginger (cut into small slices), 2oz. of the latter being sufficient for 6 lb. of fruit. Cover up the fruit and sugar, and let the latter dissolve during the night. Boil up the next morning until done.

Passion-fruit jam.—Have two basins ready ; cut the fruit in halves, scoop out all the juice and seeds into one basin, putting the shells in the other ; cover the latter with cold water, add a very little salt, and leave for twelve hours ; then boil in the same water for three-quarters of an hour, remove the inside of the shells, throwing away the outside skins and the water they were boiled in. Squeeze out the juice from the seeds, and discard the latter. Mix the rest together and boil for half an hour, allowing 1 lb. sugar to 1½ lb. fruit.

Peach jam.—Pare and stone the fruit, after which weigh it, allowing 10 lb. of sugar to every 12 lb. of fruit. Put the latter in a preserving pan and barely cover with water ; allow this to cook slowly for 1½ hours, at the end of which time add the sugar, and cook for an hour longer.

Pineapple jam.—Peel the pineapples and chop them up (discarding cores) ; weigh the fruit, and allow 1½ lb. sugar to 1 lb. fruit ; boil until of the desired consistency. A piece of ginger added will improve the flavour.

Orange marmalade.—Ingredients : 1 lb. orange, 3 pints water, 3 lb. sugar. Mode : Halve and quarter the oranges, take out cores and seeds, then slice very

thinly and soak in water for 24 hours; boil in that water until the marmalade is as clear as amber. When it has boiled for twenty minutes, add the sugar and let boiling continue till it jellies.

Rozelle Jam.—Wash 6 lb. of the unripe fruit (fleshy calyces), cut open and remove the centre and seed, when the weight of the fleshy sepals will be about 3 lbs. Add 2 cups of water and cook for about an hour, or until reduced to a soft pulp; when cooled, measure the fruit and for each cupful add 1¼ cups of sugar; cook for 20 minutes. 6 lbs. of rozelle should make 7 lbs. of jam. See also *Jellies*.

JELLIES.

Cape Gooseberry or Tippari jelly.—Boil and strain the fruit, put the juice on fire to simmer; skim, and add sugar in the proportion of three or four parts to one part juice (or to taste), and cook till it jellies. See also under *Jams*, p. 509.

Guava jelly.—After thoroughly washing the fruit, put them in an enamelled sauce-pan with sufficient water just to cover; boil until all the fruit is broken, then strain; to one breakfast cupful of juice add the same quantity of sugar or slightly more (say 6 cupfuls juice to 6½ of sugar), and boil very slowly. A little lime-juice may be added after the sugar is put in.

Lovi-lovi jelly.—Boil the fruits thoroughly and take off the scum as it comes up. Then strain, and boil with refined sugar (two to one) till it forms a jelly.

Nutmeg jelly.—Take 3 lb. nutmeg skins and 4 lb. sugar. Peel the skins and put into water for 12 hours; then take them out and place in enough water just to cover them, and boil until quite mashed; strain off the juice, add the sugar, and boil slowly till it jellies.

Another recipe.—Put the rinds of ripe nutmegs into a preserving pan, with just enough water to cover them; boil until the rinds are almost a pulp; then strain through a flannel jelly bag. To every pint of juice, add 1 lb. sugar, and boil until jelly is formed.

Rozelle jelly.—Place the fruit in a basin and barely cover with water; allow to soak all night, and in the morning slightly squeeze the fruit; place all in a preserving pan, and boil until quite soft and pulpy. Then let the juice drip slowly through a jelly bag. Allow 1 lb. sugar to 1 pint juice; boil all slowly for 15 or 20 minutes, or until a jelly is formed.

PRESERVES, FRUIT SALADS, ETC.

Billing preserve.—Prick the fruits with a fork and place them in water for a few hours; then squeeze out the fruits, wash them with hot water, and dry with a clean towel. Sugar (in the proportion of 1½ lb. to 1 lb. fruit) should be boiled separately and refined as for "Nelli preserve"; add the fruits to the sugar, and boil till the latter becomes a thick syrup. See *Jams*, p. 509.

Camaranga preserve.—Cut off the ends and sharp ridges of the fruit; prick the latter with a fork, and place in cold water for a few hours. Squeeze out and pass through hot water before putting the fruits into the sugar-syrup, and boil as other preserves. Proportion of sugar, two parts to one of fruit. See *Jams*, page 509.

Cashew-nut toffee.—Take 2 lb. sugar and 150 cashew-nuts; skin the latter like almonds, in hot water, and chop up with a knife or mincing machine. Make a syrup of the sugar with 2 tumblerfuls of water, then add nuts and cook till the whole crystallizes; put on to a buttered plate and, when partly set, cut into squares or diamond shapes.

Mango preserve.—Take mangoes which are ¾ ripe, peel off skins, cut into slices, discarding the seed. Prick the fruit with a silver fork, and soak in cold water for a few hours. Prepare sugar (1 or 1½ lb. to 1 lb. fruit) as for "nelli," and boil till the fruit is cooked.

Nelli preserve.—Pick fruits when half-ripe; wash, and prick all over with a silver fork. Squeeze the juice out by hand, and soak in cold water for about 12 hours; put the fruits in boiling water for a little while, and again squeeze out the juice. Add sugar in the proportion of 2 lb. to 1 lb. of fruits; boil sugar separately, then add the fruits and boil till all becomes a thick syrup.

Pineapple preserve.—Slice the fruit, prick it or cut into small cubes, but do not squeeze out the juice. Then boil with refined sugar (one to one) as for "nelli"; add a small piece of ginger and a few cloves to flavour.

Pumpkin toffee.—This is made like cashew-nut toffee, allowing 1 lb. sugar for 1 lb. of pumpkin, grated like coconut ; add ¼ lb. of flour and, when it begins to crystallize, a table-spoonful of butter. When set, cut into squares.

Mango chutney.—Take 1 lb. of mangoes which are mature but not fully ripe, 1 lb. Demerara sugar, ½ lb. sultanas, 2 oz. almonds, 2 oz. garlic, 2 oz. dried ginger, 2 or 3 oz. dry chillies, and a little salt. Peel the mango, slice from the seed, and cut into small pieces ; chop the sultanas and almonds ; grind the garlic, ginger and chillies on a curry stone. Mix all with a pint of malt vinegar, and boil for twenty minutes, stirring all the time.

Devilled Bananas.—Melt 1 table-spoonful of butter, add ¼ tea-spoonful of chopped red chillies, 2 tea-spoonfuls chopped pickles, 1 tea-spoonful Worcester sauce, and ¼ tea-spoonful of salt. Add four bananas, each cut in four equal parts, and cook for five minutes.

Banana Sauce.—Ingredients : ¼ pint water, ¼ lb. of sugar, 3 bananas pulped, 3 table-spoonfuls lemon juice, 2 eggs, and a pinch of salt. Boil sugar and water for ten minutes; mix the other ingredients, and pour the hot syrup over them. Beat well and serve hot.

Banana compote.—Ingredients : Sound ripe bananas, ¾ pint white syrup, ½ liqueur-glassful maraschino,chopped almonds, and a few grapes. Peel the bananas, remove the white fibres in core or centre, plunge the fruit into boiling water for 2 or 3 seconds. Drain at once, and transfer the fruit to a boiling syrup, kept ready for the purpose in a saucepan or basin. Cover with a plate and leave to cool ; then add the liqueur. Take out the bananas, dish up in a pyramid garnished with large grapes (which should be cut in halves and have the stones removed). Pour the syrup over, and serve.

Fruit Salad.—Peel and clean with a silver knife any fruit available, as pineapple, mangoes, plantains, oranges, papaws, etc. Slice the fruit, cut into neat squares, in suitable proportions, and place in a glass dish. Sprinkle with castor sugar ; mix well and, if liked, add one pint of hock or sherry. Fresh whipped cream (as Fussel's tinned cream), mixed with sugar and vanilla, or a good custard, should be served with this salad. ("Hausfrau" in *Ceylon Observer*).

Wood-apple Drink.—Take 6 wood-apples (*Feronia*), 1 coconut, and some jaggery. Scrape out the inside of the wood-apples ; squash the pulp well (removing the seeds), and strain through a sieve. Break the coconut in two, scrape out the inside, add cold water, and squeeze out the milk,—mix some of the latter with the wood-apple to pass it through the sieve. Scrape the jaggery finely with a knife and add to the liquid according to taste. Add the rest of the coconut milk till the drink becomes as thin as desired. If necessary, add more coconut milk by squeezing out the coconut again with a little water. (Mrs. Van Langenberg.)

Vegetable curry.—Take 3 carrots, 3 turnips, 3 potatoes, 1 onion, 2 table-spoonfuls curry powder, 1 apple, and some boiled rice. Scrape the carrots and cut in slices ; peel the turnips, potatoes, onions and apple, cut these in slices and fry in dripping until a nice brown ; put all in a deep pie-dish ; mix the curry powder with a ¼ pint of stock, and pour over the vegetables ; cover the dish with a plate, and simmer in the oven for one hour.

Cooking Potatoes.—Potatoes boiled in their jackets lose 1 per cent. of their protein (flesh-forming substance), 3 per cent. of their ash, and practically no starch. Plunged into boiling water after paring, and boiled, they lose 8 per cent. protein and 18 per cent. ash. Placed in cold water after paring, and boiled, they lose 15 per cent. protein, over 18 per cent. ash, and 3 per cent. starch. Slow cooking is desirable, and steaming, as with vegetables generally, is better than boiling.

Sweet-Potato Recipes.—*Biscuits* : Mash thoroughly 4 medium-sized cold, boiled potatoes, after removing the skin, ; add 4 table-spoonfuls of flour, a piece of butter the size of a small egg. Mix all together, add a little milk, and stir to the consistency of biscuit dough. Roll, cut, place in a well-greased pan, and bake in an oven with moderate heat.

Waffles : Take 2 heaped table-spoonfuls of boiled potatoes rubbed through a cullender, add a table-spoonful of melted butter, a table-spoonful of sugar, a pint of milk, 4 table-spoonfuls of flour, one egg well-beaten, a little salt, and 2 tea-spoonfuls of baking powder. Grease the irons thoroughly, place the mixture and bake brown. Serve with half tea-cupful of honey mixed and beaten with a tea-cupful of cream.

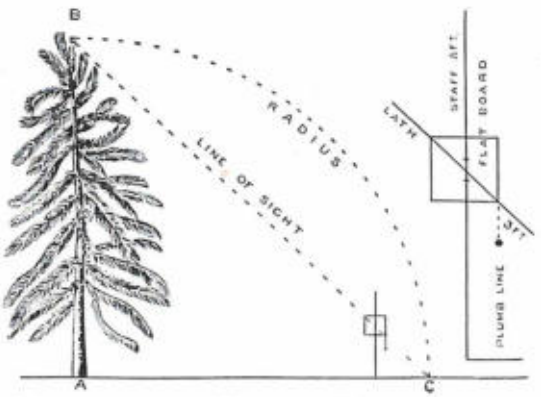
Pudding: Remove the skins of and mash finely six potatoes; take yolks of 4 eggs, a tea-cupful of white sugar, four level tea-spoonfuls of butter, and beat well together. Beat the whites of two eggs as for icing, add grated rind and juice of a small lemon, a little salt, and two cupfuls of cream; stir, then add to other mixture. Put into a buttered dish, and bake for an hour and a half. Beat whites of eggs with three table-spoonfuls of sugar, pour over the top, and brown.

USEFUL REFERENCES.

To make Charcoal. Cut the wood in lengths of 2 to 3 feet, and split the stout pieces 2 or 3 inches in thickness. Heap these into a wide pit, commencing by making a square chimney in the centre with sticks about 15 inches long laid across each other; pile the wood around this, one piece upon another, laid as closely as possible. Cover the whole with grass or leaves, and then with turf or adhesive earth, except the top of the chimney; start the fire in the chimney at the base with dry kindling. Carefully stop all outbursts of flame with soil, and close or open the draught holes (left at the base) according as the fire burns. When the fire is completely extinguished, allow the mass gradually to cool. On an average one cubic yard of wood should give 3 bushels charcoal.

Woods for making Charcoal. Fairly hard woods as a rule make the best charcoal, as they contain less water than soft woods; therefore dry-zone woods, being generally the hardest, are best adapted for charcoal-making. The following are some of the woods most commonly used in Ceylon for making charcoal: *Acronychia laurifolia* ("Ankenda" *S.*), *Adenanthera pavonina* ("Madatiya" *S.*), *Artocarpus nobilis* ("Del" *S.*), *Bassia longifolia* ("Mee" *S.*), *Calotropis gigantea* ("Wara" *S.*), *Caryota urens* ("Kitul" *S.*), *Croton lacciferus* ("Keppetiya" *S.*), *Doona zeylanica* ("Dun" *S.*), *Hemicyclia sepiaria* ("Vira" *S*, or "Viyarai" *T.*), *Trema orientalis* ("Gedumba" *S.*; "Charcoal-tree"), *Vitex altissima* ("Milla," *S.*), *Wendlandia notoniana* ("Rawanidella" *S*). *Acacia arabica* and *A. Catechu* are commonly employed in India for making charcoal used in gunpowder, &c.

Measuring Height of Trees.—Take a staff six feet long, pointed for pressing into the ground. To the centre of the staff fix with screws a piece of board twelve inches wide and exactly square. Fix to this diagonally a strip of straight lath. A plumb line is attached to the staff so as to enable the perpendicular to be obtained; this is indispensable. In measuring a tree the staff is placed at a distance from it, so that, with the plumb exactly perpendicular, the diagonal lath points to the top of the tree, the person taking the "sight" resting on one knee or reclining to bring the eye to the lower end of the lath. The sight line is then extended to the ground by means of a string. From the point where this touches the ground (C in the figure) to the centre of the trunk at the base will represent the actual height of the tree; that is, the horizontal line AC is equal to the vertical AB of the triangle. If the tree were blown over or cut down, its top would follow the course showed by the curved line, and rest at C.



DENDROMETER FOR MEASURING HEIGHT OF TREES.

Another method.—Make two lines on the ground exactly three feet apart. On one of the lines drive a stake in the ground so that the top of the stake will be exactly three feet from the ground; when the shadow of the stake will have reached

the other line, the shadow cast by the tree will be precisely the length of the height of the latter, and by measuring the length of the shadow at that moment you will obtain the height of the tree. The measurements should be taken on level ground. If the tree is leaning, incline the stake to as nearly the same angle as possible at which the tree inclines.

Famous Trees.—The largest if not the oldest trees in the world are the giant Red-wood trees of California, *Sequoia* (*Wellingtonia*) *gigantea*, of the N.O. Coniferae. One of these has been found to measure 325 feet in height, with a diameter of over 30 feet at 4 ft. from the ground. The age of some of these giants, as shown by the rings of growth in the trunk of felled specimens, is estimated to be upwards of 4,000 years. Species of Eucalyptus or "Gum Trees" attain a great height in Australia and Tasmania, notably *E. amygdalina* or "Peppermint Gum," a measured specimen of which has been found to be 303 feet high, the tallest authentically recorded, though fabulous heights up to 500 ft. or more have been described. The Douglas Fir (*Pseudotsuga Douglasii*), of N. America, reaches a height of some 230 ft. A single spar flagstaff in Kew Gardens is 215 ft. The Baobab Tree (*Adansonia*) of Trop. Africa reaches a great age and a diameter of 30 ft. in thickness of trunk (see pp. 205, 206, 428), but the age of the largest specimens can only be conjectured. A specimen of the "Bo Tree" (*Ficus religiosa*), which is sacred to the Buddhists and Hindus, brought from India and planted at Anuradhapura, Ceylon, in 288 B.C., is still flourishing (or at least a portion of it), and is therefore the oldest historical tree known. See p. 465.

Rainfall.—The depth of rainfall in inches, multiplied by 3,630, equals number of cubic feet per square acre; multiplied by 22,623, it equals number of gallons per square acre.

Thus :—

Inches.		Cubic feet per acre.		Gallons per acre.		Tons per acre.
1	=	3,630	=	22,635	=	101·1
2	=	7,260	=	42,270	=	202·2
3	=	10,890	=	67,905	=	303·3
5	=	18,150	=	113,174	=	505·5

1 Cubic foot of water = $6\frac{1}{4}$ gallons = $62\frac{1}{2}$ lbs. = 1,000 oz. = about $\frac{3}{4}$ bushel.
1 Cubic inch of water = $\frac{3}{5}$ oz. by weight.
1 Pint of water = 20 oz. by weight.
1 Gallon of water = 10 lbs. by weight.
1 lb. water measures — $27\frac{3}{4}$ cubic inches.
1 Ordinary tumbler holds 10 liquid oz.
1 Table-spoon holds — $\frac{1}{2}$,, oz.
1 Tea-spoon holds — 1 ,, drachm.
4 Tea-spoonfuls = 1 ,, oz.

Material for Cart Wheels.—The woods most generally used in Ceylon for making cart wheels are: "Hal-milla" (*Berrya ammonilla*), "Milla" (*Vitex altissima*), "Suriya" (*Thespesia populnea*), "Pihimbiya" (*Filicium decipiens*), and "Ratu-wa" (*Cassia marginata*). The usual quantity required for and cost of 2 full-sized ordinary cart wheels of $4\frac{1}{4}$ feet diameter are: 12 pieces for rims @ Rs. 1 each; 24 spokes @ 70 cents, hubs @ Rs. 6, total for two wheels Rs. 40·00. Iron tyres, bushes, &c., about Rs. 40 extra, say Rs. 85·00 in all, including labour. The cost of a double bullock cart complete with wheels and hood is about Rs. 180·00 (= £12).

To revive flowers.—Rinse the stalks in fresh warm water and put into warm salt-water, to which has been added a few drops of ammonia or a little copper sulphate. As each flower is ready to be placed in the vase of fresh water, snip off a small portion of the stalk with a sharp pair of scissors. To keep a spray of arranged flowers fresh, place them on damp cotton-wool or moss under an inverted basin. This keeps the air away and preserves their freshness. It is especially recommended for maiden-hair fern.

Preserving Specimens.—For preserving specimens of fleshy fruits, as cacao, nutmegs, &c., or other fresh vegetable matter of all kinds, for museum purposes; Immerse specimens for 5 minutes in a 20 per cent. (2 in 10) solution of formalin, then remove and place in a solution of about 8 or 10 per cent. strength. If the formalin is used too strong, it will deprive the specimens of their colour. Herbarium

specimens are more easily dried and prepared, if first dipped in a 10 per cent. solution of formalin for 2 or 3 minutes before starting to dry. Formalin solution has certain advantages over alcohol for preserving purposes; it is not so liable to discolour the specimens and, not being inflammable, is not exposed to risk of fire. For preserving specimens for purposes of dissecting or section-cutting, a solution of alcohol is best, a strength of about 25 to 30 per cent. being usually sufficient.

To prepare skeleton leaves.—Mix about one drachm chloride of lime with one pint water, adding sufficient acetic acid to liberate the chlorine. Steep the leaves in this until they are whitened (about 10 minutes should suffice), taking care not to leave them too long. Then place them in clean water and float them out on pieces of paper. Lastly remove the fronds from the paper before they are quite dry, and place them in a book or press. They look best when mounted on dark paper.

To preserve fern fronds.—Reject very young fronds, as they will lose their colour in drying. Place the selected fronds between several sheets of blotting paper, and over this pass a moderately heated flat iron for several minutes. Practice only will determine how long to continue the ironing, as ferns vary in the thickness of their fronds. Then place separately in a book, and lay aside for a day or two previous to mounting. To do this, smear the sheet or paper over with liquid gum, lay the reverse side of the frond on the gummed surface, press gently, remove frond, and place carefully on a clean sheet of paper where you intend it to remain. Finally pass over a piece of blotting paper to remove creases and absorb excess of gum.

To drive away sparrows from bungalows, etc.—Smear a few thin twigs with any sticky substance, as bird-lime, seccotine, or the resinous gum from jak-fruit; place these at intervals where the sparrows collect, and they will soon disappear.

To make bird-lime.—Boil ½ pint linseed oil, and while boiling add a lump of resin about the size of a hen's egg. Add two tea-spoonfuls of treacle, and stir frequently while cooling.

Golf greens.—For making golf-greens, see *Lawns* and *Grasses*, pages 68, 71. Crickets, ants, crabs and other burrowing creatures are sometimes very troublesome on golf links. A solution of "Silvertown," a new and effective insecticide (see p.....) will probably be found a safe and speedy remedy. Another simple remedy is to pour a small quantity of emulsion (see p. 488) or soft-soap down their burrows. A little kerosene or "liquid fuel" may be added to these to make their effects more lasting. Soft-soap may be made as follows:—

Soft-soap recipe: Dissolve 20 lb. of caustic potash (commercial) in 4 gallons of hot water; when cold, pour the solution slowly into 9 gallons of cotton-seed oil (gingelly-or coconut-oil will also answer the purpose), stirring until the potash and oil have become thoroughly combined. If too thick, add hot water to bring the mixture to the desired consistency.

A simple fly-trap.—Pour some water into a finger-bowl, or other wide-mouthed vessel, till the surface of the liquid is about an inch from the brim. Add a small quantity of oil (coconut-or castor-oil) to make a superficial film. In the centre of a piece of cardboard, sufficiently large to cover the vessel, cut a small hole about ½ inch in diameter. Smear some condensed milk or honey on one side of the cardboard round the central aperture, and place the cardboard over the vessel so that the smeared side is below. The flies will creep into the enclosed space and meet with an oily grave. A tap on the card will at once precipitate any that are resting on its under surface. The oil-film is necessary, as flies are not easily wetted by water, from which they often succeed in saving themselves.

Cockroach extermination.—Special traps for use in catching these are obtainable, but they are not always reliable. Powdered borax is usually an effective and safe material to use. Mix this with sugar and scatter in places frequented by the cockroaches, and they will soon disappear.

Book preservative.—The following makes an excellent preservative for books, as well as a preventive against insects and moulds, which are so destructive to books in the tropics: Dissolve Canada balsam in turpentine, say 2 oz. of the former to 4 oz. of the latter, so as to make a weak solution; paint this evenly and thinly over the covers or bindings of the books, and let them stand a few hours to dry.

Another receipe.—Paint the books lightly over, both outside and inside the cover, and especially along the back where paste has been used, with the following solution, using a soft brush for the purpose: 1 oz. corrosive sublimate, 1 oz. carbolic acid, 2 pints methylated spirit. No harm will be done to the books, and after the mixture has dried they may be handled with perfect safety.

Measuring land. The following lengths multiplied by the breadths opposite equal an acre (4,840 sq. yards) :—

968	y'ds	long	and	5	y'ds	wide.	110	y'ds	long	and	44 y'ds wide.
484	,,	,,	,,	10	,,	,,	88	,,	,,	,,	55 ,, ,,
220	,,	,,	,,	22	,,	,,	69½	,,	,,	,,	70 ,, ,,
121	,,	,,	,,	40	,,	,,					

A yard is a good stride, and few men step a full yard in their natural stride.

144 sq. inches (12" × 12")=1 sq. ft.; 9 sq. ft. (3' × 3')=1 sq. yard ; 30¼ sq. yards (5½ × 5½)=1 rod, pole or perch ; 40 rods, poles or perches = 1 rood ; 4 roods or 4,840 sq. yards=1 acre; 640 acres=1 sq. mile.

To measure Timber in log. Take the girth in inches in the middle, divide by 4, and square the result, which gives the mean sectional area of the trunk ; multiply the product by the length of the log in feet, divide by 144 and the quotient is the sum of the contents in cubic feet. Where there is bark, an allowance must be made for this, the usual allowance varying from ½ to 1½ inch to every foot of quarter girth ; thus, the total quarter girth being 24 inches, and the bark being thick, a deduction of 2 or 3 inches would be necessary, the quarter girth being taken at 21 or 22 inches.

Weight or measurement of Straw or Hay Stacks. To measure an oblong stack, multiply the length in feet by the width below the eaves, and the product by the height from the ground to the eaves. For the top, multiply the length in feet by the width at the eaves, and the product by half the length to the ridge. A cubic foot of hay weighs approximately from 7 lb. to 9 lb. For general purposes the weight of a stack may be ascertained by actually measuring the cubic contents of a truss, and calculating from this the weight per cubic foot. Stacks of straw are estimated at from 18 to 20 cubic yards to a ton.

To estimate Grain crops per acre. Frame together four light sticks, measuring exactly a foot square inside, and with this in one hand walk into the field and select a spot of fair average yield ; lower the square frame over as many heads as it will enclose, shell out carefully the heads thus enclosed, and weigh the grain. To make the result more reliable, make ten or twenty similar calculations, and estimate by the mean of the whole number of results.

Approximate cost per acre of bringing crops into bearing, in Ceylon.—Coconuts, £25 up to 6th year ; Tea, £30 to £35 up to 4th year ; Cocoa, £25 to £30 up to 5th year ; Rubber, £30 up to 6th year. These figures include the necessary factory or store, but not the cost of land. From £5 to £10 more per acre may be allowed, under average conditions, for the Straits Settlements and F. M. S.

Road-making and Concreting.—A cube of road metal is 18 feet long at base, 5 feet broad, 2½ feet high in centre and 14 feet long along top ridge. It contains 60 bushels of metal which, when spread, is sufficient for metalling about 500 sq. feet of road surface. Uusual cost at quarry, in Ceylon, about Rs. 8. Concrete metal is 50 per cent. finer (=road metal broken in half) ; cost per cube at quarry, Rs. 12·50. The usual charge for concreting, 4 inches thick, varies from 25 cts. per sq. foot, according to locality.

Average day's work per cooly:

Holing, 18 in. × 12 in., as for Tea,	..	..	..	100 to 120 holes.
Planting Tea,	..	..	..	200 to 250 plants.
Drains, 18 in. × 15 in.,	..	..	..	50 to 60 ft.
Pruning Tea	..	..	..	180 to 250 trees

Measuring Sawn Timber.—When the thickness of timber is 1½ inches or less, multiply length in feet by width in inches and divide by 12. When over 1½" thick, add width and thickness together, multiply by length in feet and divide by 12. To ascertain number of superficial feet of board 1" thick that may be cut from a log: Take overage girth of latter (*i.e.* the girths at both ends and centre added together and divided by 3) in inches, multiply by length in feet, and divide by 12.

Cadjans, the plaited leaves of the coconut palm; used for thatching houses, making cart-hoods, shading plants, etc., also for making temporary cheap baskets for transport of plants, fruits, etc. Each leaf, split along the centre, makes two cadjans. An expert cooly can plait 75 cadjans a day, and the usual charge for these is

from Rs. 10 to Rs. 30 per thousand, according to locality; the higher prices rule in the vicinity of towns.

Tennis Court dimensions.—Outer lines (court) 78 ft. × 36 ft., inner lines (court) 42 ft. × 27 ft.; the two long lines of the latter are extended to the end lines of outer court. A line is placed across the centre, joining outer lines, and another line placed lengthwise in centre of inner court only. Height of net in centre should be 40 in., or 1½ lengths of a racquet.

Clock Golf. Form, on a smooth lawn, a circle having a diameter of from 25 to 30 feet. Divide it at the circumference into twelve equal parts, and number the divisions like the dial of a clock. Sink a hole, 4½ inches across and 4 inches deep, at a spot inside the circle, near the figure 6 on the dial, placed in such a way that no two of the twelve points are at exactly the same distance from it. The art of the game is to "put" a golf ball into the hole in the fewest possible number of strokes, playing from each of the twelve points around the circle in turn.

Ladder Golf.—Mark 2 parallel lines, about 40 or 50 ft. long and 2½ ft. apart, on a smooth portion of lawn; mark cross lines in 4 pairs at varying distances apart, those forming each pair being 15 in. distant. Number each pair, and make a round putting-hole (4½ by 4" deep) on the top rung of the ladder. The ball is "put" from the base line to each pair in turn, the fewest number of strokes winning the game. If the ball overruns the side lines or the second line in a pair, it must be "put" again from where the last shot was played, and one is added to the score as penalty.

3.—NATIONAL FLORAL EMBLEMS.

Australia.—Wattle (*Acacia spp.*).
Canada.—Sugar Maple (*Acer saccharum*).
Ceylon.—Talipot palm (*Corypha umbraculifera*).
Egypt.—Lotus-lily (*Nelumbium speciosum*).
Holland.—Tulip (*Tulipa gesneriana*).
Ireland.—Shamrock (*Trifolium repens*).
Italy.—Lily (*Lilium spp.*).
Japan.—Yellow Chrysanthemum. (*Chrysanthemum sinense, var.*).
England.—Rose (*Rosa spp.* or *var's*).
France.—Fleur-de-lis (*Iris germanica*).
Germany.—Cornflower (*Centaurea Cyanus*).
Greece.—Violet (*Viola odorata*).
Scotland.—Thistle (*Onopordon Acanthium*).
Spain.—Pomegranate (*Punica granatum*).
Belgium. Switzerland.—Poppy (*Papaver somniferum*).
Wales.—Leek (*Allium porrum*).

4.—TABLE SHOWING APPROXIMATE WEIGHT OF SEEDS

WHEN FRESH BUT PARTIALLY DRIED, AND USUAL NUMBER IN EACH FRUIT.

NAME.	NUMBER TO AN OZ. (ABOUT).	NUMBER TO A LB. (ABOUT).	NUMBER IN EACH FRUIT (ABOUT).
Acacia decurrens. Wattle-bark. ..	1,500 ..	24,000 ..	10
Acrocarpus fraxinifolius. "Shingle Tree."	800 ..	12,800 ..	10–12
Acrocomia sclerocarpa. (Palm). ..	1 ..	16 ..	1
Adenanthera pavonina. "Madatiya," *S.* ..	100 ..	1,600 ..	8
Agathis alba. White Dammar. ..	260 ..	4,160 ..	20
Albizzia moluccana. "Albizzia." ..	1,150 ..	18,400 ..	15
Allamanda Schottii. ..	120 ..	1,920 ..	20
Alstonia macrophylla. ..	28,800 ..	460,800 ..	45
Anona squamosa. Sugar-apple. ..	85 ..	1,360 ..	30
Arenga Wightii. (Palm). ..	8 ..	128 ..	2–3
Artocarpus integrifolia. Jak. ..	5 ..	80 ..	180–280
Azadirachta indica, see *Melia*, p. 518 ..			
Barringtonia speciosa. "Mudilla," *S.* ..	— ..	2 (fruits)	1
Bauhinia triandra. ..	80 ..	1,280 ..	10

NAME.	NUMBER TO AN OZ. (ABOUT).	NUMBER TO A LB. (ABOUT).	NUMBER IN EACH FRUIT (ABOUT).
Bignonia unguis. (Climber). ..	216 ..	3,456 ..	184
Bombax malabaricun. Red Cotton-Tree ..	220 ..	3,520 ..	100
Brownea grandiceps. ..	2 ..	32 ..	4
Caesalpinia coriaria. "Divi-divi." ..	600 ..	9,600 ..	2
C.—Sappan. Sappan-wood. ..	50 ..	800 ..	6
Cajanus indicus. Rata-tora, *S.*; Pigeon Pea.	280 ..	4,480 ..	4–6
Camellia Thea. Tea. ..	14 ..	224 ..	2
Camphor, see Cinnamomum.			
Cananga odorata. Ylang-ylang; "Wana-sapu," *S.* ..	400 ..	6,400 ..	5
Canarium commune. Java almond. ..	4 (fruits)	64 ..	1
C.—Mehebethene. (Moluccas). ..	2 ..	32 ..	1
Carapa guianensis. "Crapa." ..	2 ..	32	8
Carica Papaya. Papaw. ..	500 ..	8,000	Few or many
C.—candamarcensis. Mountain Papaw.	800 ..	12,800 ..	150
Caryota urens. Kitul; Toddy Palm. ..	25 ..	400 ..	2
Cassia Fistula. "Ehela," *S.* ..	8 ..	128 ..	20
C.—grandis. Horse Cassia. ..	46 ..	736 ..	40
C.—nodosa. Pink Cassia. ..	160 ..	2,560 ..	22
Castanospermum australe. Australian ..	— ..	15 ..	23
Castilloa elastica. Panama Rubber. ..	50 ..	800 ..	20–25
Casuarina equisetifolia. Beef-wood ..	6,500 ..	96,000 ..	50–60
Casuarina montana. ..	5,000 ..	80,000 ..	40
Cedrela serrulata. ..	5,000 ..	80,000 ..	18–20
Chenopodium ambrosoides ..	10,000 ..	160,000 ..	—
Chrysalidocarpus lutescens. (Palm). ..	25 ..	400 ..	1
Chrysobalanus Icaco. Coco-plum. ..	5 ..	80 ..	1
Cinchona (See p. 369). ..	30,000 ..	480,000 ..	—
Cinnamomum Camphora. Camphor. ..	300 ..	4,800 ..	1
C.—zeylanicum. Cinnamon. ..	50 ..	800 ..	1
Citrus Aurantium. Orange. ..	100 ..	1,600, ..	6–10
C.—nobilis. Mandarin Orange. ..	120 ..	1,920 ..	12
Coffea arabica. Arabian Coffee. ..	60 ..	960 ..	2
C.—liberica. Liberian Coffee. ..	45 ..	700 ..	2
Cola acuminata. Kola-nut. ..	1–2 ..	23 ..	4
Cotton, see Gossypium.			
Crotalaria striata. ..	205 ..	3,280 ..	45
Croton Tiglium. Croton oil Plant. ..	130 ..	2,080 ..	3
Cupressus macrocarpa. "Cupressus." ..	2,600 ..	41,600 ..	65
Cycas circinalis. "Madu," *S.* ..	1 ..	16 ..	1
Cyphomandra betacea. Tree-tomato. ..	2,400 ..	38,400 ..	110
Cyrtostachys Renda. (Palm). ..	250 ..	4,000 ..	1
Detarium senegalense. ..	2 ..	32 ..	1
Dimorphandra Mora. Mora Tree. ..	— ..	4 ..	1
Diospyrus Embriopteris. "Timbiri," *S.* ..	14 ..	224 ..	3
Dichopsis pustulata. ..	13 ..	208 ..	1
Duranta Plumieri. "Duranta." ..	52 ..	832 ..	6
Durio zebithinus. Durian. ..	1–2 ..	23 ..	10
Elaeocarpus Ganitras. ..	10 ..	160 ..	1
E.—edulis. Ceylon Olive. ..	5 ..	80 ..	1
Enterolobium cyclocarpum. ..	24 ..	384 ..	5–6
Eriodendron anfractuosum. Kapok. ..	200 ..	3,200 ..	120
Erythrina lithosperma. Dadap. ..	80 ..	1,280 ..	3
Erythroxylon Coca. Coca- or Cocaine plant.	240 ..	3,840 ..	1
Eucalyptus citriodora. Lemon-scented Gum.	5,000 ..	80,000 ..	—
— globulus. Blue Gum ..	7,300 ..	116,800 ..	—
Eugenia caryophyllata. Clove. ..	19 ..	304 ..	1
E.—malaccensis. Rose-apple. ..	6 ..	96 ..	1
Filicium decipiens. "Pehimbiya," *S.* ..	32 ..	512 ..	1

Name.	Number to an oz. (About).	Number to a lb. (About).	Number in each Fruit (About).
Flacourtia inermis. Lovi-lovi.	800	12,800	10
Garcinia Cambogia. "Goraka," *S.*	48	768	3
G.—Mangostana. Mangosteen.	11	176	1–3
G.—Xanthochymus. Cochin-goraka.	4	64	3
Gliricidia maculata. "Madre" or "Gliricidia."	125	2,000	6-8
Gossypium peruvianum. Peruvian Cotton.	175	2,800	25
G.—barbadense. Sea Island Cotton.	280	4,480	35
G.—herbaceum. Indian Cotton.	400	8,000	40–45
Grevillea robusta. "Grevillea."	2,000	32,000	2-3
Heritiera littoralis. Looking-glass Tree.	1–2	24	1
Hevea brasiliensis. Para Rubber.	6–7	104	23
Howea Fosteriana. (Palm).	50	800	1
Kapok, see Eriodendron.			
Lagerstroemia Flos-reginae. "Queen's Flower."	2,450	39,200	15
Leucaena glauca.	620	10,000	15–18
Livistona chinensis. (Palm).	24	384	1
L.—rotundifolia. (Palm).	33	528	1
Lysidice rhodostegia.	20	320	7
Madras Thorn, See *Pithecolobium dulce*.			
Mangifera indica. "Jaffna" mango.	1	16	1
Manihot Glaziovii. Ceara Rubber.	44	704	3
Melia azadirachta. Margosa.	145	2,320	1
M.—dubia. "Lunu-midella," *S.*	10	160	2–4
Mesua ferrea. "Na" *S*; Ceylon Ironwood.	26	416	2
Michelia Champaca. "Sapu," *S.*	150	2,400	4
Myristica fragrans. Nutmeg.	2	32	1
M.—laurifolia. Wild Nutmeg	3	48	1
Myroxylon toluiferum. Balsam-of-Tolu.	15	240	1
Nephelium lappaceum. "Rambutan," *S.*	13	208	1
Nicotiana Tabacum. Tobacco.	400,000	6,400,000	—
Oncosperma filamentosum. (Palm).	44	704	1
Oreodoxa regia. Royal Palm.	80	1,280	1
Ormosia dasycarpa. Necklace Tree.	16	256	1
Paddy. (Rice).	1,000	16,000	1
Pahudia javanica. (*Leguminosae*).	6	96	4–5
Panicum maximum. Guinea-grass.	20,000	320,000	—
Pentadesma butyracea. "Butter Tree" of Africa.	—	14	2–3
Parkia Roxburghii.	32	512	8
Paspalum dilatatum. Paspalum grass.	25,700	411,200	—
Passiflora edulis.	1,000	1,600	184
Payena Leerii.	16	256	1
Peltophorum ferrugineum.	350	5,600	3
Pericopsis mooniana. "Nedun," *S.*	90	1,440	4
Phoenix zeylanica. (Palm).	75	1,200	1
Pinanga patula. (Palm).	80	1,280	1
Pithecolobium Saman. Rain Tree.	120	1,920	10–12
P.—dulce. Madras Thorn.	250	4,000	8–10
Posoqueria longiflora.	34	544	6
Pterocarpus echinatus.	356	5,696	1–2
P.—indicus. "Padowk."	400	6,400	1–2
Ptychosperma MacArthurii. (Palm).	60	960	1
Raphia Hookerii. (Palm).	1	16	1
R.—vinifera. (Palm).	—	10	1
Ravensara aromatica. Madagascar Clove.	3–4	56	1
Sabal glaucescens. (Palm).	75	1,200	1
Sandoricum indicum. "Santol."	16	256	4–5
Sapium indicum.	5	80	3
Sideroxylon dulcificum.	8	128	1
Spathodea campanulata.	3,600	57,600	470

NAME.	NUMBER TO AN OZ. (ABOUT).	NUMBER TO A LB. (ABOUT).	NUMBER IN EACH FRUIT (ABOUT).
Styrax Benzoin. Benzoin Tree. ..	3 ..	48 ..	3
Swietenia macrophylla. Large-leaved Mahogany. ..	46 ..	736 ..	50
S.—Mahagoni. Mahogany. ..	120 ..	1,920 ..	45–55
Tamarindus indicus. Tamarind. ..	25 ..	400 ..	4
Tea, see Camellia. ..	— ..	— ..	—
Tecoma Stans. ..	1,500 ..	24,000 ..	50
Tectona grandis. Teak. ..	24 ..	384 ..	2–3
Tephrosia candida. "Boga-medeloa." ..	1,120 ..	17,920 ..	8–12
Terminalia belerica. "Bulu," *S.* ..	8 ..	28 ..	1
Theobroma Cacao. Cocoa. ..	12 ..	192 ..	35
Trachylobium verrucosum. Copal Tree. ..	40 ..	640 ..	1
Vateria acuminata. "Hal," *S.* ..	— ..	2 (Fruits)	1
Zea Mays. Indian Corn; Maize. ..	80 ..	1,280 ..	400–600

5.—SOME WEIGHTS AND MEASURES.

CEYLON :

1 Manawa = ½ nelli or 2 chundus
4 Chundus = 1 measure
1 Nelli = ¼ kuruni or laha
1 Kuruni = ½ bera (drum)
1 Bera = ½ pela (bushel)
1 Pela = 1 bushel
1 Amuna = 4 bushels
1 Hunduwa = ¼ serua or measure
32 Cut, or 28 loaded, measures = 1 bushel
7 Seru = 1 karatuwa
1 Karatuwa = ¼ bushel
1 Thulama = 26½ rathals (pounds)
1 Thukku = 56 rathals
1 Parama = 20 thulams or 5 cwt.

CEYLON.—*Contd.*

1 Candy = 560 lb. or 5 cwt.
4 Candies = 1 ton.

WEIGHTS USED BY SINHALESE APOTHECARIES

1 Thala-eta (gingelly seed) = ⅓ Amu-eta (Paspalam seed).
1 Amu-eta = ⅓ Vee-eta (Paddy grain)
1 Vee-eta = ½ Madatiya-eta (*Adenanthera pavonina*)
1 Madatiya-eta = $\frac{1}{20}$ kalanda
1 Kalanda = $\frac{1}{12}$ palama
1 Palama = ⅓ rathala (pound)

INDIA :

1 Tola = nearly ½ oz.
1 Chittack = 2 oz.
1 Seer = 2 lb.
40 Seers = 1 Maund (80 lbs).
1 Maund = 80 lb.
1 Lac = 100,000.
1 Crore = 1,000,000.
1 Bigha (Brit. India) = 40 × 40 yds. or ⅓ acre.

MALAY :

1 Tahil = ⅓ oz.
1 Kati or catty = 1⅓ lb.
1 Picul (100 katties) = 133 ⅓ lb.
1 Picul (Java) = 136 lbs.
1 Koyan = 5,333 ⅓ lb.

DUTCH :

1 Bau (bouw) = 1¾ acres
1 Morgen = 2½ acres.
1 Picul (Java) = 136 lb.

FRANCE, GERMANY, ETC :

1 Millimetre = ·039 inches.
25 Millimetres = 1 in. (about).
1 Centimetre = ·393 inches.
30·5 Centimetres = 12 inches.
1 Metre = 1 yard 3 inches.
1 Kilometre = 1,093 y'ds, 1 ft., 10 in.
1 Litre = 1¾ pints.
1 Kilogram = 2¼ lb. (nearly).
10 Kilograms = 2¼ lbs. 0¾ oz.
50¾ Kilograms = 1 cwt.
1 Hectare = nearly 2½ acres.
1 Orlong = 1 $\frac{1}{3\frac{1}{2}}$ acres
1 Estrada = 150 Para trees (Brazil).

LOCAL AND FOREIGN MONEY (NORMAL).

ARGENTINE :
1 Peso (paper) = 100 centisimo or 1s. 9d.
1 Peso (gold) = 3s. 11½d.

AUSTRIA-HUNGARY :
1 Krone = 100 heller or 10d.
24 Krone = £1

BRAZIL :
1 Milreis (paper) = 1,000 reis or about 1s. 3d.

INDIA & MAURITIUS :
3 Pies = 1 pice.
4 pice = 1 anna or 1*d.*
16 Annas = 1 Rupee.
1 Rupee = 1*s* 4*d.*

MALAY :
100 Cents = 1 dollar
1 Dollar = 2*s.* 4*d.*

DUTCH (Java, &c.):
1 Guilder or Florin = 1*s.* 8*d.*
12½ Guilders = £.1
1 Stiver = 1*d.*

FRANCE, BELGIUM, AND SWITZERLAND :
1 Sou = ½*d.*
10 Centimes = 1*d.*
1 Franc = 10 *d.*
20 Francs = 16*s.*
25 Francs = £1

RUSSIA :
1 Rouble = 3*s.* 9*d.* or 100 kopeks.

ITALY :
1 Lira = 10*d* or 100 centesimi.
25 Lira = £1.

MEXICO :
1 Dollar (gold) = 100 centavo or 2s. 0½d.

GERMANY :
1 Mark = 1*s.* or 100 pfennige
20 Marks = £1
1 Prussian thaler = 2*s.* 11½*d.*
1 Rix dollar = 3*s.* 6*d.*

ROUMANIA :
1 Ley = 100 banis or 10*d.*

CEYLON :
1 Sallie = ½ cent.
1 Thuttu = 3 sallies or 1½ cents.
1 Panam = (anna) { 4 thuttus, 6 cents, or 1/8 Rupee
4 Panams = 25 cts.
100 Cents = 1 rupee.
1 Rupee = 1s. 4d.

SPAIN :
1 Reala = 2½*d.*
1 Peseta = 10*d.*
25 Peseta = £1
1 Eseudo = 2*s.*
1 Dollar = 4*s.*

PORTUGAL :
25 Reis = 1½d.
1 Cruzada = 2*s.* 3*d.*
1 Milreis = 4*s.* 5½d.

UNITED STATES & CANADA :
1 Cent = ½d.
1 Dime = 5*d.*
100 Cents = 1 dollar
1 Dollar = 4*s.* 2*d.*
4·87 Dollars = £1

CHINA :
1 Tael = 6*s.* 6½*d.*

JAPAN :
100 Sens = 1 yen
1 Yen (gold) = { 4*s.* 2*d.* or 1 gold dollar of U.S.A.

SIAM :
1 Tical (silver coin) = 1*s.* 1*d.* or 50 dollar cents of U.S.A.

TURKEY :
100 Piastres = 18*s.*

URUGAY :
1 Peso (gold) = 100 centimo (4s 2d.)

EGYPT :
975 Milliemes or 97½ piastres = £1

GREECE :
1 Drachme (paper) = 100 lepta or 9*d.*

ZOOLOGICAL GARDENS CALCUTTA.

CHAPTER XXXVII.

CALENDARS OF WORK FOR CEYLON

I.—FOR JAFFNA AND NORTHERN PROVINCE.

(By S. Chelliah, Agricultural Instructor, Jaffna).

January.—Average rainfall 2·15 in. Gather in the crop of different kinds of yams. Plant tobacco seedlings, also chillies and brinjals. Plantains are generally planted out this month, also the betel creeper. The latter is the staple cultivation in the west of Jaffna.

February.—Average rainfall 1·31 in. Gather in paddy crops. Sow dry grains, such as gingelly, kurakkan, peas, kollu, etc., soon after the main crops are harvested. Lift palmyra kelengu (germinated seedlings), which are used as a vegetable. Water tobacco gardens and disbud (sucker) the plants.

March.—Average rainfall ·93 in. Gather paddy crops and plough vacant paddy fields. The season for extracting the juice from Palmyra palms is from now to the end of May. This occupation forms an important industry among the lower classes of the people. Manioc (cassava) roots are now lifted and dried, to be used for food as required.

April.—Average rainfall 2·35 in. Brinjals and chillies should now be planted. This is the time for planting out coconut plants. Gather dry grains sown in February. Gather and cure tobacco crops all over the North ; harvesting and drying of chillies must be done now also ploughing and manuring paddy fields and planting out betel.

May.—Average rainfall 2·01 in. This is the time for sowing the dry grain called "Tennai" (Italian millet) after the tobacco harvest is over, also for planting manioc (cassava) cuttings and different kinds of yams.

June.—Average rainfall ·79 in. Watering dry-grain crops in gardens will now be necessary, this being the dry season ; it is also the principal fruit season in Jaffna. Plucking areca-nuts will be continued to the end of December. This is the time when land owners make arrangements to have their garden lands cultivated with tobacco on lease.

July.—Average rainfall ·87 in. Reaping of dry grains sown in May will now proceed, also planting of betel, onions, etc. Palmyra fruit season begins, and continues to the end of September, during which time this forms a great relief to the poor as an article of food.

August.—Average rainfall 1·44 in. Sowing of paddy in fields, also sowing and transplanting of kurakkan in gardens, may be done this month.

September.—Average rainfall 2·80 in. This is generally a slack month and very little is done except the sowing of dry grains, as "varaku" and "kartu-samai" (*Setaria italica*) in Palmyra gardens. Palmyra nuts are put in for a kelengu crop.

October.—Average rainfall 6·66 in. Weeding of paddy fields, also transplanting and filling vacancies in these fields, should now be seen to. Paddy seedlings are bought at Rs.2 to Rs.3 a hundred bundles. Some people sow paddy thickly for the purpose of selling thinned out seedlings at this period. Till and manure fields for tobacco ; sow tobacco seed in nurseries. Fruit-trees may be planted at this season. Planting of areca-nuts may now be done. This palm is commonly planted around wells.

November.—Average rainfall 13·38 in. Generally a busy month for collecting green-manure for tobacco gardens, &c.

December.—Average rainfall 11·34 in. Planting tobacco all over the North should now commence. Onions are planted this month.

2.—CALENDAR FOR COLOMBO DISTRICT.

Average annual rainfall 88 inches ; mean annual temperature 80° F.

By C. DRIEBERG, late Superintendent of Low-country Products and Secretary, Ceylon Agricultural Society).

January.—Average rainfall for the month 3·54 in. A fairly dry and cool month, during which little planting is done. A good season for vegetable produce, the result of the previous October and November planting. Yams and gourds plentiful. Annuals now well in bloom.

February.—Average rainfall 2·08 in. A particularly dry month, during which no planting can be done. Seeds should be gathered and the soil worked up as crops go out Where plants are growing, the surface should be stirred to prevent loss of moisture, beds being copiously watered and, when necessary, shaded.

March.—Average rainfall 4·80 in. This is the month for cleaning, digging, and manuring the soil Occasional showers may be expected. Nurseries, where necessary, should be started.

April.—Average rainfall 11·03 in Planting begins with this month, when the rainfall is usually plentiful. All varieties of vegetables and flowers may be planted with good prospects of favourable growing weather.

May.—Average rainfall 12·04 in. South West monsoon rains begin towards end of month, when planting may be continued. Fruits (such as mangoes, oranges, pineapples, mangosteens, etc.,) begin to come in. Many flowering trees in blossom.

June.—Average rainfall 8·27 in. This is the best month of the South-west monsoon for planting generally. Weather fairly wet and hot. Many fruits in season.

July.—Average rainfall 4·61 in. Fruits begin to go out of season; vegetables of April to May planting begin to come in.

August.—Average rainfall 3·67 in. Slack month ; weather hot and generally dry. Vegetables fairly plentiful. Fruits mostly out of season.

September.—Average rainfall 5·03 in. Weather still dry. All crops fall off. Seeds should be collected, and land worked up for planting again. Nurseries should be started.

October.—Average rainfall 14·67 in. Second planting season begins with the North-east monsoon rains, which are now more or less general throughout the Island. All kinds of crops may now be started, and fruit trees also planted.

November.—Average rainfall 12·38 in. Planting may be continued. The best month for planting tomatoes and gourds in the low-country.

December.—Average rainfall 6·03 in. General vegetable produce begins to come in, also annual flowers. Weather generally cool.

3.—CALENDAR FOR UP-COUNTRY.

(By the late J. K. Nock, Curator, Hakgala Gardens.)

January.—Weather wet, with foggy mornings; latter half of the month often fine. Average rainfall 8·22 inches on 16 days. Mean temp. 58 deg. Fah. The month during which the finishing touches should be given to a garden. Drives, paths, etc., should be attended to. All general planting should be finished early in the month. Fork up frequently the surface of the ground around all young plants; afford mulching with leaf-mould or well-rotted cattle manure; a top-dressing of artificial manures mixed with fine soil should be given when possible. Liquid manure may be applied to pot-plants once a week, especially to flowering kinds. Phloxes, Verbenas, Petunias, etc., need pegging down as their growth advances. Remove superfluous buds from roses if fine blooms are required. Afford protection to tender plants against frost (as stated for December) during the nights of this and the next two months. Vegetable seeds of all kinds may be sown for keeping up a succession.

February.—Weather dry, with cold nights and mornings, and hot bright days. Average rainfall 3·05 in. on 9 days. Mean temp. 60 deg. Fah. Much watering is usually necessary. Liquid manure may with benefit be applied to bed and border plants. Supply vacancies where necessary. Weed and point over beds and borders frequently. Stake plants needing supports, e.g., Carnations, Antirrhinums, etc. Collect cattle dung for potting work, and cut and stack turf-clods; the latter should be placed grass-side down, with manure between each layer. Pot out flowering plants. Remove fruit capsules from rose bushes. Place clean straw under the Strawberries before they begin to ripen. Vegetables of all kinds, especially those of the cabbage tribe, may be sown.

March.—Weather dry. Average rainfall 4·54 on 9 days. Mean temp. 62 deg. This should be the brightest month in the flower garden up-country. Routine work as last month,—collect seeds as they ripen. If a lawn is to be made, prepare the ground early in the month for sowing in April, or for turfing in May or later.

April.—Weather showery. Average rainfall 7·62 in. on 16 days. Mean temp. 64 deg. Sow seeds collected last month, and continue collecting. Cut away dead stems, leaves, etc., from annuals, and pull out unsightly plants that have finished flowering, keep drains and culverts clear in case of heavy plumps of rain. This is the best month for sowing lawn-grass seed. Owing to the approaching monsoon rains, it is

not advisable to put down such vegetables as potatoes, peas, beans, and onions, until at least the end of July.

May.—Weather showery with strong wind, after the arrival of the South-west monsoon about end of month. Average rainfall 6·90 in. on 15 days. Mean temp. 65 deg. At the commencement of the month, stake all tall plants in exposed positions. Continue to collect and sow seeds. Where annuals have finished flowering, the ground should be dug up, manured lightly and prepared for planting out with seedlings in June or July. Advantage should be taken of the wet weather for planting pockets in banks, rockeries. etc. Repair turf of lawns where necessary. Except potatoes, onions, and peas, a few vegetables may be sown, although they are liable to be damaged by the strong wind and rain. These remarks apply also to June and July.

June.—Weather generally wet and constantly windy. Average rainfall 8·13 in. on 19 days. Mean temp. 62 deg. Plant up vacant corners and banks. Put in cuttings of all kinds, especially such as Verbenas and Petunias, which have finished flowering. Stack manure; where necessary lay down turf and repair verges. Prune shrubs and shape trees during this or the next month. Order foreign seeds so as to arrive by the end of August, for the next "flowering season", viz. February-May.

July.—Weather moderately wet, but still very windy. Average rainfall 6·02 in. on 19 days. Mean temp. 62 deg. The most difficult month in which to keep a garden tidy, owing to the prevailing strong winds. Clear up all rubbish, and place collected leaves in pits to rot and form leaf-mould. Continue planting banks, rockeries, etc. Divide and replant violets in open sheds. Prune fruit-trees generally. Prick out seedlings, and plant out when large enough. Plant-shed roofs should be made rain-proof. Most pot-plants will now require re-potting or top-dressing. When the weather is too hot for out-door work, all pots, pans, boxes, etc., should be thoroughly washed inside and out, and then put away to dry and be ready for the foreign seeds which are due to arrive at the end of next month. Collect good soil, and store away leaf-mould and dry cattle dung. Cuttings of all kinds do well if put in during this month. This is one of the best flowering months for Amaryllids and Liliaceous plants.

August.—Weather fairly dry and pleasant, though often windy. Average rainfall 4·43 in. on 17 days. Mean temp. 62 deg. The foreign seeds ordered in June should now have arrived, but must not be opened until everything is ready for sowing them, as most kinds deteriorate rapidly when exposed to the air. Whether pots, boxes, or sheds are used, the soil for sowing in must be fine, light and rich; a sprinkling of sand should be added to render it porous; dung should be rubbed through a sieve before mixing with the soil. Sow such seeds as Begonias, Campanulas, Carnations, Cyclamens, Gloxinias, Golden Feather, Petunias, Salpiglossis, Stocks, Sweet-Peas, etc. Sow small quantities at intervals, rather than all at once, keeping the balance in air-tight tins or bottles. Sweet-peas and Nasturtiums may be sown at once where they are intended to remain, the plants being afterwards slightly cut back so as to retard flowering. Cuttings of Verbenas, Petunias, etc., should be put in early in the month, so as to be ready for December planting. Supply vacancies in beds and borders. Prune shrubs and trees where necessary.

Fork up the soil among shrubberies, burying any decayed refuse. Top-dress or re-pot orchids. Vegetables of all kinds, except potatoes, may be planted out early in the month.

September.—Weather mild and pleasant. Average rainfall 5·78 in. on 18 days. Mean temp. 62 deg. Mulch annuals which have been planted out in June and July, especially those in un-manured beds. Continue supplying vacancies where they occur. Prick out seedlings, as they become large enough to handle, into boxes or beds under cover. Where the sowings in sheds have been too thick the seedlings must be thinned out, or all the plants will become weak and useless. More sowings should now be made of such seeds as Pansies, Phlox, Dianthus, Nemesia, etc. Sowings of Sweet-peas should be made again towards the end of month. Keep an eye on young Cinerarias and Stocks for a green caterpillar generally found on the underside of the leaves, also for green-fly; hand-pick the former, and fumigate, or syringe with soapy water for the latter. Dahlias should be taken up and stored in a dry place for a six weeks' rest before re-planting in November. Collect and stock manure. Sow vegetables of all kinds, except potatoes, which may suffer from the heavy rains that may be expected during the next two or three months.

October.—Weather usually wet in the afternoons with the advent of the North-east monsoon. Average rainfall 11·95 in. on 23 days. Mean temp. 62 deg. One of the most suitable months of the year for general planting. Plant up pockets in banks. Re-pot any plants that need it. Prune back Geraniums, Pelargoniums, etc.; water sparingly until new growth has commenced, then re-pot. Insert cuttings of all kinds. Sow succession of Sweet-peas towards the end of month. Put into small-sized pots Cinerarias, tuberous-rooted Begonias, Gloxinias, etc., increasing the size of pots each time of potting. Where annuals are wanted to be in bloom during the "season" (middle of January to end of May), these should be sown in succession from the end of October to end of January. Rose bushes here take two months to come into bloom from the time of pruning, so the latter operation should be carried out according to one's requirements. Vegetables as last month.

November.—Weather wet and dull, often with heavy plumps of rain. Average rainfall 11·29 in. on 21 days. Mean temp. 60 deg. Watch for pests, especially black-grub; the early morning is the best time to catch these. Slugs and insect pests are liable to be troublesome this month. Unslaked lime will destroy them. Green caterpillars are liable to attack Cinerarias and Stocks. The general planting up of beds and borders should be commenced as soon as the seedlings are large enough. Plant out roses, giving them a light pruning 3 or 4 weeks later. The weather during this and next month is generally suitable for budding and grafting. Sow vegetables of all kinds from now onwards.

December.—Weather often excessively wet and misty. Average rainfall 12·84 in. on 21 days. Mean temp. 58 deg. Weather conditions are generally against plant-growth, the days being sunless and misty, with an almost continual drizzle and heavy plumps of rain at intervals. "Damping off" and pests are prevalent. Constant attention must be directed to the destruction of pests and the supply of vacancies. Weeds

are apt to become troublesome this month. The surface of the soil should be frequently pointed over, as the continuous rain tends to cake it. Attend to potting of plants generally ; this should be about the last shift for flowering plants for the season. Replant strawberries. Cadjans or some similar material should be obtained for covering all plants that are susceptible to frost, which is now liable to occur at night at the higher elevations. Sow vegetables of all kinds.

4.—CALENDAR FOR THE MOIST LOW-COUNTRY & MEDIUM ELEVATIONS.

(By the Author).

The following general remarks may need modification according to weather, local circumstances, and elevation. For average rainfall in principal towns in Ceylon, see page 5.

January.—Weather generally dry, with strong north-east wind. Planting operations in the open should cease, as the dry season is now almost at hand. Collect fallen leaves on lawns, etc., and place in a deep trench to form leaf-mould. Order plants of roses, etc., from abroad, so as to receive them in April or May. Cloves are now in season. These should be collected before the buds open and spread out on mats to dry in the sun. Tamarinds, pineapples, and Cochin-goraka are fruits in season. *Congea tomentosa* still in flower.

February.—Usually the driest month of the year, with very dry, parching N. E. winds. The surface soil should be stirred up frequently so as to check the evaporation of moisture. Much watering will be necessary for pot-plants, shrubberies, beds and borders. Overhaul pot-plants and seed-boxes, and order new stock if required. Syringe pot-plants frequently, at least twice a day in hot, dry weather. Repair drives and paths, which work is best done now. Mulch surface soil among crops of all kinds. Where practicable, all plants with delicate leaves should be afforded partial shade. Do not water bulbous plants which may now be in a resting state. Flower seeds may be ordered from Europe. Star-apple, pineapple, and lovi-lovi in season. *Bombax, Jacaranda, Bignonia venusta, Gliricidia, Tabebuia, Petrea, &c.*, in flower.

March.—Weather dry and hot, and most trees, crops and tender plants suffer from drought. Towards end of month, plant out yams, sweet-potatoes, and similar root-crops. Watering, shading and mulching should be the order of the day. Loosen the surface soil frequently by a hand-fork where artificial watering is carried on. Syringe pot-plants morning and evening with clean water. Re-potting of plants should now be carried out. Fruits in season : Pineapple, pomegranate, cannon-ball tree, velvet-apple, Madagascar clove, &c. In flower :— *Jacaranda, Gliricidia, Spathodea campanulata, Bignonia venusta, Saraca declinata, Amherstia nobilis, Tabebuia spp., etc.*

April.—Weather hot and muggy, with frequent thunderstorms. Keep drains, water-channels and culverts clear of leaves and rubbish, and provide means of escape for excessive rain-water. Plant out yams and native vegetables of all sorts. Overhaul banana clumps, cutting out barren stems and dried leaves, and burying these round the plant

Oranges, jak-fruit, star-apple and bullock-heart in season. *Cassia grandis, Schizolobium, Bignonia unguis, Jacaranda, Poinciana* (Flamboyante), *Gliricidia, Sterculia colorata, Hippeastrums, Zephyranthes*, etc., in flower.

May.—The hottest month of the year. Prepare ground for all kinds of vegetable seeds. Procure sticks for supporting peas, beans, etc. Collect potting soil and store away as much manure and leaf-mould as possible before the South-west monsoon rains begin. Re-planting of flower beds and borders should be put in hand, the ground being first well trenched and manured. Fertilise Vanilla flowers now in season. Mangoes, cashew-nut, pineapples, papaws, etc., in season. *Dendrobium MacArthiae* ("Wesak-mal"), *Michelia Champaca* (Sapu), *Lagerstroemia Flos-reginae, Cananga odorata* (Ilang-ilang), *Cassia nodosa, Poinciana regia, Petrea*, &c., in flower.

June.—If not already arrived, the south-west monsoon is due early in the month. As soon as rainy weather begins sow English vegetables and flower seeds of all kinds. Mow lawns and dig out white-ants' nests. Dig up, manure, and re-plant borders, flower-beds, &c. Renovate rockeries and ferneries, applying fresh soil if necessary. Overhaul foliage plants, &c., in pots, and re-pot those that require it. Principal fruits in season:—Mango, mangosteen, pineapples, oranges, kamaranga, jambu, bread-fruit, cashew-nut, Java-almond, nam-nam, sandoricum, soursop. Flowers in season:—*Lagerstroemia Flos-reginae, Cassia nodosa, Peltophorun ferrugineum, Kleinhovia*, etc.

July.—Weather usually cool, with moderate rainfall. Plant out fruit, shade, and other useful or showy trees, also general ornamental plants. Attend to propagating work of all kind. Keep down weeds. Earth up root-crops, and stake peas, beans, etc. Mow and roll lawns. Budding and grafting work may now be undertaken. Prune roses which are finished flowering. Flower seeds may be ordered from Europe for sowing in September. Fruits in season:—Mangosteen, pineapples, mamme-apple, durian, bread-fruit, Cochin-goraka. Flowers in season: *Pometia eximia, Porana volubilis, Fagraea fragrans, Ipomoea, Petrea, etc.*

August.—Weather moderately dry. Gardens in the low country should be at their best during this month. Attend to general weeding of vegetable and flower gardens, also mowing of lawns. Fork up surface soil between crops, also of beds and borders generally. Attend to the lopping of shade trees which have exceeded their proper limit. Principal fruits in season:—Avocado-pear, mangosteen, durian, sapodilla, guava, oranges, goraka, &c. In flower: *Cassia Fistula, Solanum macranthum, Spathodea*, Teak, etc. Hevea seed in season.

September.—Usually a fairly dry month. Renovate flower-beds and borders, affording mulch to the surface; tie up tender stems or heavy flowers to neat stakes. Fresh sowing of English vegetables and annuals should now be made. Repair drives and paths. Fruits in season: Oranges, papaws, pineapples, Ceylon-gooseberry, lovi-lovi, soursop, &c. In flower: *Cassia multijuga, Spathodea, Gloxinia maculata, etc.*

October.—Usually the wettest month of the year. See to the planting of shade, fruit, and wind-belt trees; also of ornamental plants generally. This is a good month for transplanting as well as general planting work. Prune shrubberies, fruit trees, etc. Attend to propagating work

of all kinds, also to the re-potting of ornamental plants. Principal fruits in season: Oranges, pineapples, voa-vanga, soursop, custard-apple, bullock's-heart, papaw, and nutmeg (second crop). Principal flowers: *Vanda spathulata, Spathodea, Congea, &c.*

November.—Weather usually wet and fairly cool. All general planting work should be completed this month. Pruning or thinning out of shrubs, trees, etc., should now be attended to. Sow peas, beans, beet and other vegetables. Yams are now ripe and should be lifted and stored in sand, in a cool shed. Attend to pollinating Vanilla flowers, now in season. Prune roses that have finished flowering. See to drainage and soil requirements of pot plants. Principal fruits in season: Papaws, oranges, bullock's-heart, pineapple, soursop, &c. Flowers: *Aristolochia* (several spp.) *Palicourea, Acalypha sanderiana, Petrea,* etc.

December.—Generally a fairly wet month, often with strong wind. Support all tender plants and young trees in exposed situations, fixing a stout stake in the ground close to the plant, and tying up the latter. Afford shade to such plants as require it, in view of the approaching dry season. Collect seeds of flowering plants, annuals, etc., and store when dry in stoppered jars. Collect fallen leaves and place them in a pit or trench to form leaf-mould. Several trees drop their leaves for a short period during this and next month. Collect all fallen leaves and place in a pit to form leaf-mould. Principal fruits in season: Custard-apple, wood-apple, *Dillenia indica,* and *Elaeocarpus edulis.* Flowers: *Wagatea spicata, Naravelia zeylanica, Pachira insignis, Wormia Burbidgei, Mussaenda, Petrea, Congea,* etc.

GLOSSARY.

Adventitious, abnormal, as buds or shoots which arise out of an unusual position.
Ala, Sinhalese for yam, bulb, or tuber.
Albuminoid, see protein.
Alburnum, see sapwood.
Angiosperms, one of the two great divisions of phanerogams or seed-bearing plants, which possess true flowers and ovules enclosed in a carpel, as distinct from gymnosperms, which have no true flowers and in which the ovules are not enclosed in carpels.
Annual, a plant which completes its life cycle, including flowering and fruiting, within one year.
Aquatic, specially adapted for growing in water ; a water plant.
Arboretum, a place assigned to the culture of trees, generally in systematic order.
Air-plants, applied to epiphytic plants, especially Bromeliads, Orchids, &c.
Aril, an expansion or growth from the placenta enveloping the seed, *e.g.* mace of the Nutmeg, also in Rambutan, Akee, &c.
Assimilation, the formation of organic substance from carbon dioxide and water by green plants in sun-light; the conversion of crude food into plant substance. See p. 13.
Asweddumize, to clear ground and bank up for irrigation, as in paddy cultivation.
Attaps, plaited leaves of palms, especially *Nipa*, used for thatching, &c., in Malay. See page 362.
Awn, a bristle-like appendage on the glumes of grasses, corn, &c.
Axil, the angle formed between the axis and any organ which arises from it, as a leaf or shoot.
Balati, foreign (Hindustani). See also *Rata*.
Balm, a fragrant exudation of certain plants used in ointments for healing or for soothing pain.
Balsam, a semi-fluid, viscid, fragrant gum obtained by exudation from certain plants, valued in medicine, &c.
Balut, Malay term for gootee or marcottage method of propagation.
Barbecue, a drying ground for gathered crops, as for coffee, cocoa, copra, &c., close to the store or factory.
Bast, a fibrous tissue used for tying purposes ; especially the fibrous inner bark (phloem) of certain trees.
Biennial, a plant which requires two years to complete its life cycle, flowering and fruiting only in the second year.
Bipinnate, twice pinnate, as when both primary and secondary division of a leaf are pinnate ; see pinnate.
Blight, an epidemic, generally of minute fungi (moulds) or of insects.
Blood-sucker, a large lizard.
Bloom, the white waxy covering on certain fruits, *e.g.* grapes ; also applied to blossom or inflorescence.
Bole, the trunk or base of a tree.
Boll, fruit capsule or pericarp, as of the cotton plant.
Bonchi, Sinhalese for young beans, from boontje (Dutch).
Boutique (Portuguese), a native shop or kaddie ; in India, a bazaar.
Bract, a modified leaf, intermediate between the calyx and normal leaves.
Bulb, a modified stem covered at base with fleshy modified leaves or scales folded round the central bud, forming (a) a *scaly bulb*, as in Lilium, or (b) a *tunicated bulb*, as in onion. See also corm.

Budding, a mode of propagation in which a bud from one plant (scion) is inserted under the young bark of another (stock). See p. 43.

Bullate, a leaf-surface in which the parts between the veins are raised like blisters.

Bund, a raised bank or dam surrounding a reservoir, tank, or irrigated field.

Burr, a rough prickly covering of fruits or seeds.

Cabook, a Ceylon word, of Portuguese origin, for laterite or moorum of India; a red ferruginous clay or marl which hardens on exposure. Common in low-country and often used for building, &c. See p. 10.

Cadjan, a plaited coconut-leaf split from the midrib. See p. 515.

Caffeine, the active principle of coffee; also found in kola-nut, &c.

Calcareous, lime-stone or chalky soil.

Callus, an outgrowth of tissue formed to cover a wound or a cut, as at the base of a cutting when planted.

Calyx, composed of sepals; the outermost circle or envelope of a flower.

Cambium, a thin layer of formative tissue between the wood and bast, adding elements to both, viz. wood (xylem) on the inner, and bast (phloem) on the outer side. See p. 410.

Canker, a fungus disease generally indicated by malformed bark with swollen cushion-like margin and depressed centre.

Capsule, a dry dehiscent fruit, naturally bursting open when ripe.

Caterpillar, the larva of a moth or butterfly (*Lepidoptera*).

Carpels, component sections of a fruit or ovary; the pod of a bean consists of a single carpel.

Centreing, to cut out centre of bush or tree, as in Tea or Coffee, to induce a spreading bush.

Chatty, an earthenware vessel.

Chena (Sinh.); "ladang" (Malay); "jhuming" (Hind.); see p. 31.

Cheddy, scrub; secondary vegetation, after a clearing of jungle.

Chekku, a crude oil-mill worked by bullocks.

Chlorophyll, the green colouring matter of plants, formed under the influence of sun-light. See pp. 12, 13, 15, 499.

Chlorosis or pallor, loss of colour; blanching of normally green tissues, or the turning green of petals, as in a green rose.

Chunam (Sinh. & Tam.), lime, either slaked or unslaked.

Cob, fruit of maize.

Cladode, a branch or shoot simulating a leaf, *e.g.* *Asparagus*, *Casuarina*, some *Phyllanthus spp.* See also phyllode and phylloclade, and pp. 123, 128.

Collar, the ground-line or neck of a plant; the imaginary boundary between the above and underground portion of a plant.

Compound, the garden or ground round a bungalow.

Cone, fruit of a pine-tree, with scales.

Coppicing, the periodical cutting back of trees, as often practised in street or road-side trees; secondary or ratoon growth in forestry.

Corm, a bulb-like fleshy stem; a "solid" bulb. See under Bulb.

Corn, cereals generally; in the United States, maize; in Scotland, oats.

Corolla, the inner, usually coloured, envelope of modified leaves of a flower.

Cortex, the inner or live portion of bark, the outer scaly or corky portion being the true bark. See p. 11.

Coumarin, the odour of new-mown hay. See *Dipteryx* and *Gliricidia*.

Creeping, growing along on the soil surface or on walls, and rooting at the nodes, as distinct from climbers which ascend by means of tendrils, spines, twining stems, and other means.

Cross, the offspring resulting from two flowers of different but allied varieties by cross pollination, as distinct from hybrid, which is a cross between two species or, in some cases, genera.

Culm, the hollow stem or "straw" of grasses and grain crops.

Cryptogams, the division of spore-bearing plants comprising ferns, fungi, etc., which are destitute of stamens, pistils, and true seeds, but usually reproduced as a result of a sexual act. See *prothallus*.

Deciduous, periodical falling of leaves, as at beginning of dry season in the Tropics, or in the cold season in cool countries.

Dicotyledons, one of the two main divisions into which flowering plants (Angiosperms) are classed (the other being *Monocotyledons*), characterised by the possession of 2 cotyledons or seed-leaves. See p. 11.

Dioecious, the male (staminate) flowers on one plant, and female (pistillate) flowers on another, as usually in Carica and many tropical trees and palms. See p. 13.

Dormant, resting, not in active growth ; usually deciduous.

Duramen, heart-wood of an exogenous (dicotyledonous) stem which has become hardened and often coloured by deposits of tannic acid, &c., as distinct from sap-wood.

Ear, spike of grain, as in corn or paddy.

Ecology, the study of plant-life in relation to environment.

Economic botany, concerning the uses or technical application of plants.

Economic plants, applied to species which are of use to man, directly or indirectly as distinct from plants which are merely ornamental.

Endemic, confined to a given region, as an island or country.

Endocarp, the innermost layer of a pericarp or outer covering of certain fruits, *e.g.* edible portion (copra) of the coconut.

Endosperm or albumen, the contents of a seed in flowering plants (Angiosperms) surrounding the embryo ; in some cases, as in Legumes, the whole seed is filled with the embryo or cotyledons. See p. 13.

Epicarp, external layer of a pericarp.

Epiphyte, a plant which grows upon another either for support or in order to reach light and air, but not parasitically ; an "air plant." See *Terrestrial*, also p. 143.

Esculentus, edible ; used in botanical names.

Evanescent, lasting only a short time, as flowers. See fugacious.

Exogens, formerly applied to plants which increase in growth by addition of wood on the outer side, beneath the bark ; dicotyledons.

Exudation, a discharge of viscid or milky substance from plants, *e.g.* gums, resins, rubber, etc., spontaneously, through wounding or from incisions made in the bark.

Fairy-rings, circles of light or deep green in pastures caused by a fungus which, dying out from the centre, spreads in circles. See p. 71.

Fan palm, a palm whose leaves are not pinnate or divided to the midrib or rachis, *e.g.* Licuala, Livistona, Corypha, &c.

Farina, starch or starchy matter, as arrowroot, sago, &c.

Farinaceous, of the nature of starch or containing starch ; mealy.

Fasciation, a bundle or fascicle caused by abnormal growth due to a form of disease or galls. See p. 500.

Fertilisation, the action of pollen (from the anthers) upon the pistil through the stigma. See also pollination.

—, cross-, fecundation by pollen from a flower of another individual, generally of same or allied species..

—, self-, the action of pollen upon the pistil of its own flower or on that of another flower of the same plant. See p. 12.

Filament, the stalk of a stamen, bearing one or more anthers. See p. 12.

Flagging or wilting, hanging loosely, without normal rigidity, as owing to insufficient water in the tissues, or to excessive watering causing an unhealthy condition of the roots.

Flush, the periodical production of young shoots, as of Tea in bearing ; a sudden rise of sap after a dormant period.

Flowering-plants, phanerogams or seed-bearing plants, as distinct from cryptogams (comprising ferns, fungi, &c.), which produce spores but no seeds.

Foetid, smelling strongly and disagreeably.

Fossil, the remains of a plant (or animal) changed into stone ; fossilised.

Fugacious, fleeting, soon perishing, as flowers ; evanescent.

Gecko, a small creamy-white lizard which inhabits bungalows and appears chiefly at night.

Genus, see under species.

Gluten, a tough protein substance occurring in grain, as distinct from starch.

Go-down, a store-room or out-house.

Goiya, a Sinhalese farmer or cultivator. See *Ryot*.

Gootee, see marcottage, also p. 39.
Gourmandisers, strong shoots or suckers issuing from near the base of the stem, as in Cocoa, Coffee, &c. See p. 40.
Grandiflorus, large-flowered, used in botanical names.
Gregarious, applied to plants of one kind which occur naturally in close proximity, in considerable numbers, sometimes to the exclusion of other kinds. Gregarious flowering, applied to plants which flower simultaneously after a number of years, as species of Bamboos, Strobilanthes, &c.
Grubs, the larvae of beetles and weevils (*Coleoptera*); maggots, the larvae of flies (*Diptera*).
Gum-resin, a semi-solid or viscid sub-resinous exudation from certain plants.
Gur, see jaggery.
Gymnosperms, a division of seed-bearing plants including Fir-trees, Cypress, Cycads, &c. See under Angiosperms.
Hakuru, see jaggery.
Halophytes, plants specially adapted to sea-shores; salt marsh or salt-loving plants.
Herbaceous garden, a section of a botanic garden devoted to herbaceous or herbaceous-perennial plants, planted in their natural orders.
— plants, those with perennial rootstock and succulent stems which die down periodically; in cold countries they die down in winter to the crown or rootstock.
Heart-wood, the inner hard portion of wood of a dicotyledonous plant, no longer useful for conducting sap, generally distinguished from sap-wood by its darker colour.
Herbarium, a collection of dried specimens of plants, mounted on sheets of paper and systematically arranged and named.
Hermaphrodite flowers, both pistil and stamens in one. See p. 13.
Hilum, see under micropyle.
Humus, decomposing organic matter in the soil; see pp. 6, 8.
Hybridisation, the crossing or blending of two different species by the action of the pollen of one species on the pistil of another, the resulting plant being a hybrid. See p. 46, also Cross-fertilisation.
Incompletae, applied to a group of plants whose flowers are either without a corolla or calyx (incomplete), as in Urticaceae, Euphorbiaceae, &c.
Inflorescence, a collective term for flowers, when several are borne on one main axis.
In situ, sowing at stake, or where a plant is intended to remain.
Internode, the space between two nodes or joints of a shoot.
Jaggery, palm sugar, hakuru (Sinh.), karupoti (Tamil), gur (Hind.). See pp. 360, 363.
Jat, a variety or kind.
Kaddie or Kaddai, a boutique; a native shop.
Kangani, a native foreman.
Kai, ripe fruit; often used in Tamil names; "pallam" denotes unripe fruit.
Karupoti, see jaggery.
Katti (Tamil), a knife of any kind.
Kelengu, Tamil for yam, bulb, or tuber,
Kernel, seed or "stone" of a fruit, especially an edible seed enclosed in a shell.
Kharif, an autumn crop in India, sown just before the South-West monsoon and harvested in August or September.
Kurumba (Sinh.), an immature coconut, containing a refreshing, clear liquid. See also Tambili.
Lamellae, the gills of a mushroom or toadstool. See p. 221.
Lamina, a thin plate or layer; the blade of a leaf.
Larva, an insect in the stage between the egg and pupa or chrysalis. See caterpillar.
Latex, the milky juice of plants, as of Hevea, Ficus, Euphorbia, &c.
Layering, the rooting, as by artificial means, of a branch whilst attached to the parent plant. See pp. 38, 39.
Legume, a pod; a single carpel fruit, as in peas and beans, belonging to the family of legumes.
Lianas or lianes, great woody climbers found in the tropics. See p. 132.
Lichen, a cryptogamic compound-plant, without stem or leaves, formed by union of an alga and fungus, growing on rocks, trees, &c., or in water.
Lilies, commonly applied to plants of Amaryllideae, Liliaceae, Nymphaeaceae, &c.; strictly speaking, Liliums only.

Lines, houses of native labour force, usually built in double rows with a single central wall.
Maguey, a general South American term for Agave.
Maha-crop (Sinh.), the larger or principal crop of N. E. monsoon season, as distinct from "yala" or small crop, the former being sown in September or October and harvested in February or March. See under Rice.
Malacophilous, see *Snail-plants*.
Mamoty, a large hoe ; see p. 60.
Maram (Tamil), a tree; used as an affix in Tamil names.
Marcottage, a method of propagation by a form of layering. See gootee, p. 39.
Medullary rays, plates of open cellular tissue radiating from the pith to the cortex ; the "silver grain."
Mesocarp, the middle part of the wall or husk of a fruit, between endocarp and epicarp. See p. 418.
Mesophyll, the interior or parenchyma of a leaf, under the epidermis.
Micropyle, a small opening, often dark in colour (scar or hilum), in ovule, through which the radicle emerges in germination. See p. 35.
Monocotyledons. See *Dicotyledons*. Plants with one cotyledon or seed-leaf, the leaves being usually parallel-veined, not net-veined as in dicotyledons.
Monoecious, with male and female flowers on same plant, as in many gourds (Cucurbitaceae). See also *dioecious*, and p. 13.
Mother plant, a parent-plant from which vegetative portions have been derived.
Mycelium, see spawn, also p. 491.
Mycorhiza, a fungus whose hyphae take the place of root-hairs on its host plant, growing symbiotically with the latter, as in orchids. See p. 144.
Myrmecophilous, a plant having hollow tubers, internodes, petioles, spines, or other adaptations which harbour ants for mutual benefit. See p. 464.
Naturalised, a plant of foreign origin but thoroughly established and reproducing itself as though indigenous.
Nectar, a sweet fluid excreted from various parts of a plant ; in the flower it is called honey.
Nematodes, minute worms or grubs, many of which are injurious to plants. See p. 481.
Nidus, literally a nest ; a favourable spot for a seed or spore to germinate in.
Nitrification, the building up by a nitric ferment of nitrites and nitrates, the reverse process being de-nitrification.
Node or joint, the part (often swollen) of a stem from which normally arises a leaf or a whorl of leaves.
Nucleus, the central part of an ovule in which the embryo plant is generated ; an essential part of a plant cell.
Officinal or official, applied to medicinal plants, such as are procurable at apothecaries' shops.
Offset, a lateral shoot used for propagation.
Ola, immature leaves of "talipot" and "palmyra" palms, bleached, and used for writing on by means of an iron stylus. See *Talipot* ; also p. 433.
Ovary, that part of the pistil which contains the ovule or ovules, which on being fertilized become the seed or seeds.
Pabco thermo-gen mulch, a thick, black, felt-like material used largely in Hawaii as mulch or ground-cover in pine-apple cultivation; recommended for checking evaporation and growth of weeds. See p. 616.
Pachwai, an intoxicating beer made from rice in India.
Pallam, see Kai.
Pallor, see chlorosis.
Parasite, a plant which grows and lives on another plant, deriving nourishment from its host, as fungi and *Cuscuta*. See p. 474.
—, Semi-, a plant living upon another, but bearing green leaves and therefore not entirely dependent on it, *e.g. Loranthus, Mistletoe, Viscum*, &c.
Patana, a grassy expanse almost or quite devoid of trees.
Pedicel, the stalk bearing a single flower, sometimes absent, as in *Compositae*.
Peduncle, the main stalk of a group of flowers.
Peltate-leaf, *e.g.* Nelumbium, Colocasia, Macaranga, &c. See p. 295.
Perennial, a plant which lasts three or more years, as distinct from annuals and biennials.

Perianth, the calyx and corolla, specially when both are similar. See p. 12.
Petaloid, petal-like ; sepals, stamens, or leaves assuming the appearance of petals. See p. 500.
Petiole, the stalk of a leaf, sometimes absent, *i.e.* the leaf is *sessile*.
Phanerogams or Flowering plants, the higher orders of plants in which flowers with stamens and pistils are distinctly developed. See Angiosperms.
Phylloclade, a stem structure usually flattened, assuming the functions of a leaf, *e.g. Muehlenbeckia, Semele*, &c. See also cladode and phyllode.
Phyllode, a flattened petiole resembling a leaf, *e.g. Acacia melanoxylon*, and other species of Acacia in seedling stage.
Phloem, the outer part of a vascular bundle, conducting prepared food.
Pileus, the umbrella-like expansion of a mushroom or toadstool. See p. 321.
Pillu, Tamil for grass or weeds.
Pinnate, applied to leaves with divisions reaching to the midrib, like a feather ; if twice divided, it is bipinnate, *e.g.* many species of Acacia and Cassia.
Pinnatifid, pinnately cleft (a leaf), not divided to midrib.
Pip, a popular name for small seeds ; also for seeds of apple, orange, &c.
Pistil, the female organ of a flower, consisting of ovary, style, and stigma when complete. See *Incompletae*.
Pita, a South American term for Bromeliad fibre. See p. 431.
Pitch, a resinous, tar-like exudation from the Spruce tree.
Pitcher-plant, *Nepenthes*, whose leaves end in a distinct pitcher with a lid ; also *Sarracenia*, in which the whole leaf is formed into a pitcher.
Pith, the centre of a young exogenous stem ; soft, cellular, spongy wood. See Pith-tree.
Plumule, the primary stem-bud of an embryo as it develops from the seed in germination. See p. 13.
Pollen, the fertilising dust-like powder produced by the anthers of flowering-plants.
Pollinate, to apply pollen to the stigma or receptive surface of the female organ ; pollination. See pages 12, 471.
Proliferation, generally an abnormal growth, as a leaf or flower growing out of another leaf or flower, *e.g.* the Rose in some cases. See p. 500.
Protein, a complex organic compound formed in the leaf, or grain, *e.g.* the aleurone layer of paddy grain.
Prothallus, a leafy expansion resulting from a germinated spore and bearing sexual organs. See Cryptogam, also under Spore.
Protoplasm, a transparent substance in the cells of animal and plant tissue ; the basic principle of live matter.
Pulp, the juicy or fleshy tissue of fruit.
Pulse, a common name for small peas or gram crops. See p. 285.
Quintane, a long narrow hoe, similar to a mamoty. See p. 60.
Rabi-crop, spring crop in India, sown during the North-East monsoon and harvested in March or April.
Raceme, an inflorescence in which a number of flowers with short pedicels (stalks) of equal length are arranged on a common axis or central stalk.
Radicle, the rudimentary root of the embryo which first appears through the seed in germination. See p. 13.
Ragi (*Eleusine*) crop or season, end of June to end of August (India).
Rata, foreign (Sinh.) ; used as a prefix to vernacular names. See *Seemai*.
Ratoon, a shoot (or shoots) from a plant or crop that has been cut down, as Sugarcane and Indigo, after first harvest ; a secondary crop. Some crops may be grown from ratoons for several years.
Resin, a solid inflammable exudation from certain plants, valuable in varnishes, &c. See gum-resins, p. 411.
Retting, steeping in water in order to free fibre from the cellular portion, as in the preparation of fibre from jute, flax, coconut-husks, &c.
Rhizome, a creeping stem, above or under ground, with buds or eyes, and scales representing leaves, often resembling a tuberous root, *e.g.* Canna, Arrowroot, Cardamom.
Root-pressure, the forcing up of fluids into the xylem (wood elements) to all parts of the plant or tree. It has not yet been discovered how this is effected, though osmotic pressure is considered to play some part in it.
Root-stock, under-ground stem or crown ; a short rhizome or cluster of rhizomes.

Rostellum, the part of a monandrous orchid flower representing the suppressed third stamen. See p. 343.
Runner, a stolon ; an elongated lateral shoot, rooting at the nodes, as strawberry, sweet-potato, &c.
Ryot, Indian (= goiya, Sinh.), a peasant cultivator or farmer.
Samara, fruit of *Dipterocarpus*, *Myroxylon*, &c.
Sap, the juice of a plant ; water, with its dissolved mineral substances, absorbed by the roots and thence through the stem, &c., to the leaves.
Sapwood, the new wood of an exogenous tree through which water and sap are conducted ; the alburnum or portion of stem outside the heartwood.
Sapling, a young tree.
Saprophytic, living on decaying vegetable matter ; a saprophyte. See p. 491.
Scion, the upper shoot or twig used in grafting and representing the kind it is desired to propagate, the lower portion growing on its own roots being the stock. See under Stock, also p. 42.
Seedling, a young plant raised from seed, as distinct from a grafted or budded plant or a rooted cutting.
Seemai, foreign (Tamil), used as a prefix to vernacular names. See *Rata*.
Seet, the sediment obtained after the extraction of indigo from the leaves and stems.
Shuck, sick, not thriving ; " out of sorts " or " off colour."
Snail-plants, those whose flowers are supposed to be fertilised by snails ; malacophilous plants.
Solitary flowers, not in clusters ; borne singly.
Spathe, a large bract or sheath, enclosing a flower stalk or spadix, as in palms, aroids, &c. The male and female flowers, usually separate, are embedded in the spadix.
Spawn, mycelium ; mushroom " spawn " made up in the form of brickettes, &c., permeated with the mycelium of the mushroom-fungus.
Species, the unit of classification, a collection of species forming a genus ; from groups of the latter (genera) are made up Natural Orders, Tribes, Divisions, &c.
Sporangium, a receptacle containing spores, as in ferns, etc. See p. 37.
Spore, the analogue of seed in fungi or cryptogams; a cell capable of direct germination into a prothallus, a flat, leafy expansion bearing sexual organs. See Prothallus.
Sporophyll, a special form of leaf or frond which bears spores, as in " flowering " ferns.
Sport, a variation starting from a bud or seed.
Sprout, the germination of seed ; the development of new shoots.
Stamen, the pollen-bearing part of a flower, consisting usually of filament and anthers.
Sterile, barren, as a flower destitute of pistil, or stamens without anthers.
Stigma, the receptive part of the pistil or style which receives the pollen.
Stilt-roots, roots developed from the stem of certain trees, reaching to the ground and then developing normal roots, as in Mangroves, Pandanus, &c.
Stock, in grafting, the root-bearing plant or portion in which the scion is inserted. See scion, also p. 42.
Stoma (plural stomata), a breathing pore or aperture in the epidermis of leaves, &c., through which respiration and transpiration take place.
Stool, a plant from which offsets or layers are taken ; rhizome.
Storax, a fragrant gum-resin obtained from certain trees and used in incense, medicine, scent, &c. See Benzoin, Bursera, &c.
Strain, a variety which differs from the race or type.
Strike, to emit roots, as from a cutting.
Stringy-bark, an Australian general term for different species of Eucalyptus.
Strobilus, a cone ; an inflorescence made up of imbricated scales, as in firs, " horse tails " (*Equisetum*), *Selaginella*, &c.
Style, the part of a pistil or carpel, usually attenuated, connecting the ovary and stigma.
Sucker, a shoot or stem which springs from a subterranean portion of a plant.
Talipot (from Sanskrit and Hindu). The popular name of a very large, erect, stout palm (*Corypha umbraculifera*) a native of the moist low-country of Ceylon and Malabar. The " talipot " grows to a height of 60 to 80 feet, with a

straight cylindrical trunk, sometimes 3–4 ft. in diameter, surmounted by a crown of immense fan-like leaves, which are used for olas, large fans, umbrellas, or sun-shades, &c. A single leaf blade at full size may be as much as 16 ft. in diameter, with a stout petiole 15 ft. long. The palm, under favourable conditions, takes 15 to 20 years to show a stem, sometimes 25 years or more. At the age of about 40-60 years it produces an enormous pyramidal panicle of creamy white inflorescence, 14 to 15 feet high, which first appears as an erect pole issuing from the centre of the crown; this is followed about 8 months later by the large, hard, marble-like fruit, followed about 12 months later still by the death of the palm. The leaves become gradually smaller as the palm approaches the flowering stage, withering and falling back along the stem, and finally dropping off, leaving only the fruiting panicle at the top. See pp. 165, 167, 168, 170, 413, 433, 461, 516.

Tambili, the immature yellow nut of the "King-coconut," furnishing a pleasant refreshing drink. See Kurumba.

Tap-root, the primary descending root, forming a direct continuation of the radicle.

Tari, see toddy.

Tendril, a slender, filiform, spiral, or hooked shoot affording a plant a means of obtaining support by climbing up trees or other bodies. See p. 11.

Terrestrial, applied to orchids, &c., which grow on the ground, in distinction from those which grow on trees (epiphytes).

Testa, the outer hard coat of a seed.

Thein, the bitter tonic forming the active principle of tea.

Theobromine, the active principle of cocoa.

Tillering, spreading by throwing out stems from the base of the plant, as in growing corn, rice, &c.

Toddy, (from tari), the unfermented juice of certain palms. See pp. 361, 362.

Touchwood, dry decayed wood permeated with fungus mycelium.

Transpiration, the exhalation of watery vapour from the stomata of plants, as distinct from evaporation. See p. 13.

Tuber, a thickened rhizome or stem, usually underground, bearing "eyes" or buds, *e.g.* Arrowroot. See *bulb*.

Tussock, a tuft of grass, or grass-like plants.

Unisexual flower, a flower containing either stamens or pistil, but not both, the other sex being in another flower on the same or different plant. See *dioecious* and *monoecious*, also p. 327.

Variety, a sort or modification subordinate to a species; a jat.

Vascular system, distinct tissues of a stem, branch or leaf which are especially concerned with the conduction and circulation of water and sap and give rigidity; in young shoots, it is generally formed of *vascular bundles* or *strands* (xylem and phloem). In dicotyledonous stems these unite and form a cylinder; in monocotyledons they are scattered throughout the pith, as plainly seen in a cross-section of a palm stem. In leaves they are known as *veins*, see following para.

Veins, fine fibro-vascular strands traversing the blade of a leaf, either in parallel or net form. They vary in arrangement in different species, and are therefore of importance in the identification of plants. See preceding para.

Vitamines. Organised ferments, present in small quantities in most natural foods, but chiefly in fresh or green vegetables and uncooked fruits, certain oils and fats. Three different kinds of vitamines have been discovered, viz. (1) *anti-ricketts*, as in fresh butter, lettuce, and cod-liver oil (deficient in margarine, lard, skim milk, bran, &c.); (2) *anti-beri-beri*, as in seeds, bran, eggs, &c. (deficient in polished rice, tinned foods, butter, &c.); (3) *anti-scorbutic* or *anti-scurvy*, as in fresh vegetables and fruit (deficient in tinned food, dried peas, lentils, haricot-beans, manufactured lime-juice). A mixed diet is therefore essential, especially in growing persons or animals, in order to ensure proper nutrition and freedom from certain diseases. Vitamines are destroyed or reduced by heat or desiccation.

Wal (Sinh.), common or wild, used as a prefix in vernacular names.

Water plants, those growing in water, immersed wholly or in part. See aquatic plants.

Weed, a plant in the wrong place; generally a plant which rapidly reproduces itself in large numbers and, if not checked, supersedes or destroys cultivated crops; a pest. See p. 471.

Weeping, pendulous in habit, as species of Willow (*Salix*), Cypress (*C. funebris*, *Schinus*, &c.

Wel or Vel, climber or creeper ; used as affix in Sinhalese names.

Whorls, circles of 3 or more leaves, shoots, or branches, each circle issuing from one point, *e.g.* in branching of the Kapok tree.

Witches' Broom, a disease shown by tufts of abnormal shoots, due to attack by fungus or mites. See p. 498.

Xerophyte, a plant with special characters adapted to withstand loss of water by reduced transpiration ; especially a plant naturally adapted to a dry region ; a desert plant.

Xylem, the wood elements of a vascular bundle ; the true wood, associated chiefly with the upward conduction and storage of water.

Yala-crop, the S. W. monsoon crop, sown in April or May and harvested in August or September. See *Maha-crop*.

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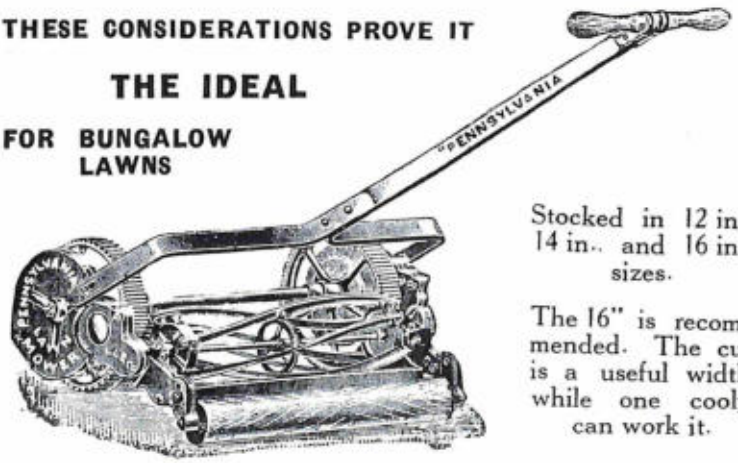
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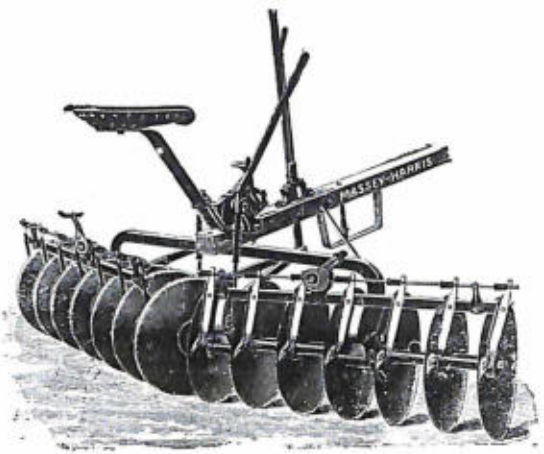
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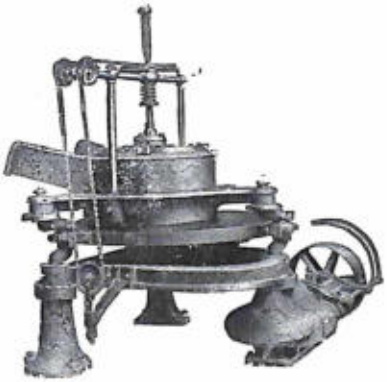
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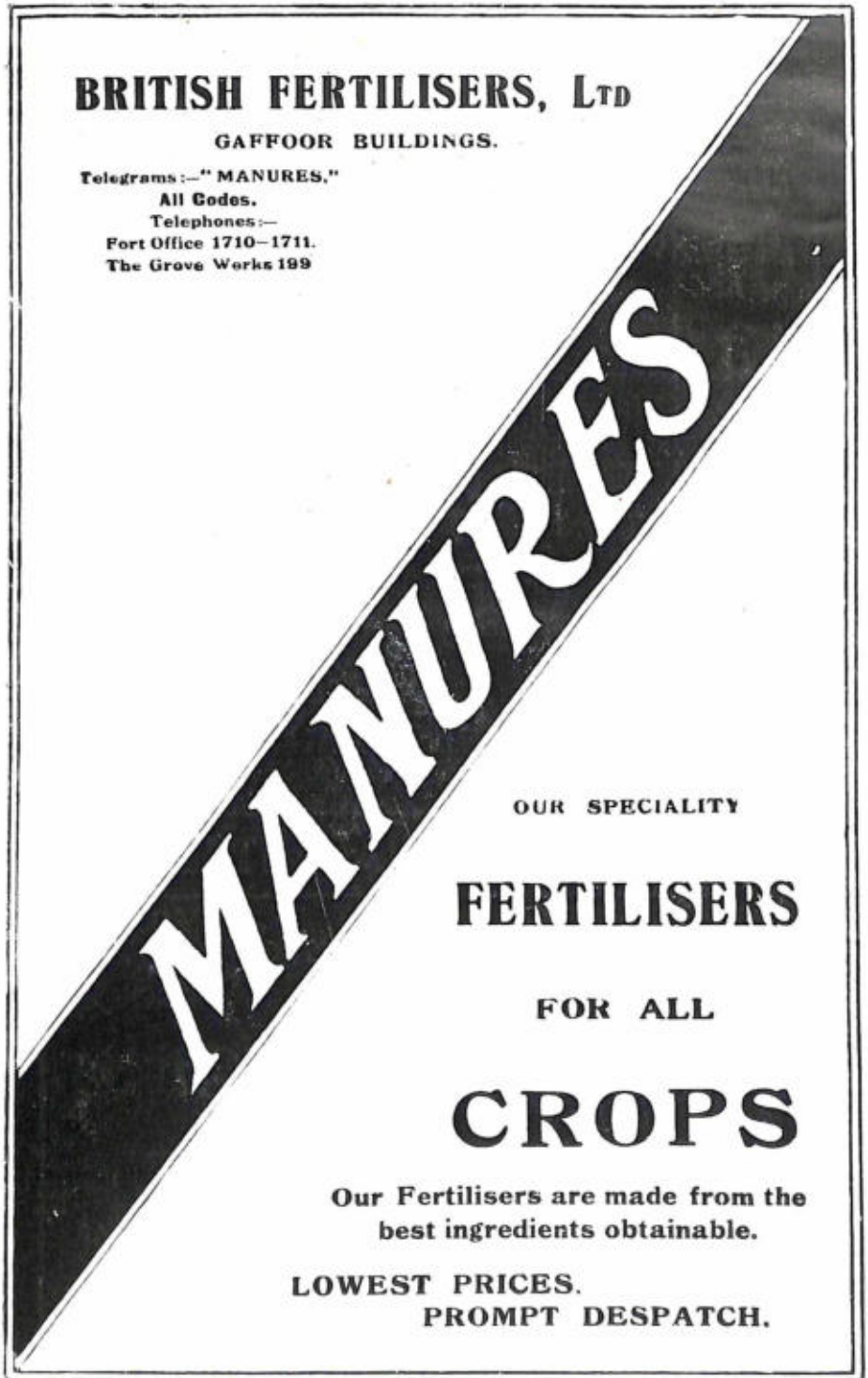
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